

The use of unified theory of acceptance and use of technology to confer the behavioral model of 3G mobile telecommunication users

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Abstract

Although Taiwan's 3G services started its operation in 2003, the main profit source for every telecommunication company is still the cheaper fees of airtime minutes. Therefore, this study is directed on how these companies design the marketing tactics closer to the consumers' need under the dual influences of the decreasing individual's contribution and the low utility rate, as well as how to improve customers' willingness to adopt 3G mobile telecommunication services. *Unified Theory of Acceptance and Use of Technology* (UTAUT) is used as the model to carry out expert interviews and consumers' questionnaire investigation. This study found that the factors that significantly influenced the "behavioral intention" include "performance expectancy", "social influence", and "facilitating conditions", while the traditional known "effort expectancy" did not. Moreover, three non-assumed relationships were discovered during the Structural Equation Model analysis, which helped to revise the UTAUT model for 3G telecommunication services. The results of this study can be helpful

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to Taiwan's mobile telecommunication companies to adjust their corporate strategies and tactics for providing customer-oriented 3G services to both existing and potential customers, such that the overall 3G market can be expanded as well as a win-win situation for the 3G industry and their consumers can be achieved.

Keywords and phrases : 3G mobile telecommunication, unified theory of acceptance and use of technology (UTAUT), structural equation modeling.

I. Introduction

According to the latest research report of GSM Association, the number of global mobile telecommunication users will surpass 5 billion in 2015, which is three times the current number. Meanwhile, the coverage of the mobile network has already reached 80% of the global population, which is twice of the number in 2000. The annual output value of global mobile telecommunication market has already reached US\$700 Billion, and this value continued to grow with 10% every year [6]. But facing such a great business opportunity of huge market, besides Japan and Korea, in fact the global application of 3G has just officially started in 2005. In the past, limited to the software and hardware abilities of 2G cell phones, thus the cell-phone was unable to send information rapidly and safely, since the 3G cell phone can offer high-speed data transmission, it can solve the deficiency of data transmission speed of 2G cell phones, and it can also offer diversified services, such as voice, data and video services.

In Taiwan, cell-phone number users had reached 2,2970,000 users in the third quarter of 2006, and the popularity of cell-phone number was up to 100%, there were 3,840,000 users for 3G data services and PHS users in the third quarter of 2006, which accounted 42.7% of the total users of network Internet. The above figures show that the numbers of cell-phone and mobile Internet of Taiwan usage have always kept at a high level. Nevertheless, the mobile value-added services have been at low level at the same time, which only accounts for 5% to 10% of mobile telecommunication industry's profit [11].

In the past, Taiwan's cell phone market is relatively small on the data services. For user's contribution to data-service profit, the highest one is 8% by Far EasTone, and then 6% by Chunghwa Telecom and Taiwan Mobile. Among Taiwan's mobile data services, picture and ring tone downloading, game and friend-meeting are the most popular mobile

value-added services besides messaging, which reflects that the current mobile services has not been widely accepted by the consumers. This is really a general bottleneck faced by the mobile phones suppliers in the whole world.

On the other hand, the behavioral intention that is adopted to discuss information technology is always the extremely important topic in the information management field [3], [4], [8], [12], [14], [15], [18]. This study attempts to use *Unified Theory of Acceptance and Use of Technology* (UTAUT), which has good explanatory power in behavior for information technology, as the main framework from the information management field, and then focuses on the 3G mobile telecommunications departments of each telecommunication company to carry out expert interview and consumer's questionnaire investigation at present, trying to understand whether there is cognitive difference between the 3G mobile service subscribers and consumers in Taiwan with regard to mobile telecommunication services now; and then this study investigates the cognition towards mobile telecommunications service and behavioral intention of mobile telecommunications service from the point of view of consumers. Therefore, the purpose of this study mainly (1) verifies the suitability of UTAUT under the background of mobile telecommunications; (2) understands consumers' relevant factors of behavioral intention with regard to mobile telecommunications service; (3) focuses on different users' characteristics, using habits, and the connection between service types and key successful factors in order to serve as the reference for the marketing strategies of mobile telecommunications subscribers and the customer relationship management.

II. Literature review

A. *The current situation of 3G mobile telecommunication industry*

Mobile telecommunication system continuously progresses with the advancement of technology and the users' demands towards transmission speed and application services. A noteworthy point is that the mobile telecommunication system is not only evolved and developed unilaterally, but the 1G, 2G, 3G that this study mentioned are also the classifications of the current mobile telecommunication system according to their transmission speeds and applications. In particular, the so-called third generation mobile telecommunication system is the mobile telecommunication system that combines the multimedia communications, such as wireless

communication and global Internet, copes with many kinds of media, such as picture, audio-visual, and video conference, and offers diversified information services including Internet surfing, video conference, and mobile e-commerce. The third generation of mobile telecommunication system must possess enough bandwidth and transmission speed in order to offer this kind of multimedia service [24], such that customers can have the best quality of receiving environment in any place and any time [21].

According to the investigation report of Global System for Mobile Entertainment Services Market of Informa Telecoms & Media, the Global System for Mobile Entertainment Services Market is up to US\$18.8 billion in 2006, and it is expected to be up to US\$39.3 billion by 2011 [9]. In terms of the user population, the new research report, "Worldwide Cellular User Forecasts, 2005-2010", by Strategy Analytics Wireless Network Strategies Service points out that the global mobile users will be up to 2.5 billion by the end of 2006, and reaches 3.5 billion users before the end of 2010. In addition, Strategy Analytics also predicts that in the following ten years, the industry of the mobile telephone will produce the service profit of US\$800 billion.

With the gradual progress of technology and the mobile device of downloading, 3G technology will be commercialized successively. The market of 3G becomes gradually clear in other countries. For example, since the third quarter of 2006 in Japan, the 3G user population has already been up to 57 million. In addition, the transmitting rate of 3G technology increases from 384bps to 2Mbps, so that the potential multimedia network services, such as e-book, electronic comic, mobile TV (audio-visual stream), mobile game, mobile music, etc., are put forward successively. Take South Korea as another example, the consumers are charged for about US\$15 per month for the service of watching TV through the cell phone.

B. *Unified Theory of Acceptance and Use of Technology (UTAUT)*

With respect to the development of 3G telecommunication services in Asia, the 3G subscribers of Japan, Korea, Singapore, and Hong Kong have already set up 3G services before June of 2005, though the first 3G subscriber (Asia Pacific Telecom) in Taiwan set up the 3G services earlier than the subscribers in Hong Kong and Singapore, but the 3G services of the main 3G subscribers started to operate continually until May 2005, and the last subscriber, VIBO Telecom, set up the 3G services until December 2005 (Table 1), the starting time of Taiwan had not only fallen behind Japan and Korea, it also has a gap with Hong Kong and Singapore [11].

Table 1
The general situation of 3G mobile telecommunication subscribers' systems in Taiwan

3G mobile telecommunication companies	Chungwa Telecom	Taiwan Mobile Co.	Far Eastone Telecom	VIBO Telecom	Asia Pacific Telecom
System	WCDMA	WCDMA	WCDMA	WCDMA	CDMA 2000
Frequency bands (GHz)	1.960~1.975 2.020~2.025 2.135~2.150	1.945~1.960 2.015~2.020 2.135~2.150	1.915~1.935 2.125~2.135	1.945~1.960 2.125~2.135	0.825~0.845 0.870~0.809
3G image roaming	25 countries, 41 networks	5 countries, 9 networks	14 countries, 22 networks	37 countries	X
The number of 3G users in November 2006	850,000	490,000	300,000	300,000	990,000
The time of setting up commercial service	July 2005	September 2005	July 2005	December 2005	September 2003

Source of materials: Telecommunication Bureau (2006/12)

However, until the forth quarter of 2006, the number of 3G of users has increased 26.7% comparing to last season, the number of users broke 3,420,000. Compared with the end of 2005, the growth was astonishing, the 3G users in the forth quarter of 2006 has increased 157.5% more than the same period of last year, the number of 3G users has increased 2,097,000. Thus it can be seen that the increasing power of 3G users is considerable, the mobile telecommunication users of Taiwan shift to 3G specifications progressively, but the fact is not so. According to "The behavioral investigation of the usage of Taiwan mobile data service" conducted by the Institute for Information Industry, the popularity of mobile data service for Taiwanese was 59% in 2006, which is only relatively fair compared with 2004 and 2005. In other words, the mobile data service has not been significantly improved as the rapidly growth of 3G user population. In addition, the profit of Taiwan mobile data service accounts for only 8.3% of average profit per user, which is still incomparable with 20% in Japan and Korea [10].

The third generation of communication service has the same advantage of the traditional e-commerce as well as the unique service characteristics and value-added benefits. If the companies of the third generation of communication service can understand the consumers' behavior of using 3G services in depth, then they can not only promote the quality of communication service, but also can obtain abundant consumers' information [19]. Accordingly, investigating the customers' behavior of using 3G services can improve the effective customer service and expand the using market [20]. However, the success of mobile value-added service market must be established under the prerequisites of complete customers, content, terminal device, service platform, marketing service and operational models, and none of above-mentioned conditions can be dispensed with. The cell phone subscribers in Taiwan are full of expectation towards mobile value-added services, but they are currently not satisfied in the actual applications. This polarized response has been shown on the content and application of the mobile value-added services and paying desire. Therefore, how to understand the consumers' demands and intention/behavior and then bring out the consumers' actual application of mobile services. So, this is the main purpose of this study.

C. *Technology acceptance model (TAM)*

Davis [3] uses *Theory of Reasoned Action* (TRA) from Fishbein and Ajzen [5] as the foundation and cooperates with the application situation

that is used by information system, so as to propose *Technology Acceptance Model* (TAM). In other words, it can be regarded as TRA and then applied to explain the specific model that is adopted by information technology [22]. The purpose of TAM is to simplify TRA and provide a generalization model that possesses theoretical foundation and parsimony and the tools that a manager uses. It also allows the manager to use TAM to weigh the introduction of new technology, and then predicts and explains the user's behavior of accepting information technology [27]. At the same time, the researcher can understand the external factors that affect researcher's internal faith, attitude and desire when using the technology.

The reason why TAM is generally valued and adopted by researchers is because it uses users' perception to infer *Behavioral Intention* (BI) directly, its method is simple and clear, but questions such as "which factors would influence users' perception" have not been discussed. Legris *et al.* [13] suggested that other variables should be added to TAM so as to provide a more complete model structure; thus, Venkatesh and Davis [26] have proposed a new structure, TAM2, which extends forward, and they claimed that "Social influence" and "Cognitive instrumental" are the two main variables that influence users' consciousness. The former includes three dimensions, which are "Subjective norm", "Voluntariness" and "Image"; the latter includes four dimensions, which are "Job Relevance", "Output Quality", "Result Demonstrability" and "Perceived Ease of Use". TAM2 has omitted behavioral attitude (ATU) because ATU does not have significant influential effect towards BI and *actual system usage* (AU).

The Evidence-based study shows that the explanatory power of two forward extending variables with regard to "Perceived Usefulness" has reached 51%, and the entire model has 49% of explanatory power for "Behavioral Intention". Besides forward extending the TAM framework and improving the completeness of theory, the more important thing is that TAM2 expands the study field to the internal parts of actual enterprises, it also brings them into the dimensions that are closely related to the business, such as Job Relevance.

D. *Unified Theory of Acceptance and Use of Technology (UTAUT)*

With the vigorous development of TAM2's relevant studies, more and more external variables that focus on different fields have been brought up. Venkatesh has finished a review in accordance with the relevant studies over the years, he found out the previous evidence-based models have their own characteristics, each of the models also had been verified

Table 2
The discussion of relevant individual behavioral acceptance models and theories

Theory	Core Structure	Definition
1 Theory of Reasoned Action (TRA)	Attitude Toward Behavior	The positive or negative feeling that an individual has towards certain behavior
	Subjective Norm	An individual experiences others thinking that he should or should not have what kind of behaviors
2 Technology Acceptance Model (TAM)	Perceived Usefulness	The degree that the user believes that using the information system can improve work performance
	Perceived Ease of Use	The degree that an individual believes its easy to use the system
	Subjective Norm	An individual experiences others thinking that he should or should not have what kind of behaviors
3 Motivational Model (MM)	Extrinsic Motivation	User has the feeling to perform some actions because of some activities, improvement of work, salary, and advertisement
	Intrinsic Motivation	User has the feeling to perform certain behaviors because he wants to, not because of any obvious stimulus
4 Theory of Planned Behavior (TPB)	Attitude Toward Behavior	The positive or negative feeling that an individual has towards certain behavior
	Subjective Norm	An individual experiences others thinking that he should or should not have what kind of behaviors
	Perceived Behavioral Control	The restriction that an individual has experienced from inside and outside towards his behavior
5 Combined TAM and TPB (C-TAM-TPB)	Attitude Toward Behavior	The positive or negative feeling that an individual has towards certain behavior
	Subjective Norm	An individual experiences others thinking that he should or should not have what kind of behaviors
	Perceived Behavioral Control	The restriction that an individual has experienced from inside and outside towards his behavior
	Perceived Usefulness	The degree that the user believes that using the information system can improve work performance

(Contd. Table 2)

Theory	Core Structure	Definition
6 Model of PC Utilization (MPCU)	Job-fit	The degree that the system can strengthen an individual's work performance.
	Complexity	The degree that the system is difficult to understand and use.
	Long-term Consequences	The result will be somewhat benefited in the future.
	Affect Towards Use	An individual feels joyful, happy, depressed and detesting towards a certain behavior.
	Social Factors	The internalization of individual towards team culture and the agreement with the group.
7 Innovation Diffusion Theory (IDT)	Facilitating Conditions	The subjective factor that makes people feel it is easy to take action under a certain environment.
	Relative Advantage	The degree of using new method and can do better.
	Ease of Use	The degree of using new system and make people feel difficult to use.
	Image	The degree that using new system can strengthen others' impression.
	Visibility	The degree that one can observe different users to use the new system in the organization
	Compatibility	The degree that user feels the new system is in chorus with the value of existence, demand, and experience.
	Results Demonstrability	The substantial result of using new system includes the things that are visible and can be expressed by languages.
8 Social Cognitive Theory (SCT)	Voluntariness of Use	The user experiences the innovation of the new system and begins to have voluntariness and freedom.
	Outcome Expectations-Performance	The performance expectancy is related to the result of behavior, especially the performance expectancy that is related to work.
	Outcome Expectations-Personal	The individual expectancy is related to the result of behavior, especially personal respect and achievement feeling.
	Self-efficacy	The judgment ability that an individual has when using a kind of technique to complete a specific work or assignment.
	Affect	Personal interest towards a special behavior.
	Anxiety	The anxiety or emotional response that an individual has when performance behavior is involved.

Source of the materials: Venkatesh *et al.* [27]

in its own field and category respectively; hence he integrated the eight models from previous documents: TRA, TAM, *Motivational Model* (MM), *Theory of Planned Behavior* (TPB), *Combined TAM and TPB* (C-TAM-TPB), *Model of PC Utilization* (MPCU), *Innovation Diffusion Theory* (IDT), *Social Cognitive Theory* (SCT), addressing the new framework of *Unified Theory of Acceptance and Use of Technology* (UTAUT). The discussion of the eight relevant individual behavioral acceptance models and theories is shown in Table 2. Its theoretical structure is shown in Figure 1.

UTAUT model integrates the issues that are mentioned in the relevant documents into four main core determinants: *Performance Expectancy* (PE), *Effort Expectancy* (EE), *Social Influence* (SI), *Facilitating Conditions* (FC), and four control variables, which are "Gender", "Age", "Experience", and "Voluntariness of Use". Its four main dimensions are shown in Table 3.

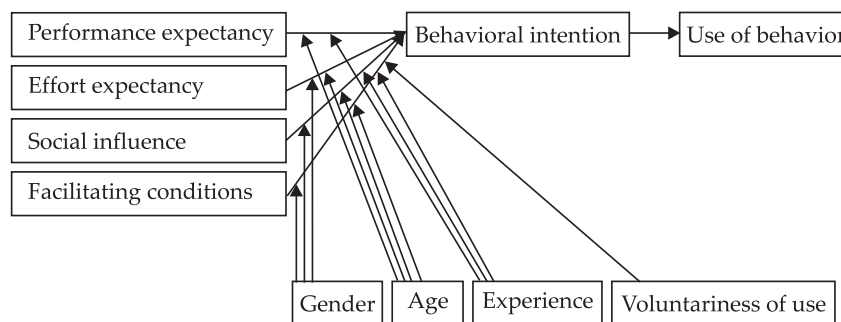


Figure 1

UTAUT model (Source of the materials: Venkatesh *et al.* [27])

Venkates *et al.* [27] thinks that the purpose of UTAUT model is to offer the manager with using tools, the manager can use UTAUT to weigh the introduction of new technology and predict and explain the user's behavior of accepting information technology. From the previous test result, one found that the explanatory power of this UTAUT model is up to 70% with regard to technology using behavior, it is more effective than any of the models that are known before; and the use of UTAUT model has become more extensive in recent years, it is no longer confined to the discussion of the use of information system, such as mobile commerce [2], [16], online learning [28], and wireless network [7]; and the study problem of this study takes user's desire and behavior as the core, so this study uses UTAUT model as the theoretical foundation of this study.

Table 3
The four core determinants of UTAUT

UTAUT determinant	The sub-determinant	The source of integrated model
Performance Expectancy/PE	Perceived usefulness	TAM/TAM2/ C-TAM-TPB
	Extrinsic motivation	MM
	Job-fit	MPCU
	Relative advantage	IDT
	Outcome expectations	SCT
Effort Expectancy/EE	Perceived ease of use	TAM/TAM2
	Complexity	MPCU
	Ease of use	IDT
Social Influence/SI	Subjective norm	TRA, TAM2, TPB/DPTB, C-TAM/TPB
	Social factors	MPCU
	Image	IDT
Facilitating Conditions/FC	Perceived behavioral control	TPB/DTPB, C-TAM-TPB
	Facilitating conditions	MPCU
	Compatibility	IDT

Source of the materials: Venkatesh *et al.* [27]

III. The study framework

A. The study framework

Synthesizing the above-mentioned literature reviews, the framework of this study can be integrated and shown in Figure 2. The external variables are formed by the four core determinants in UTAUT model; the control variables are in accordance with the UTAUT model's variables, including gender, age, experience, voluntariness of use, and level of education is added.

The major differences between this study and the original UTAUT study [27] lie in the temporal dimension and the connotation of determinants by "external variables". For the temporal dimension, because Venkatesh *et al.* [27] focused on the specific application software to train the same participant, it was required to carry out three tests in three periods of time before and after training. This study only has one test because it is designed to survey participants at different stages of the

temporal dimension all at once. Also, because the user's "familiarization" with regard to that software will change with time, this can be used to measure the influence of "using experience" towards each determinant. Therefore, "using experience" in this study refers to the individual's using habit in the past [25]. Finally, education is added into the control variable group because it is conjectured to be relevant as the other control variables in mobile communication adoption.

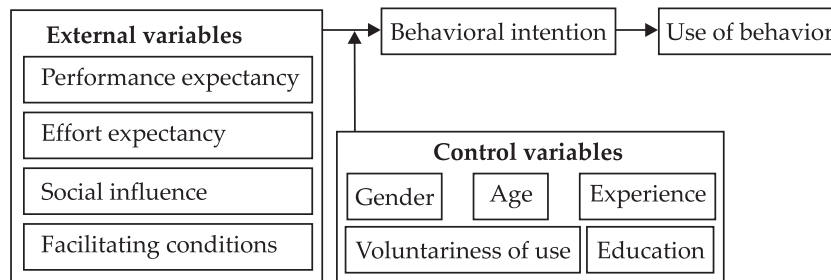


Figure 2
The study framework

B. *The study dimensions*

This study uses the four main dimensions of UTAUT, which includes Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions, and the control variables. Each dimension is defined referring to relevant documents, the explanation is as follows:

(1) *Performance Expectancy/PE*

It refers to "the degree that the user believes that using the information system can improve work performance", Venkatesh has arranged five sub-dimensions from the documents in the past, which are Perceived Usefulness (TAM/TAM2/C-TAM-TPB), external motivation (MM), work correlation (MPCU), relative advantage (IDT), and expectancy to the achievement (SCT). Venkatesh *et al.* (2003) thinks that expected effectiveness refers to "able to obtain significant rewards after using the system", and from the previous studies, one could know that the influence that the difference between Gender and Age has towards performance expectancy is relatively significant; therefore, the male worker or young worker who pursues performance will be more outstanding than other groups.

(2) *Effort Expectancy/EE*

It refers to "The easiness that an individual thinks of when using the system", Venkatesh has arranged three sub-dimensions from the documents in the past, which are "consciousness of easy to use" (TAM/TAM2), "systematic complexity" (MPCU), and "operating simplicity" (IDT). This means that whether the design of information system can allow the user to use it easily or not is one of the key factors of accepting information technology, for instance: whether the operation of cell-phone functions is clear and easy to be understood, whether it is easy for the user to use 3G mobile telecommunication to access Internet, all of these are the factors that determine whether the system is easy to use or not. Venkatesh *et al.* [27] believes that the diligent expectation of an individual towards the use of system would be somewhat different because of gender and age, women or old people are usually more significant, but these influences will be reduced as the using experience increases.

(3) *Social Influence/SI*

It refers to "the degree that an individual senses that the person who is important to him thinks that he should use the new system", Venkatesh has arranged three sub-dimensions from the documents in the past, which are "subjective norm" (TRA, TAM2, TPB/DPTB, C-TAM/TPB), "social factor" (MPCU), and "public image" (IDT).

The so-called "subjective norm" refers to "a certain kind of image of the party that is given by the people around him", or "people think that how the party should do". "Subjective norm" will urge the party to produce the point of *behavioral intention* (BI), this was first proposed by Fishbein and Ajzen [5] in TRA, thereafter through the discussions of a lot of scholars, different results have also appeared. Taylor and Todd [22] found out "subjective norm" would really make party produce the behavioral intention, and Mathieson [15] and Davis *et al.* [3] believed that the relationship between them is not significant. According to the view of Davis [4], the strong or weak strength of "subjective norm" is closely related to the environment that the discussion subject is in. "Public image" refers to "the party thinks a certain image helps to maintain or improve his own position in the group" [17], because the image or impression that the party hopes to establish is usually related to role model that the group identifies, so there is significantly positive relation between the so-called "public image" and "role model identification" [26].

Venkatesh *et al.* [27] believes the relationship between social influence

and use intention would be influenced by the interfering factors such as gender, age, experience and use voluntarily. In addition, social influence has very significant influence towards old workers; if use gender to distinguish, women workers will be easily influenced by the attitudes of senior managers and colleagues. But these influences would usually happen only at the beginning of use, after using for a while, social influence does not have significant influence on behavioral intention.

(4) *Facilitating Conditions/FC*

It refers to "the degree of supporting that an individual feels from the organizational and technical relevant equipment towards system use", Venkatesh has arranged three sub-dimensions from the documents in the past, which are "the control of conscious behavior" (TPB/DTPB, C-TAM-TPB), "promoting condition" (MPCU), and "compatibility" (IDT). Among them, the so-called "control of conscious behavior" refers to user's self-efficacy to the system in general, which is the user's judgment of able to operate the system or not; "promoting condition" refers to the technology assistance that is provided by the objective environment; "compatibility" is the consistency of system and organization value. Therefore, cooperating situation means that the organization and technical framework support the user to use the system, including the support of computer software and hardware or the assistance on systematic operation [23], [27]. Experience and age are the interfering factors between cooperating situation and behavior. In conclusion, Venkates *et al.* [27] considers the purpose of experience, gender, age, and user is to emphasize that there is difference between personal acceptance and the strategy of using IT under different situation, one must consider these interfering factors and correct the implemented strategy appropriately. It arranges the sub-dimensions of UTAUT's each dimension and their definitions.

(5) *Moderators*

Besides the above-mentioned four core determinants, there are still four significant moderators in the theoretical structure of UTAUT: Gender, Age, Experience and Voluntariness of Use.

There is no lack of the discussions of these variables in the previous relevant studies, take Gender as an example, a lot of studies point out the influence of different dimensions towards BI is related to Gender, just like the influence that *Performance Expectancy* (PE) has towards *Behavioral Intention* (BI), female is more significant than male, and in the mean time because female cares about others' point of view more, so *Social Influence*

(SI) is more significant [26]. UTAUT further cross-analyzes the roles of other relevant variables (such as Age), the result of study finds out the complex interaction of two or more variables will make the influence even more significant. For example, in PE's influence towards BI, in case of only considering Gender, male is more significant than female; if adding Age factor, then young male is more significant than other groups; In the influence of "Effort Expectancy" (EE) towards BI, female is more significant than male, especially the young female who is lack of the experience of using computer; in SI's influence towards BI, female is more significant than male, especially under involuntary situation and the older female who is lack of the experience of using computer; maybe SI has more significant influence towards older age employees, and the intensity of this influence will decrease progressively with the accumulation of use experience [27].

C. Study assumptions

According to the structure of this study, the variables are divided into external variables and control variables in order to establish the following assumptions:

(1) External variables

- Hypothesis 1. The consumers of 3G mobile telecommunication services think that "performance expectancy" will lift the "behavioral intention" of the 3G mobile telecommunication services.
- Hypothesis 2. The consumers of 3G mobile telecommunication services think that "effort expectancy" will lift the "behavioral intention" of the 3G mobile telecommunication services.
- Hypothesis 3. The consumers of 3G mobile telecommunication services think that "social expectancy" will lift the "behavioral intention" of the 3G mobile telecommunication services.
- Hypothesis 4. The consumers of 3G mobile telecommunication services think that "facilitating conditions" will lift the "behavioral intention" of the 3G mobile telecommunication services.
- Hypothesis 5. The consumers of 3G mobile telecommunication services think that "behavioral intention" will lift the "use behavior" of the 3G mobile telecommunication services.

(2) *Control variables*

Hypothesis 6. Gender has significant difference towards the study variables of 3G mobile telecommunication services.

Hypothesis 7. Age has significant difference towards the study variables of 3G mobile telecommunication services.

Hypothesis 8. Voluntariness of Use has significant difference towards the study variables of 3G mobile telecommunication services.

Hypothesis 9. Experience has significant difference towards the study variables of 3G mobile telecommunication services.

Hypothesis 10. Education has significant difference towards the study variables of 3G mobile telecommunication services.

D. *Questionnaire design and data collection*

In order to understand the consumers' demands and intention/behavior, and then bring out the consumers' actual application of 3G mobile telecommunication service, this study used the questionnaire method to examine the framework of this study. The questionnaire was initially designed in accordance with the operational definitions referred in "2006 WMIS Global Mobile Internet Investigation" issued by Institute for Information Industry in 2006. Then interviews were conducted with related units of five domestic 3G mobile telecommunication companies for possible modifications of the final questionnaire. The questionnaire was divided into three sections, including the questions for external variables, the questions for behavioral intention, and the questions for use behavior.

The tables that this study use mainly adopt the table of technology acceptance model that is developed by Davis [3] and the items that are arranged from Venkatesh *et al.*'s UTAUT model [27] so as to serve as the foundation; thus, the question about content validity does not exist. In the part of Behavioral Intention, because the questionnaire content of UTAUT relies mainly on investigating "the follow-up Behavioral Intention of different period", this does not correspond to the subject's characteristics of this study. Therefore, the questionnaire content of Behavioral Intention would refer to TAM2, besides substituting with the proper words in accordance with the subject's characteristics, the content has not been revised additionally. Because the study object of this study is mainly the consumer who is already using 3G telecommunication services, so in Use behavior, it investigates the whole acceptance that the users have with

regard to the use of every area of 3G mobile telecommunication services. Finally, the pre-questionnaire is produced according to the definitions of this study structure's study variables and the questionnaire content of relevant documents.

After completing the tables, this study sends 40 questionnaires out at random so as to carry out the pretest of the small sample, 40 questionnaires have been retrieved, and the retrieval rate of questionnaire is 100%. The retrieved questionnaires are analyzed using SPSS15.0 software, and the questions in the pre-questionnaire are deleted through factor analysis. In Performance Expectancy, 12 questions have been deleted; in Effort Expectancy, 5 questions have been deleted; in Social Influence 4 questions have been deleted; in Facilitating Conditions, 4 questions have been deleted; in Behavioral Intention, 3 questions have been deleted; in the acceptance of Use behavior, 1 question has been deleted; thus, there are 29 questions in the formal question table.

In the end, this study has received 292 valid responses via online questionnaire lasted for 3 weeks, plus another 102 valid responses distributed on-the-spot of telecommunications companies, which summed up to 394 valid responses altogether. The user profile is summarized in Table 4, which indicates majority of them were male, between 26-35 age group, working professionals, above college degree level, living in metropolitan area, having over five years of telephone experience, paying over 400 NT\$ monthly fees, and spending less than 15 minutes on 3G services.

IV. The study result and analysis

A. Factor analysis

KMO is Kaiser-Meyer-Olskin measure of sampling adequacy, the higher the value of KMO, the more the common factors between variables and the more suitable to undertake factor analysis. According to the views of Banning and Kaiser [1], if the value of KMO is higher than 0.9, it means that it is "very suitable for factor analysis", the KMO values of this study are all higher than 0.8, so they are suitable for factor analysis. In addition, from Bartlett's Test of Sphericity, one can find that they all reach the level of significance, representing the common factors exist between the relevant matrixes of population, so they are suitable for factor analysis (Table 5).

In the Questionnaire of this study, 29 questions are divided into three parts in accordance with UTAUT model, questions PE-1 to FC-4 belong to

Table 4
The user profile

Variables	Categories	Frequency	Percentage (%)
Sex	Male	242	61.4
	Female	152	38.6
	Total	394	100
Age (year)	Under 17	2	0.5
	17-25	70	17.8
	26-35	258	65.5
	36-45	62	15.7
	Over 46	2	0.5
	Total	394	100
Occupation	Students	114	28.9
	IT industry	44	11.2
	Manufacturing	26	6.6
	Financial and insurance/ real estate industry	16	4.1
	Mounties	46	11.7
	Services	90	22.8
	Medical industry	8	2.0
	Media/advertising industry	4	1.0
	Others	46	11.7
	Total	394	100
	Foreign countries	14	3.6
Education	High school/grade	158	40.1
	University/specialist	188	47.7
	Over Institute	34	8.6
	Total	394	100
Region	North	114	28.9
	Central	42	10.7
	Southern	228	57.9
	Eastern	4	1.0
	Islands region	6	1.5
	Total	394	100

(Contd. Table 4)

Variables	Categories	Frequency	Percentage (%)
Use phone time (year)	Less than a year	2	0.5
	1-2	6	1.5
	3-4	24	6.1
	Over 5 years	362	91.9
	Total	394	100
The monthly phone rates (NT\$)	Under 200	38	9.6
	201-400	60	15.2
	401-600	108	27.4
	601-1000	86	21.8
	Over 1001	102	25.9
	Total	394	100
The daily average amount of time spent online 3G	0-15 minutes	328	83.2
	16-30 minutes	20	5.1
	31-60 minutes	12	3.0
	Between 1 and 2 hours	10	2.5
	Between 2 and 3 hours	8	2.0
	Over 3 hours	16	4.1
	Total	394	100

Source of the materials: arranged by this study

Table 5
KMO and Bartlett's test

Study variables		PE	EE	SI	FC	BI	UB
KMO measure of sampling adequacy		0.925	0.824	0.897	0.712	0.9661	0.808
Bartlett's test of sphericity	Approximate chi-square distribution	16.936	10.349	15.529	25.755	12.690	18.505
	Degree of freedom	3	3	6	6	3	3
	Significance	0.000	0.000	0.000	0.000	0.000	0.000

Source of the materials: arranged by this study

Table 6
The result of factor analysis

Factor	Question code	Questions in questionnaire	Factor loading	Cronbach' α value
PE	PE1	I think it is useful to use 3G mobile telecommunication service.	0.932	0.935
	PE2	I have new experience in using 3G mobile telecommunication service	0.935	
	PE3	3G mobile telecommunication service includes a lot of information that is relevant to my work	0.929	
	PE4	I think 3G mobile telecommunication service can satisfy the demand from work	0.927	
	PE5	I think the use of 3G mobile telecommunication service can bring some recreation to my work	0.932	
	PE6	I think the use of 3G mobile telecommunication service can bring convenience to my work	0.927	
	PE7	To some of my work, it is essential to use 3G mobile telecommunication service	0.929	
	PE8	I think the use of 3G mobile telecommunication service can lift my work efficiency	0.923	
	PE9	I think the use of 3G mobile telecommunication service can lift my work quality	0.926	
	PE10	I think the use of 3G mobile telecommunication service can produce innovativeness for my work	0.926	
EE	EE1	I think it is easy to understand 3G mobile telecommunication service	0.773	0.811
	EE2	I think the using interfaces of 3G mobile telecommunication service is easy to be familiar with	0.810	
	EE3	I can be skilled at the use method of 3G mobile telecommunication service very quickly	0.883	
SI	SI1	The people around me think that I should use 3G mobile telecommunication service	0.902	0.913
	SI2	I will discuss the feeling of using 3G mobile telecommunication service with family and friends	0.893	

(Contd. Table 6)

Factor	Question code	Questions in questionnaire	Factor loading	Cronbach' α value
	SI3	My family and friends can influence me to use 3G mobile telecommunication service	0.900	
	SI4	I think not able to use 3G mobile telecommunication service is really a kind of falling behind phenomenon	0.904	
	SI5	I think it is an admirable thing for me to be able to use 3G mobile telecommunication service to engage in various kinds of relevant activities	0.896	
	SI6	I think the use of 3G mobile telecommunication service can help me to maintain or improve my own position in the group	0.888	
FC	FC1	When I want to use 3G mobile telecommunication service, I can search and connect to the Internet easily	0.729	0.794
	FC2	I can easily obtain the relevant knowledge of using 3G mobile telecommunication service	0.786	
	FC3	Once I have encountered difficulty with the use of 3G mobile telecommunication service, I can use the information from various areas to solve the problems (books, Internet, friends)	0.720	
	FC4	I think using 3G system to surf the Net is better, more convenient and faster than using 2G system	0.833	
BI	BI1	I would want to use 3G mobile telecommunication service because of some activities, propaganda and fashion trend	0.896	0.903
	BI2	If the rate is reduced, I am glad to use 3G mobile telecommunication service	0.859	
	BI3	I will continue to use 3G mobile telecommunication service in the future	0.924	
UB	UB1	Overall speaking, the effect of using 3G mobile telecommunication service makes me feel satisfied	0.966	0.885
	UB2	Overall speaking, using 3G mobile telecommunication service to engage in various kinds of activities makes me feel satisfied	0.801	
	UB3	Overall speaking, the experience that I used 3G mobile telecommunication service in the past is happy	0.849	

Source of the materials: arranged by this study

the question group of “external variables”; questions BI-1 to BI-3 belong to the question group of measuring *Behavioral Intention* (BI); questions UB-3 to UB-1 belong to the question group of measuring *Use behavior* (UB). First, SPSS15 software is used in order to adopt Principal Component Analysis to undertake factor analysis to the 29 questions, and the result shows Cronbach’s $\alpha = 0.9521$, and then retest of Reliability Analysis is carried out to these three parts, the result is shown in Table 6.

B. *Analysis of structural equation modeling*

According to the above-mentioned of the establishments of UTAUT model, measuring variables and weighing indices, *Structural Equation Modeling* (SEM) is used to classified “Performance Expectancy”, “Effort Expectancy”, “Social Influence” and “Facilitating Conditions” as the independent variables, and “Behavioral Intention” and “Use behavior” are independent variables, also “Behavioral Intention” is intermediary variable. And then, AMOS7.0 software is used to adopt maximum likelihood to undertake overall model fitness test with regard to each dimension, the path change of each variable is based on the *Modification Indicators* (MI) that is recommended by SEM for data analysis, Modification Indicators revise or delete the content of each variable, so as to improve the explanatory power of the model towards the actual behavior.

After revising the model, χ^2 is 479.732; P -value is 0.00 which is significant; χ^2/df is 2.62; GFI value is 0.940; AGFI is 0.990; RMSEA value is 0.046; NFI value is 0.980; and NNFI value is 0.993. The fit indices of all judgments have already reached the standard, which means that the overall model fitness is good, namely the fitness between the path plot of the model and the actual observed information is good; thus the assumption of causal model that is mentioned by this study has obtained statistical support. The result is shown in Table 7.

After modifying the model, all fit indices’ determinations had reached the desirable standard, which means that the overall model fit was good. In another word, the path diagram of the model fitted well with the actual observed data, the assumption of the cause and effect model diagram that this study addressed had obtained the statistical support. Moreover, some non-assumed variables’ relationships, including “performance expectancy/use behavior”, “effort expectancy/use behavior”, and “social influence/use behavior”, were significant. So, these three non-assumed variables’ relationships were added to the study framework. The

modified study framework with SEM statistics is shown in Table 8 and Figure 3.

Among the 5 hypotheses, only hypothesis 2 was disproved. The direct interpretation of this result was that for users of 3G mobile communication services, their "effort expectancy" did not significantly influence their "behavioral intention". This is an interesting characteristic of 3G mobile communications services since most other technology adoption models credited the influence of "ease of use" factor on "behavioral intention". This reveals an important but uncommon insight for 3G mobile communication services that only "ease of use" is not enough to attract the users.

Table 7
Fit indices

Test statistic	Fit standard or threshold value	Data of test result
χ^2 value	$P > 0.045$ (does not reach significant standard)	479.732 ($p = 0.000$)
χ^2 and its degree of freedom	> 2	2.62
Goodness of fit index (GFI)	> 0.90	0.940
Adjusted goodness of fit index (AGFI)	> 0.90	0.990
Root mean square error of approximation (RMSEA)	< 0.05	0.046
Normed fit index (NFI)	> 0.90	0.980
Non-normed fit index (NNFI)	> 0.90	0.993

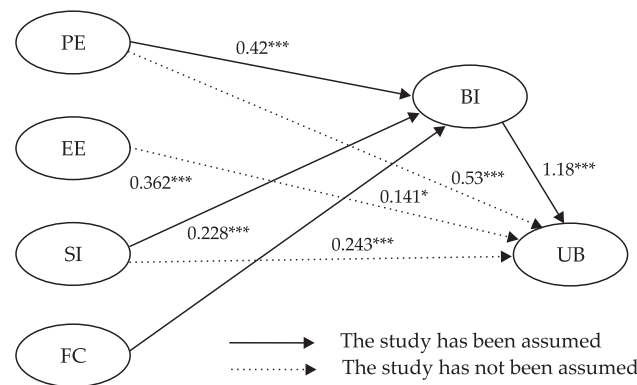
Source of the materials: arranged by this study

Table 8
Revised SEM study structure

The relationship of variables	Path coefficient	Critical ratio	P-value	Significance
PE→BI	0.419	7.020 (> 1.96)	***	Yes
EE→BI	0.057	1.192	0.233	No
SI→BI	0.362	6.239	***	Yes
FC→BI	0.228	3.054	***	Yes
FC→UB	-0.212	-2.154	*	No
BI→UB	1.179	6.063	***	Yes
PE→UB	0.529	5.747	***	Yes
EE→UB	0.141	2.459	*	Yes
SI→UB	0.243	3.621	***	Yes

: p -value < 0.05 , *: p -value < 0.01 , *: p -value < 0.001

Source of the materials: arranged by this study



*: represents p value < 0.05 , **: represents p value < 0.01 , ***: represents p value < 0.001

Figure 3

The SEM analytical structure that does not consider the control variables

C. Influences of control variables

This study focuses on Internet user's "gender", "age", "education", "experience", and "voluntariness of use" to analyze the result with regard to the entire path coefficients, the result is shown in Table 9.

In accordance with the above-mentioned result, it shows that the external variables' influence towards the degree of acceptance of 3G mobile telecommunication service (Behavioral Intention and Use behavior) would have significant difference because of different control variables, including "gender", "age", "education", "experience", and "voluntariness of use", thus Hypotheses 6, 7, 8, 9, and 10 are proved. This study also finds out the four factors' influence towards "Behavioral Intention" and "actual use" has reached the significance that was proven in the previous documents, but they are controlled by different conditions (gender, age, voluntariness of use, experience, and education), thus their influential degree towards "Behavioral Intention" and "Use Behavior" is varied.

V. Conclusion and suggestions

1. Conclusion of study

In the development of 3G, the most important business opportunity is no longer the cell-phone hardware only, but it is important to know how to offer more application content services and software to more and more

Table 9
The SEM study structure of control variables

Control variables	The relationship of variables	Path coefficient	P-value	Significant ratio
Gender	PE → BI	0.30	**	Female > Male
	SI → BI	0.29	**	Female > Male
	FC → BI	0.46	***	Male
	PE → UB	0.56	***	Female > Male
	EE → UB	0.27	*	Female > Male
	SI → UB	0.26	**	Male > Female
	BI → UB	0.36	***	Male > Female
	PE → BI	0.75	***	Over the age of 36
Age	FC → BI	0.74	***	Over the age of 36 > under the age of 35
	EE → UB	0.75	***	Over the age of 36
	SI → UB	0.55	***	Over the age of 36
	BI → UB	0.52	***	Over the age of 36
Voluntariness of use	PE → BI	0.22	**	Medium voluntariness > high voluntariness
	SI → BI	0.73	***	Low voluntariness > high voluntariness > medium voluntariness
	FC → BI	0.28	**	High voluntariness > medium voluntariness
	PE → UB	0.53	***	High voluntariness > medium voluntariness
	EE → UB	0.17	**	Medium voluntariness > high voluntariness
	SI → UB	0.30	***	Medium voluntariness > high voluntariness
	BI → UB	0.31	***	High voluntariness > medium voluntariness

(Contd. Table 9)

Control variables	The relationship of variables	Path coefficient	P-value	Significant ratio
Experience	PE→BI	0.45	**	1 to 5 years > more than 5 years
	SI→BI	0.68	***	Less than 1 year > more than 5 years
	FC→BI	0.44	***	1 to 5 years
	PE→UB	0.51	*	Less than 1 year > 1 to 5 years > more than 5 years
	EE→UB	0.35	*	More than 5 years > 1 to 5 years
	SI→UB	0.39	*	1 to 5 years > more than 5 years > less than 1 year
	BI→UB	0.53	**	More than 5 years > 1 to 5 years
	PE→BI	0.24	*	University or above
Education	SI→BI	0.44	***	Vocational School or below > university or above
	FC→BI	0.59	***	Vocational School or below > university or above
	PE→UB	0.51	*	University or above
	EE→UB	0.20	*	University or above
	SI→UB	0.39	***	Vocational School or below > university or above
	BI→UB	0.21	***	University or above

*: represents p value < 0.05, **: represents p value < 0.01, *** represents p value < 0.001

3G users. For this reason, expanding cell-phone function differences and creating demand motive have very important influence in the mobile telephone development of new generation. The main purpose of this study focuses on different users' characteristics, using habits, and the connection between service types and key successful factors in order to understand the structure of current users and serve as the reference for the marketing strategies of mobile telecommunications subscribers and the customer relationship management. And also, under the situation that the users' degree of familiarization towards that software would change as time passes, UTAUT is used to measure the influence of using Experience towards each dimension. The important conclusions of this study are generalized and shown as follows:

- (1) With regards to the users' "Performance Expectancy" of 3G mobile telecommunication services, it has positive influence towards "Behavioral Intention" and "Use behavior", and its' influence towards "recreation" is greater. In 3G mobile telecommunication services, the practicability of system is still the major influential factor that influences the users to use technological service, and system that is easy to operate is the important basic ability for the use of 3G mobile value-added services. In addition, the recreation that 3G mobile telecommunication services brings will improve the consumers' desire to use 3G services as well, this is because 3G service is a kind of technical service product. However, consumers' preferences towards 3G services would not influence their satisfaction for 3G mobile telecommunication service, because the functions of 3G services are far more than 2G service functions; and consumers can change telecommunication subscriber and cell phone brand easily, thus consumers' initiatives are stronger than before.
- (2) With regards to the users' "Facilitating Conditions" of 3G mobile telecommunication services, it has positive influence towards "Behavioral Intention" and "Use behavior", and its' influence towards "system completeness" is greater. System completeness is also the important factor that influences the consumers to use the service. Therefore, website's system must be accurate, it needs to provide the latest information immediately in order to attract consumers' use. Secondly, website's connection quality will influence the desire of consumers' use, and 3G Internet connection quality can extend the time and place that consumers use and solve the urgent demand, that

is to say the better the connection quality is, the user will be more willing to use that website.

- (3) With regards to the users' "Social Influence" of 3G mobile telecommunication services, it has positive influence towards "Behavioral Intention" and "Use behavior". Consumers' family, friends can influence them to use 3G mobile telecommunication services, some consumers think that not able to use 3G mobile telecommunication service is really a kind of falling behind phenomenon. Consequently, the behaviors and manners of the family or friends around the consumers would all influence the consumers' desire to use 3G telecommunication services.
- (4) With regards to the users' "Behavioral Intention" of 3G mobile telecommunication services, it has positive influence towards "Use behavior", while the influence of "reduced rate" is greater. Every telecommunication subscriber combines the favorable measures that the terminal device offers, it is easy to attract consumers to use 3G service naturally, and then it can influence the consumers' desire to use and use frequency.

2. *Study limitations*

Although this study strives to be perfect, but because of objective factors, the following limitations still exist: (1) The design of questionnaire mainly uses the tables of UTAUT model and then revises and tests the tables so as to discuss the users' behavioral model towards the acceptance of 3G mobile telecommunication services. When the follow-up researchers discuss the same subject, they can think of adopting the theories of different technology acceptance and weighing models, in order to undertake the study of acceptance of the user's behavioral model towards 3G mobile telecommunication services further. (2) In sample selection, because of limited manpower, the questionnaires are distributed to the consumers who have used the 3G services of each telecommunication subscriber, and also this study mainly distributes network questionnaire. Because the main users of Internet are mostly students, the result of study may be unable to be completely applicable to all groups. (3) Because this study does not focus on the primitive technology acceptance model to undertake discussion, it is impossible to compare the strengths and weaknesses between the explanatory powers of the model that is constructed by this study and primitive models. But it is sure that the model that this study constructed still has certain explanatory

power towards the use intention of mobile value-added services, and the newly added external variables also have positive significant effect.

References

- [1] Banning, H. James, Kaiser and Leland (1974), An ecological perspective and model for campus design, *Personnel and Guidance Journal*, Vol. 52 (6), pp. 370–375.
- [2] C. Carlsson, J. Carlsson, K. Hyvonen, J. Puhakainen and P. Walden (2006), Adoption of mobile devices/services-searching for answers with the UTAUT, in *Proceedings of the 39th Hawaii International Conference on System Sciences*, IEEE Computer Society Press.
- [3] F. D. Davis (1989), Perceived usefulness, perceived ease of use and user acceptance of information technology, *MIS Quarterly*, Vol. 13 (3), pp. 319–340.
- [4] F. D. Davis, R. P. Bagozzi and P. R. Warshaw (1989), User acceptance of computer technology: a comparison of two theoretical models, *Management Science*, Vol. 35 (8), pp. 982–1003.
- [5] M. Fishbein and I. Ajzen (1975), *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Addison-Wesley, Boston, MA.
- [6] GSM Association (2006), <http://www.find.org.tw/find/home.aspx?page=newsand&id=4539>
- [7] H. C. Zhang, C. Y. Guo, M. C. Lai (2004), The new thinking of constructing high-quality enterprise internal network, *Quality Magazine*, Vol. 7 (2004), pp. 46–49.
- [8] M. Igbaria, N. Zinatelli, P. Cragg and A. L. M. Cavaye (1997), Personal computing acceptance factors in small firms: a structural equation model, *MIS Quarterly*, Vol. 21 (3), pp. 279–302.
- [9] Informa Telecoms and Media, Frost and Sullivan (2006), December 2006, <http://www.informatm.com/itmgcontent/icoms>
- [10] Institute for Information Industry, April 14, (2007), <http://www.find.org.tw/>
- [11] Institute for Information Industry, October 23, (2006), <http://www.find.org.tw/>
- [12] C. M. Jackson, S. Chow and R. A. Leitch (1997), Toward and understanding of the behavioral intention to use an information system, *Decision Sciences*, Vol. 28 (2), pp. 357–389.
- [13] P. Legris, J. Ingham and P. Collette (2003), Why do people use information technology? A critical review of the technology acceptance model, *Information and Management*, Vol. 40, pp. 191–204.

- [14] S. Liao, Y. P. Shao, H. Wang and A. Chen (1999), The adoption of virtual banking: an empirical study, *International Journal of Information Management*, Vol. 19 (1), pp. 63–74.
- [15] K. Mathieson (1991), Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior, *Information Systems Research*, Vol. 2 (3), pp. 173–191.
- [16] M. H. Xiao (2006), The acceptance assessment of enterprise who develops mobile-commerce – Take T. Join Transportation Co., Ltd. as an example, Master Thesis, Department of Information Management, National Yunlin University of Science and Technology.
- [17] G. C. Moore and I. Benbasat (1991), Development of an instrument to measure the perceptions of adopting an information technology innovation, *Information Systems Res.*, Vol. 2, pp. 192–222.
- [18] P.P. Mykytyn and D.A. Harrison (1993), The application of the theory of reasoned action to senior management and strategic information systems, *Information Resources Management Journal*, Vol. 6 (2), pp. 15–26.
- [19] N. Nohria and M. Leestma (2001), A moving target: the mobile-commerce customer, *MIT Sloan Management Review*, Vol. 42, p. 104.
- [20] R. B. Green, V. Hatini, K. A. Johansen, X. J. Liu and J. A. Lengyel (2002), Drumstick is a zinc finger protein that antagonizes lines to control patterning and morphogenesis of the drosophila hindgut, *Development*, Vol. 129, pp. 3645–3656.
- [21] S. C. Zeng (2002), The study of the tactics of 3G mobile telecommunications market, *Master Thesis*, Graduate School of Information Management, National Sun Yat-sen University.
- [22] S. Taylor and P. Todd (1995), Assessing IT usage: the role of prior experience, *MIS Quarterly*, Vol. 12, pp. 561–570.
- [23] L. Thompson (1991), Family Work: Women's sense of Fairness, *Journal of Family Issues*, Vol. 12, pp. 181–196.
- [24] Topology Research Institute (2005), The Review and analysis of investigating the application trend of cell phones and the competition of 3G telecommunications market, *TRI Industrial Report*, Published by Topology Co., Ltd., September 2005, 40th issue.
- [25] V. Venkatesh and F. D. Davis (1996), A model of antecedents of perceived ease of use: development and test, *Decision Science*, Vol. 27, pp. 451–481.
- [26] V. Venkatesh and M. G. Morris (2000), Why don't men ever stop to ask for directions? Gender, social influence and their role in technology acceptance and usage behavior, *MIS Quarterly*, Vol. 24, pp. 115–139.

- [27] V. Venkatesh, M. G. Morris, G. B. Davis and F. D. Davis (2003), User acceptance of information technology: toward a unified view, *MIS Quarterly*, Vol. 27, pp. 425–478.
- [28] Y. Y. Zeng (2005), The study of employees' acceptance towards enterprise's online-learning system – Take China Steel as an example, *Master Thesis*, Department of Business Studies, National Sun Yat-sen University.

Received January, 2008