

## A Study of Behavioral Intention for Mobile Commerce Using Technology Acceptance Model

Yuchung Hung<sup>1</sup>, Haoerl Yang<sup>2</sup>, Chinghung Hsiao<sup>1</sup>, Yunglu Yang<sup>1</sup>

<sup>1</sup>Department of Information Management, Tatung University, Taipei, Taiwan, China

<sup>2</sup>Department of Business Management, Tatung University, Taipei, Taiwan, China

{<sup>1</sup>hung6599, <sup>2</sup>heyang}@ttu.edu.tw

### ABSTRACT

Davis's Technology Acceptance Model (TAM) suggests that perceived ease of use and perceived usefulness can predict user behavior and acceptance when using information technology. In this study we use it as a tool for evaluating the acceptance and usage for mobile commerce by employing data collected from 205 students selected proportionally from nine universities located at Taipei City. The results show that perceived ease of use and perceived usefulness are the fundamental determinants of user acceptance and have positive impact. They demonstrate positive impacts on attitude to use and behavioral intention to use. In addition, the attitude toward using m-commerce has a partial mediating effect on behavioral intention to use. Behavioral intention to use exerts a positive, though lesser, impact on actual use of m-commerce.

**Keywords:** Technology Acceptance Model, M-commerce, Confirmatory Factor Analysis, Regression Analysis, partial mediating effect.

### 1. INTRODUCTION

Digital mobile phone has improved the defects of analogue mobile phone, and brought mobile communication into a digital era. Governments of many countries have released their telecom policies for new dealers to invest in the market so as to compete with each other and cause the telecom fee to reduce. In the meantime, emulation among the dealers will bring innovations of communicative semi-conductor technique. As a result, the "used to be" heavy mobile phone now turns into portable and light personal stuff, which makes the mobile communication service grow rapidly.

Ever since the "i-Mode" service promoted by NTT DoCoMo, all global wireless dealers pay great attention to this emerging commerce, and start to run a similar business model which leads to a trend for crashing in the wireless network. With the vast application of Wireless Application Protocol (WAP), the promotion of GPRS communication service, and various newly promoted wireless terminal equipments (such as Smart Phone, Wireless PDA etc.), the integration of wireless communication and network will quicken the grand opportunities.

The technology acceptance model (TAM) proposed by Davis (1989) has been widely applied and empirically tested in the adoption or acceptance of information technology (IT) to explain end-users' acceptance

behavior. The technology such as e-mail and graphics, word process, voice mail were tested with TAM to explain the users' acceptance behavior. However, a meta-analysis of empirical findings indicates that the relationship between ease of use and acceptance is weak and the relationships in the model may be moderated by

a third variable such as gender, culture(Ma and Liu, 2004). In this study, we use m-commerce technology to test if the relationships in the TAM still validate.

### 2. LITERATURE REVIEW

#### 2.1 Technology Acceptance Model

Davis (1986) used belief-attitude-intention-behavior relationship of TRA(Theory of Reasoned Action) to develop TAM to model user acceptance of IT, as shown in Figure 1. This model provides a theoretical foundation to understand how external variables influence the user's inner beliefs in a technology, and then predict his/her behavior, which in turn affect the use of technology. The purpose of TAM is to provide an explanation toward the acceptance of technology which explains user's behavior on accepting new IT, and analyze the factors that influence their attitude toward using new IT. The design of the constructs used in TAM is both valid and reliable, and has been discussed, experimented, and amended by many scholars. So the same constructs could be adopted even though the technologies to be studied are different. (Adams et al., 1992; Taylor and Todd, 1995; Mathieson and Chin, 2001).

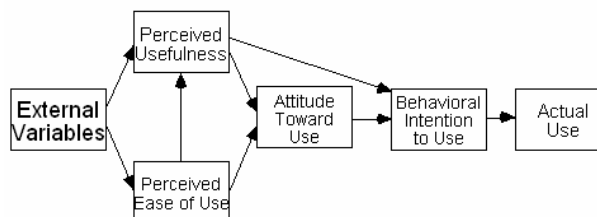


Figure 1 Technology acceptance model  
(Davis et al., 1989)

## 2.2 Mobile Commerce

Durlacher (1999) figured mobile commerce (m-commerce) as a vast area of activity comprised of transactions with monetary value conducted via wireless network. Other scholars like Skiba et al. (2000) defined m-commerce as transactions using a wireless device either in word or speech that result in the transfer of value in exchange for information, services, or goods. Jiang (2001) mentioned that m-commerce is the transactions conducted by terminal equipment, such as PDA, and SmartPhone etc, and the services should be paid. The related services and application include the downloading of music and picture, mobile monetary control, and mobile advertising.

From the above definitions, we can find that the divarication for the definition of m-commerce is whether monetary transactions should be included. The definition by Skiba et al. (2000) will be adopted as the foundation for this study, which referred m-commerce to transactions using a wireless device either in word or speech that result in the transfer of value in exchange for information, services, or goods.

The definition for m-commerce by Skiba et al. (2000) is not restrained for monetary service only. Therefore, the formation of m-commerce will depend upon the match of software and hardware. According to the framework proposed by Varshney and Vetter (2002), the formation of m-commerce is divided into two main sections, application, and development and supply. For development and supply, there are three categories: the supplier of service, the supplier that provides content, and the developer of application framework. Therefore, there are four levels for application, infrastructure for wireless network, intermediary software, device, and the application of m-commerce. This framework provides the m-commerce not only a direction but also a reference for standard allocation before investing in m-commerce.

## 3. RESEARCH MODEL AND HYPOTHESES

This study adopts the extended structural definition of TAM proposed by Davis et al. (1989), without considering external variables, as shown in Figure 2.

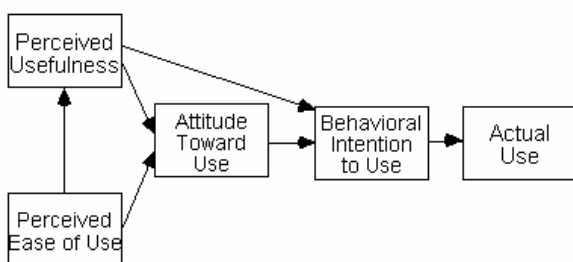


Figure 2 Research framework

## 3.1 Measures

In this study we used five questionnaire items to describe the construct of perceived usefulness and four items for perceived ease of use, which were adapted from Davis (1989) and Moore and Benbasat (1991) and measured on a five-point Likert scale with anchors ranging from strongly agree (1) to strongly disagree(5).

Attitude toward using m-commerce were indicated by four items adapted from Ajzen and Fishbein (1980), Malhotra and Galletta (1999) and measured on a five-point Likert scale; behavioral intention to use by two items adapted from Ajzen and Fishbein (1980), Davis (1989) on a five-point Likert scale.

As for the actual use of m-commerce it was defined as the frequency used per week (Malhotra and Galletta, 1999; Igarria et al., 1997).

## 3.2 Research Hypotheses

The research hypotheses for this research were made according to the structural theory of TAM proposed by Davis et al. (1989).

H1: Perceived ease of use will have a positive effect on perceived usefulness.

H2: Perceived usefulness will have a positive effect on attitude toward using m-commerce.

H3: Perceived ease of use will have a positive effect on attitude toward using m-commerce.

H4: Perceived usefulness will have a positive effect on behavioral intention toward using m-commerce.

H5: The attitude toward using m-commerce will have a positive effect on behavioral intention of use.

H6: The behavioral intention to use will have a positive effect on actual use of m-commerce

## 3.3 Data Collection

According to the ten years information communication technology research for university students made by Macleod et al. (2002), the percentages of students that were expected to use information communication technology frequently increased from 15%~30% to 65%, and the percentages of emphasize on self-use also increased from 20%~35% to 73%, which showed that most students had more desire to use information communication technology. According to the 2004 Taiwan Internet and Broadbar Usage Survey published by TWNIC, as of the end of January 2004, they are 12.64 millions Internet users in Taiwan and the number of broadband Internet users are 9.03 millions and about 81.55% with age of 21~25 (TWNIC, 2004). Since almost of those users are college students, they can be formed the sampling units. However, due to the limited resources, we decided to collected data from the students studied at nine universities located in Taipei City. We planned to select a sample from each university with

sample size proportional to its size. So 500 questionnaires were delivered with 205 usable copies returned including 95 female and 110 male.

### 3.4 Analytical Procedure

In this study we used Cronbach's  $\alpha$  with the cut-off of 0.7 (Nunnally, 1994) to assess the reliability of each construct. Exploratory factor analysis using principle component analysis with varimax rotation and confirmatory factor analysis were employed to assess construct validity and unidimensionality. The former is to investigate if the number of factors extracted is the exact number of constructs determined prior to the analysis and the later to assess construct validity and unidimensionality.

The Correlation analysis and multiple regression analysis were used to test the relationships among the scales or constructs and the effects on dependent variables. The causal direct, indirect, and total effects between the exogenous and endogenous variables can be calculated by using structural equation modeling (SEM).

## 4. DATA ANALYSIS

### 4.1 Reliability and Validity Analysis

The Cronbach's  $\alpha$  coefficients for perceived usefulness, perceived ease of use, attitude toward using m-commerce, behavioral intention to use m-commerce, are 0.8969, 0.8028, 0.9216, and 0.7562 respectively. All those Cronbach's  $\alpha$ 's are above the cut-off of 0.70. The reliability of each construct is acceptable.

Exploratory factor analysis for the items of perceived usefulness and perceived ease of use reveals that the items produce two proposed factors with total variance explained 68.7% and the individual items are loaded with loadings above 0.7 on their appropriate factors as intended. The items for attitude toward using m-commerce, behavioral intention to use reveals and actual use produce three proposed factors with total variance explained 83.9% and all loadings above 0.78. The results of confirmatory factor analysis also show the consistency with the findings in exploratory factor analysis. The validity and unidimensionality for the constructs of both perceived ease of use and perceived usefulness are supported. The validity and unidimensionality for the constructs for attitude toward use, intention of use, and actual use are also supported.

### 4.2 Correlation Analysis

The averaged item scores are used as a measure of their posited construct. The correlation matrix for the constructs used in the model are shown in Table 1. It indicates that the correlation between each pair of constructs is statistically significant at the 0.05 level, except the pair of behavioral intention to use (*intention*)

m-commerce and actual use (*action*) of m-commerce (marginal significance,  $p$ -value=0.061). Independent variables, perceived usefulness (*use*) and perceived ease of use (*ease*) show significantly positive correlation with attitude toward use (*attitude*), 0.656 ( $p=0.000$ ) and 0.543 ( $p=0.000$ ) respectively, and with behavioral intention toward use, 0.527 ( $p=0.000$ ) and 0.457 ( $p=0.000$ ) respectively, at  $\alpha=0.01$ . The correlation coefficient between perceived usefulness and perceived ease of use (0.477) is significantly positive at  $\alpha=0.01$ . The correlation coefficient between attitude toward use and behavioral intention to use (0.591) is significantly positive at  $\alpha=0.01$ .

Table 1 The correlation analysis of variables

	<i>use</i>	<i>ease</i>	<i>attitude</i>	<i>intention</i>	<i>action</i>
<i>use</i> Sig.	1 .				
<i>ease</i> Sig.	.477** .000	1 .			
<i>attitude</i> Sig.	.656** .000	.543** .000	1 .		
<i>intention</i> Sig.	.527** .000	.457** .000	.591** .000	1 .	
<i>action</i> Sig.	.224** .001	.201** .004	.162* .021	.131 .061	1 .

\*\* : Correlation is significant at the 0.01 level (2-tailed)

\* : Correlation is significant at the 0.05 level (2-tailed)

### 4.3 Hypotheses Testing

In correlation analysis the correlation coefficient between perceived ease of use and behavioral intention to use (0.457) is significant with  $p$ -value=0.000. Regress behavioral intention toward use on perceived usefulness, perceived ease of use and the attitude toward using m-commerce with stepwise method. The results, as presented in Table 2, show that the three independent variables are all significant in predicting the dependent variable with standard beta coefficients in the regression equation,  $b_{Attitude}=0.368$ ,  $b_{Use}=0.211$ ,  $b_{Ease}=0.157$ . The total variance of intention toward use can be explained 0.391 (adjusted  $R^2$ ) by perceived usefulness, perceived ease of use and attitude toward use

Table 2 Stepwise regression analysis

Order	R	A- $R^2$	$\Delta$ A- $R^2$	Std. $\beta$	$\Delta$ F	Sig.
1. <i>attitude</i>	0.591	0.346	0.346	.368*	109.058	0.000
2. <i>use</i>	0.619	0.377	0.031	.211*	11.141	0.001
3. <i>ease</i>	0.633	0.391	0.014	.157*	5.581	0.019

Dependent variable: *intention* (Behavioral intention to use)

\*significant at  $\alpha=0.05$ , A-  $R^2$ : Adjusted  $R^2$ .

In order to test the hypotheses we established the related regression models as presented in Table 3. All models are significant at  $\alpha=0.05$ , except the model  $action=intention$ , significant at  $\alpha=0.10$ .

Table 3 Regression analysis

Model	Variable	$\beta$	Std. $\beta$	A- R <sup>2</sup>	Sig.
use=ease	Constant	2.131		0.224	0.000**
	<i>ease</i>	0.448	0.477		
attitude=Use+Ease	Constant	0.479		0.494	0.000**
	<i>use</i>	0.597	0.514		
	<i>ease</i>	0.324	0.297		0.000**
	Constant	0.985		0.377	0.001**
intention=use+attitude	<i>use</i>	0.295	0.244		
	<i>attitude</i>	0.448	0.431		0.000**
action=intention	Constant	1.673		0.012	0.061*
	<i>intention</i>	0.153	0.131		

Table 4 shows that the results of the six hypotheses testing in this research, which indicates that all research hypotheses are supported by data.

Table 4 The results of research hypotheses testing

Item	Hypotheses	Result
H1	Perceived ease of use positively influences perceived usefulness.	supported
H2	Perceived usefulness positively influences attitude toward using m-commerce.	supported
H3	Perceived ease of use positively influences attitude toward using m-commerce.	supported
H4	Perceived usefulness positively influence behavioral intention toward using m-commerce.	supported
H5	The attitude toward use positively influences on behavioral intention toward using m-commerce.	supported
H6	The intention toward use positively influences actual use of m-commerce.	supported

The causal direct, indirect, and total effects between the exogenous and endogenous variables were calculated by using SEM. As can be seen in Table 5, all the effects are statistically significant at or above the 90% confidence level. For example, the total and indirect effects of perceived ease of use on attitude toward use are .543 (t value=8.48) and .246(t value=5.72), respectively. The direct effects presented in Table 5b can be shown in TAM diagram as in figure 3.

Table 5 Total effects, direct effects, and indirect effects

a. Standardized total effects (t value)

	<i>ease</i>	<i>use</i>	<i>attitude</i>	<i>intention</i>
<i>use</i>	.477 (6.91)	.000	.000	.000
<i>attitude</i>	.543 (8.48)	.514 (6.76)	.000	.000
<i>intention</i>	.350 (5.47)	.466 (7.17)	.431 (5.32)	.000
<i>action</i>	.046 (1.70)	.061 (1.79)	.057 (1.78)	.131 (1.93)

b. Standardized direct effects (t value)

	<i>ease</i>	<i>use</i>	<i>attitude</i>	<i>intention</i>
<i>use</i>	.477 (6.91)	.000	.000	.000
<i>attitude</i>	.297 (4.24)	.514 (6.76)	.000	.000
<i>intention</i>	.000	.244 (2.77)	.431 (5.32)	.000
<i>action</i>	.000	.000	.000	.131

	<i>ease</i>	<i>use</i>	<i>attitude</i>	<i>intention</i>
				(1.93)

c. Standardized indirect effects (t value)

	<i>ease</i>	<i>use</i>	<i>attitude</i>	<i>intention</i>
<i>use</i>	.000	.000	.000	.000
<i>attitude</i>	.246 (5.72)	.000	.000	.000
<i>intention</i>	.350 (5.47)	.222 (4.35)	.000	.000
<i>action</i>	.046 (1.70)	.061 (1.79)	.057 (1.78)	.000

The t values >1.66, 1.98, and 2.35 are considered to be significant at the 0.10, 0.05, and 0.01 levels, respectively.

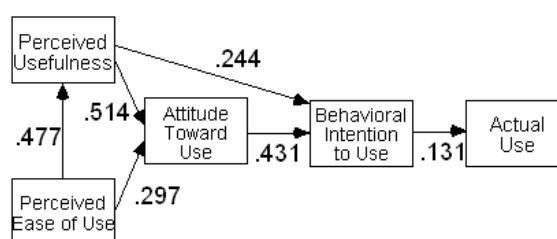


Figure 3 The causal direct effects between constructs

### 5. CONCLUSIONS AND SUGGESTIONS

A number of hypothesized relationships in Davis's TAM with different IT, i.e. m-commerce, were tested based on a sample of 205 college students. The results of our study generally confirm the Davis's findings. The relationships between perceived ease to use and perceived usefulness, and between perceived usefulness and attitude toward use are strong. The relationships between perceived ease to use and attitude toward use is also strong, while weak reported by Ma and Liu(2004). We found from regression analysis that behavioral intention to use can be predicted by perceived usefulness and attitude toward use.

Although we did not proposed a formal hypothesis about the mediating effect of attitude toward use, we added one more regression model,

$$intention = .400 use + .266 ease,$$

p values=.000 for beta testing,

with two models, that is,  $attitude = .514 use + .297 ease$ , p values=.000, from Table 3, and  $intention = .211use + .157ease + .368 attitude$ , p values<.050, from Table 2. By mediating effect test (Baron and Kenny, 1986) the beta coefficient of *use* decreases from .400 to .211 when adding *attitude* toward use into the regression model, which demonstrates that attitude toward use has a partial mediating effect on behavioral intention to use. However, the effect of behavioral intention to use on actual use is marginally significant (p=0.061).

In this survey one question about the most common used

m-commerce service, it is the message-sending, the most typical service provided. About the service the users of m-commerce expect most is the improvement of entertainment service, followed by global positioning, financial service, and general information. The above information implies the trend that the users may gradually accept more m-commerce services and use them.

That the effect of behavioral intention to use on actual use is statistically marginal significance may imply that there are some important variables omitted, such as the service charge, the security of the system, and the problem of on-line quality, when users considering taking action to use.

Because m-commerce is expected to have a prosperous market for service providers, they should realize user's behavior in the market and manage potential user's requirements for it. Potential user's attitude toward using m-commerce and the factors that influence their intention to use should be realized and emphasized in order to develop proper marketing strategies for the use of m-commerce.

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