

Using UTAUT to explore the behavior of 3G mobile communication users

Yu-Lung Wu¹, Yu-Hui Tao², Pei-Chi Yang³

¹ Department of Information Management, I-Shou University, Kaohsiung County, Taiwan

² Department of Information Management, National University of Kaohsiung, Kaohsiung, Taiwan

³ Department of Information Engineering, I-Shou University, Kaohsiung County, Taiwan

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 Modeling analysis, which helped to revise the UTAUT model for 3G telecommunication services. The results of this study can be helpful 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.

Key words - 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. In Taiwan, as pointed out by the Institute for Information Industry, the cell-phone numbers has reached 22,970,000 in the third quarter of 2006, which is a 100% of popularity rate [1]. Among them, around 8,990,000 users adopted Taiwan's mobile Internet [2]. Specifically speaking, 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 [2].

In the past, Taiwan's cell telephone 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. The major factors that hinder the transition from 2G to 3G mobile phones may be attributed to the size of the screen, the convenience of materials inputting, the restriction of bandwidth allocation and the support of value-added service's companies.

To our understanding, the true barrier for increasing 3G mobile phone's usage maybe due to the incapable of effectively communicating the differences and benefits between 3G and 2G mobile phone to the users [3]. Therefore, this study intends to probe into the relationships between intention/behavior of adopting 3G telecommunication services and their determinants using a theoretical-based model, such that the specific results of technology acceptance for 3G services can be useful references for Taiwan's mobile telecommunication companies to develop their marketing tactics and 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 [4], such that customers can have the best quality of receiving environment in any place and any time [5].

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 [6]. 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 3.500 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 steam), 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 though the cell phone. However, the statistics in 2006 shows that Taiwan 3G users have already exceeded 3 million, the popularity of mobile data service should grow significantly, 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 [7].

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 [8]. Accordingly, investigating the customers' behavior of

using 3G services can improve the effective customer service and expand the using market [9]. 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 using formal theory like Unified Theory of Acceptance and Use of Technology is desirable.

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

With regard to the study of "technology acceptance behavior", TAM mainly offers a basic framework so as to explain the influence of external variables towards behavioral idea [10]. Practically, one must cooperate with the theme characteristics to choose different external variables and probe into the roles that these variables play [11]. With the flourishing development of TAM's relevant studies, the external variables that counter different fields are more and more as well. Venkatesh et al. [12] have done a review on relevant studies over the years, and found the models that were evidenced based in the past differ from one another which have all been verified in each field and category separately. As a result, they combined the eight models in the previous documents to address the new framework for Unified Theory of Acceptance and Use of Technology (UTAUT). The eight models include Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behavior (TPB), C-TAM-TPB, Model of PC utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT).

UTAUT model integrates the points that were addressed in the relevant documents into four core determinants: performance expectancy, effort expectancy, social influence, facilitating conditions; and four control variables: gender, age, experience, and voluntariness of use. The evidence-based result shows that this new framework's explanation strength for technology acceptance behavior is up to 70%, which is more effective than any known models from the past. Its theoretical framework is shown in Fig. 1, and its four core determinants are shown in Table I.

III. THE STUDY FRAMEWORK

Synthesizing the above-mentioned literature reviews, the framework of this study can be integrated and shown

in Fig. 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.

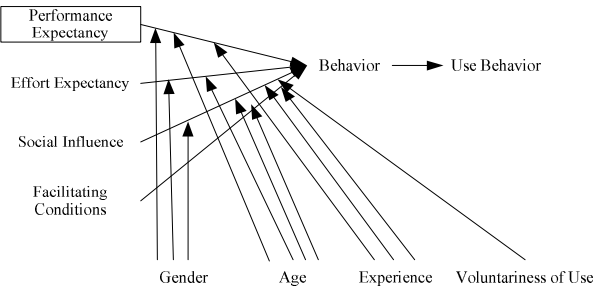


Fig. 1 – The theoretical framework of UTAUT [12]

TABLE I
THE FOUR CORE DETERMINANTS OF UTAUT

UTAUT Determinant	The Sub-Determinant	The Source of Integrated Model
Performance Expectancy	Perceived Usefulness	TAM/TAM2/C-TAM-TPB
	Extrinsic Motivation	MM
	Job-Fit	MPCU
	Relative Advantage	IDT
Effort Expectancy	Outcome Expectations	SCT
	Perceived Ease of Use	TAM/TAM2
	Complexity	MPCU
Social Influence	Ease of Use	IDT
	Subjective Norm	TRA, TAM2, TPB/DPTB, C-TAM/TPB
	Social Factors	MPCU
Facilitating Conditions	Image	IDT
	Perceived Behavioral Control	TPB/DTPB, C-TAM-TPB
	Facilitating Conditions	MPCU
	Compatibility	IDT

Source of the materials: [12]

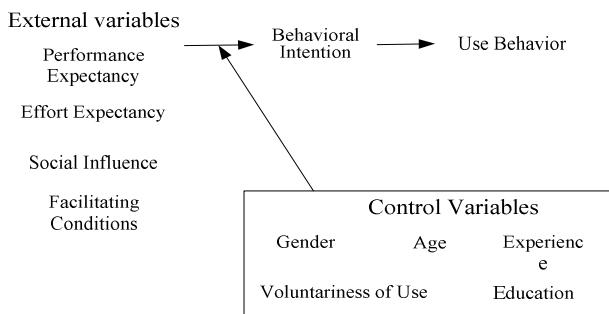


Fig. 2 – The Proposed Framework

The major differences between this study and the original UTAUT study [12] lie in the temporal dimension and the connotation of determinants by “external variables”. For the temporal dimension, because Venkatesh et al. [12] 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 [13]. 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.

Due to the page-length limitation, the 5 hypotheses of this study can be referenced in Table III in next Section. Also, the analysis of control variables is omitted in this paper to accommodate the 5-page length limit.

IV. THE STUDY RESULT AND ANALYSIS

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.

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 II, 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.

For the validity analysis, the KMO (Kaiser-Meyer-Olkin) values of this study were all greater than 0.8, which is greater than the suggested minimum value of 0.5 for adequacy. In addition, from Bartlett’s test, the test result was also showing good sphericity with the common factors existed between the related matrix of the population. Both tests indicated that these 29 variables were suitable to carry out the factor analysis. For the reliability analysis, SPSS15 software was used and a high overall Cronbach’s $\alpha = 0.9521$ was obtained. Then the reliability analysis re-test for these three sections was carried out separately, their final values were all showing highly acceptable values of greater than 0.8.

According to the above-mentioned establishment of UTAUT-based framework, “performance expectancy”, “effort expectancy”, “social influence”, and “facilitating conditions” are the independent variables or exogenous variables, whereas “behavioral intention” and “use behavior” are the dependent variables or endogenous variables, and the “behavioral intention” is also the intermediary variable.

TABLE II
VULATION POPULATION OF TESTANTS

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
Occupation	Total	394	100
	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
Education	Foreign countries	14	3.6
	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
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
The daily average amount of time spent online 3G	Total	394	100
	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 III
THE MODIFIED SEM STUDY FRAMEWORK

The Relationship of Variables	Path Coefficient	Critical Ratio	P-value	Significance
Performance Expectancy → Behavioral intention	0.419	7.020 (>1.96)	***	Yes
Effort Expectancy → Behavioral intention	0.057	1.192	0.233	No
Social Influence → Behavioral intention	0.362	6.239	***	Yes
Facilitating Conditions → Behavioral intention	0.228	3.054	***	Yes
Facilitating Conditions → Use behavior	-0.212	-2.154	*	Yes
Behavioral intention → Use behavior	1.179	6.063	***	Yes
Performance Expectancy → Use behavior	0.529	5.747	***	Yes
Effort Expectancy → Use behavior	0.141	2.459	*	Yes
Social Influence → Use behavior	0.243	3.621	***	Yes

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

The study adopted AMOS7.0, a maximum likelihood-based SEM (structural equation model) software. The overall model fitting focused on each determinant whereas the change of each variable path was according to the modification indicators recommended by SEM with

regard to the data analysis. Particularly, all variable were adjusted so as to lift the explanation ability of the model for the use behavior.

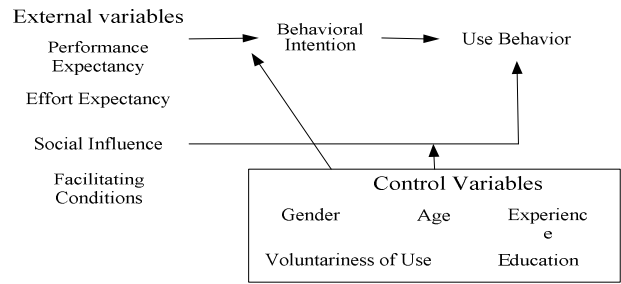


Fig. 3 – The Revised Framework

After modifying the model, all fit indicators' 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 III whereas the results of the hypotheses are summarized in Table IV.

TABLE IV
THE VERIFIED RESULT OF SEM STRUCTURAL ASSUMPTION

Study Assumption	Verified Result
Hypothesis 1 – The consumers of 3G mobile telecommunication services think that "performance expectancy" will lift the "behavioral intention" of the 3G mobile telecommunication services.	Proved
Hypothesis 2 - The consumers of 3G mobile telecommunication services think that "effort expectancy" will lift the "behavioral intention" of the 3G mobile telecommunication services.	Disproved
Hypothesis 3 - The consumers of 3G mobile telecommunication services think that "social expectancy" will lift the "behavioral intention" of the 3G mobile telecommunication services.	Proved
Hypothesis 4 - The consumers of 3G mobile telecommunication services think that "facilitating conditions" will lift the "behavioral intention" of the 3G mobile telecommunication services.	Proved
Hypothesis 5 - The consumers of 3G mobile telecommunication services think that "behavioral intention r" will lift the "use behavior" of the 3G mobile telecommunication services.	Proved

Source of the materials: Arranged by this study

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.

V. CONCLUSION AND SUGGESTIONS

This study used a well-established UTAUT model to measure the influence of the user’s experience towards each potential determinant of behavioral intention for 3G mobile telecommunication services. The results show that the consumers agreed that “performance expectancy”, “social expectancy”, and “facilitating conditions” will lift the “behavioral intention”, and “behavioral intention” will lift the “use behavior” of the 3G mobile telecommunication services. In the non-assumed relationships, “performance expectancy”, “effort expectancy”, and “social influence” were found to influence the “use behavior” as well, which infers a revised UTAUT model specifically for 3G mobile telecommunication services as shown in Fig. 3.

The revised UTAUT model in Fig. 3 sustained that majority of UTAUT paths via the data collected for Taiwan’s 3G mobile telecommunication services, but differences did exist in either the industry type or the geographical area. Therefore, the research implication is that UTAUT is a pretty robust model for technology acceptance prediction, but is still subject to modifications for at least industry type and geographical area as proven in this study.

On the counterpart of managerial implications, among the four determinants, only “effort expectancy” was proven to be insignificantly influencing the “behavioral intention”. This implies that 3G mobile telecommunication companies may deploy their R&D or marketing strategies and tactics by following previous UTAUT theory to increase potential consumers’ intention to use 3G value-added services by focusing on aspects of performance expectancy, social influence and facilitation conditions. On the other hand, effort expectancy may be a necessary condition, but not the sufficient criterion to lift consumers’ intention to adopt. This is an unusual exception to general technology acceptance situations and thus is worthy of the attention of the 3G mobile telecommunication companies. Another managerial implication is that the 3G companies can skip measuring behavior intention because “performance expectancy”, “effort expectancy”, and “social influence” were proven to have directly influences on the actual “use behavior” in this study. Specifically speaking, 3G companies can have the flexibility to base on their marketing target of either behavior intention or use behavior to deploy their strategies and tactics.

Several limitations do exist to scope the above conclusions. First, the analysis of control variables was not included in this paper due to the page limit, thus the complete analyses of the full model in Fig. 3 is left to be

reported in another paper. Second, because currently 3G companies will frequently update the contents and functions of mobile value-added services, it is difficult to follow the trail of consumers’ using outcomes. Therefore, this study used only one point-in-time method to explore consumers’ use experience for easier data collection. However, the three tests at three different time periods as the original UTAUT study [12] did is preferred in future studies for lifting the rigorousness of the revised model as seen in Fig 3. Finally, the proposed UTAUT model is only valid for Taiwan’s 3G mobile telecommunication services due to the data collection restriction. A generalization of the application scope of this revised UTAUT model would require a global-area data collection process for a more thorough validation.

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