Do Mobile Commerce and Electronic Commerce Mean Differently? An Exploratory Investigation from Users' Perspective

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Abstract

While mobile technologies are gradually utilized as the wide spread of electronic commerce (EC) applications, the growth of mobile commerce (MC) is not so rapid as that of EC. Consequently, this study investigated whether MC can be appropriately projected and developed by adopting the business models of EC. We explored through the viewpoint of users, and regarded the technology acceptance model (TAM) as the research basis. By considering the key features of MC, this study proposed three antecedents of TAM - local independence, time critical, and personalization - to examine the applicability of the extended TAM in EC and MC contexts. Data was collected from a survey on 261 respondents, and was analyzed by structural equation modeling (SEM) techniques. According to our results, the extended TAM performed well in predicting users' perceptions and intentions in both EC and MC contexts. Meanwhile, the results showed that users indeed recognized the differences between MC and EC. However, the value of MC on location independence was not perceived by users. This finding implied that MC vendors should adopt different, or more creative, practices in developing and marketing MC applications, particularly location-based services.

Keywords: Mobile commerce (MC), electronic commerce (EC), technology acceptance model (TAM).

I. Introduction

As the power of mobile technologies is gradually recognized, in particular after the wide spread of electronic commerce (EC) applications, the development of mobile applications has become a major trend. In particular, with the tremendous advances in mobile computing and communication capabilities, the development of mobile devices facilitates the emergence of new, creative commerce applications. Such commercial applications, in term, are expected to help vendors generate revenue (Elliott & Phillips, 2004). In such cases, consumers and businesses may conduct information and transactions through mobile or wireless devices.

Theoretically, mobile applications are an extension of EC that have their users conduct business or interact with people via wireless technologies at any time and any place (Tsalgatidou & Pitoura, 2001). Although these wireless applications extend the qualities of PC-based experiences of EC (Magura, 2003), to make the distinction between the original ideas of EC, they are termed "mobile commerce (MC)".

Generally speaking, MC covers a wide variety of functions, ranging from games, banking services, advertising, ticketing, shopping, toward value-added information assessment (MacDonald, 2003). According to CellularOnline (http://www.cellular.co.za/stats/stats-main.htm), global mobile users have reached 1.52 billion. To the extreme, in some regions, such as Taiwan and Hong Kong, the number of mobile subscribers is higher than the population of that region (Yeo, 2002). Not surprisingly, mobile vendors and the academy both claimed that the first decade of 21st century will be the decade of MC, as the argument that the 1990s is best titled as the decade of the Internet (Urbaczewski et al., 2003).

Although the development of the supply side of MC grows rapidly, this claim has surpassed the reality. Not nearly enough people stepped up to use mobile services; mobile users were left feeling less than satisfied (Urbaczewski et al., 2003). In other words, even though mobile technologies have improved dramatically, the business models of MC vendors are still immature, which make users with less interest in adopting MC applications or services (Thorat & Waryas 2004).

Consequently, it is of great interest exploring how to develop MC efficiently; one fundamental issue of it is to determine whether MC can be appropriately projected and developed by adopting the business models of EC directly. To answer this question, this study investigated through the viewpoint of users, rather than from the viewpoint of vendors. The technology acceptance model (TAM) was taken as the basis of our research, owing to its great generalizability in predicting users' behavior on technology adoption. In the following sections, details of our research model and its corresponding hypotheses were developed, examined, and discussed.

II. Basic concepts, research model and hypotheses

In this study, MC refers to all purchases of products and services that occur through a mobile data platform as a result of interactions with subscribers (Varshney et al., 2000; Barnes, 2002); while EC refers to transactions that conduct via a wired PC browser (Varshney & Vetter, 2002). From the very nature, MC and EC are quite similar. However, some studies still found the differences between these two shopping mechanisms (Vatanasombut et al., 2004). Therefore, MC vendors (e.g., network designers, service providers, vendors, and application developers) are suggested cautiously taking the needs and considerations of users, thus providing customized services to attract potential users. To validate this claim empirically, the following work helped to form our research model and hypotheses.

2.1 Technology acceptance model

Technology acceptance model (TAM) was proposed in the late 1980s (Davis, 1989; Davis et al., 1989). It is a well-established model that has been used broadly to predict and to explain human behavior in various IS domains during the past two decades (Ong et al., 2004; Wu & Wnag, 2005). Generally speaking, TAM consists of several key constructs: external variables, perceived ease of use (PEOU), perceived usefulness (PU), and behavioral intention to use (BI). PU and PEOU are cited as the most valuable constructs, as they help predict users' intention, which then determine actual IS use (Davis, 1989; Davis et al., 1989). Besides, external variables serve equally important role in TAM. They provide the bridge between the internal beliefs, attitudes, and intentions represented in TAM, as well as the various individual differences, situational constraints, and managerially controllable interventions impinging on behavior (Davis et al., 1989). Thus, many recent TAM-related studies examined the impacts of external variables in different contexts; one typical example is TAM II (Venkatesh & Davis, 2000).

With regard to its application on EC and MC, TAM has been applied in many studies, such as Shih (2004), Ong et al. (2004) and Wu & Wang (2005). However, due to different focuses and settings, these studies are hard to compare between each other, let alone telling the differences between MC and EC. To overcome this weakness, it calls for studies highlighting the key features of EC and MC concurrently as the comparison basis.

2.2 Differences between EC and MC: A diffusion perspective

From the very nature, technology is to a very large extent synonymous with innovation (Elliott & Phillips, 2004). Therefore, the diffusion of innovation theory is widely adopted in explaining the process of IS adoption recently (Karahanna et al., 1999; Wu & Wang, 2005). Based on this theory, four major elements were identified in determining the speed of diffusion process: innovation, time, communication channel, and the social system (Rogers, 2003). By applying this perspective, the major difference of EC and MC may lie in

communication channels. Furthermore, if an in-depth analysis is taken, three features could be recognized as the major drivers that influence user patterns in MC adoption different from EC adoption. These features were: location independence, time critical, and personalization.

2.3 The research model and hypotheses

Figure 2.1 illustrated our research model. In this model, the three key features of MC were modeled as antecedents of TAM. Besides to examine the differences resulting from the context, a moderate variable (MC versus EC) was included, which was expected to influence all path coefficients within the research model. Thus, corresponding to our research question and our research model, the following research hypotheses were made.

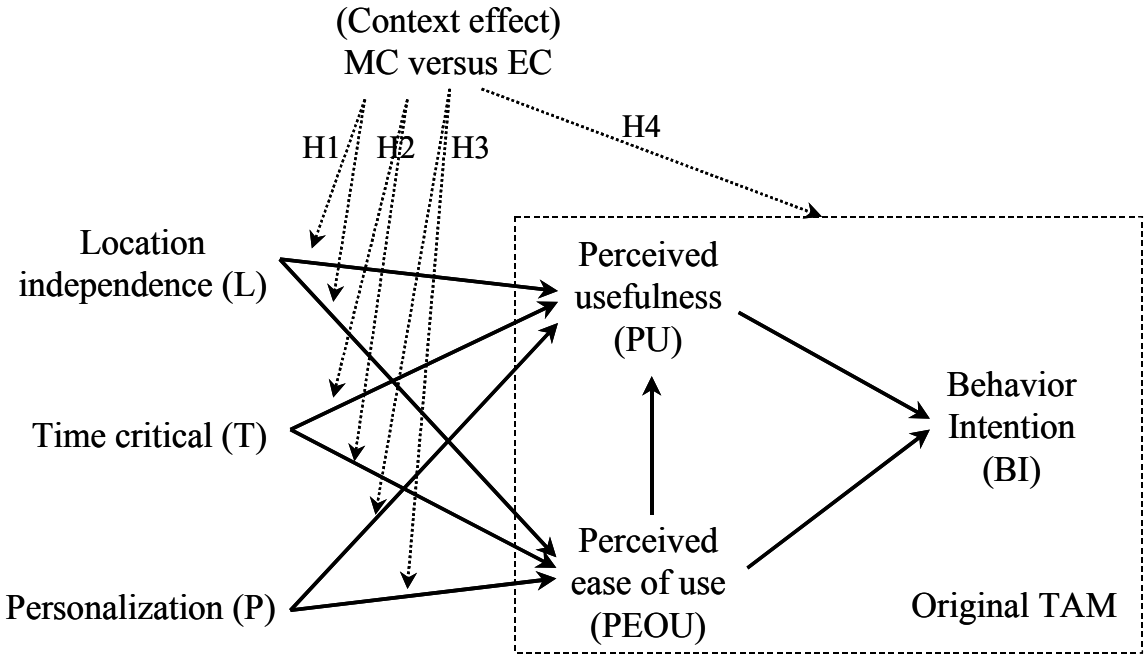

Figure 2.1 The proposed research model: The extended TAM

(a) Location independence

Users conduct transactions by mobile technology may be entirely independent of physical location, such as obtaining a stock quote through cellular phones (Balasubramanian et al., 2002). It implies that using MC application may attract users than the power of EC, owing to less location limitation. Therefore, we hypothesized this issue as:

H1: The effects of location independence (L) on perceptions in MC context is stronger than that in EC context ($MC_L > EC_L$)

H1a: The effects of L on PU in MC context is stronger than that in EC context

H1b: The effects of L on PEOU in MC context is stronger than that in EC context

(b) Time critical

When transactions (in particular business ones) are urgent or time critical, they involve the exchange of information related to tightly or strictly scheduled events (Balasubramanian

et al., 2002). For instance, one user may need real time services, such as getting a flight departure schedule, participating in a virtual auction, or calling a roadside assistance request. In these cases, MC applications provide more real time or higher time flexibility service capabilities than that of EC applications. As a result, we hypothesized:

H2: The effects of time critical (T) on perceptions in MC context is stronger than that in EC context ($MC_T > EC_T$)

H2a: The effects of T on PU in MC context is stronger than that in EC context

H2b: The effects of T on PEOU in MC context is stronger than that in EC context

(c) Personalization

Mobile devices are used by individuals with different personal traits. Therefore, making mobile devices ideal for individual requests is the key to success (Nohria & Leestma, 2001). To highlight the fact that MC users enjoy customized transactions, we hypothesized:

H3: The effects of personalization (P) on perceptions in MC context is stronger than that in EC context ($MC_P > EC_P$)

H3a: The effects of P on PU in MC context is stronger than that in EC context

H3b: The effects of P on PEOU in MC context is stronger than that in EC context

(d) Contextual effects

Owing to the above features of MC, users may perceive MC and EC differently. To specify possible contextual effects, we hypothesized:

H4: The path coefficients of TAM in MC context are different from those in EC context ($MC_{TAM} \neq EC_{TAM}$)

H4a: The impact of PEOU on PU in MC context is different from that in EC context

H4b: The impact of PEOU on BI in MC context is different from that in EC context

H4c: The impact of PU on BI in MC context is different from that in EC context

III. The research method

3.1 Research subjects and procedure

The research design was applied to collect data from students in several institutes of technology in north Taiwan. The students were taking undergraduate courses in fall 2004. Data assessment was done by the following procedures: one of the authors went to classes, with the permission of the course instructors; students of those courses were given an option to participate in the study. Each participating student had to fill in questionnaires for both EC and MC contexts.

Of the 338 surveys, 261 useful responses were applied for analysis. The respondents averaged 24 years old in age. Forty percent of the respondents were part-time students (i.e., having regular jobs during the week day), with an average monthly income of NTD 25,000. Besides, all students have used Internet and mobile phones in their daily lives for many years.

3.2 Measurement

To ensure content validity of the scales, items must represent the concept about which generalizations are to be made. Items selected for the constructs, thus, were adapted mainly from previous research (Ong et al., 2004).

First of all, the measurement of the three constructs of TAM (i.e., PU, PEOU, and BI) was adopted from Wu & Wang (2005), except for the wordings of measurement for satisfying our research targets. All the items were measured using 7-point Likert scales. PU was measured using a four-item scale; PEOU was measured using a three-item scale; whereas BI was measured using two items.

With regard to the antecedents of our model (i.e., location independence, time critical, and personalization), the measurement was self-developed and was mainly derived from Clarke (2001) and Balasubramanian et al. (2002). The scale of location independence (L) consisted of two 7-point Likert items; the scale of time critical (T) consisted of three 7-point Likert items; whereas the scale of personalization (P) consisted of three 7-point Likert items.

IV. Data analysis and results

4.1 Analysis of measurement validity

Measurement validity in terms of reliability, convergent validity, discriminated validity, and construct validity was evaluated. Reliability of the instrument was evaluated using Cronbach's alpha. In our case, Cronbach's alphas of the constructs ranged from 0.70 toward 0.95 (see Table 4.1), revealing that the common threshold recommended by previous studies was satisfied (Ong et al., 2004).

Table 4.1 Descriptive statistics of items and Cronbach's alpha

	Number of items	Cronbach's alpha
Behavior intention (BI)	2	0.93
Perceived usefulness (PU)	4	0.91
Perceived ease of use (PEOU)	3	0.95
Location independence (L)	2	0.70
Time critical (T)	3	0.82
Personalization (P)	3	0.89

To confirm convergent and discriminant validity, a correlation matrix approach was applied (Ong et al., 2004). As shown in Table 4.2, most of the smallest within-factor correlations were considerably higher among those designed to measure different constructs (ranging from 0.25 to 0.62). It, therefore, suggested adequate convergent and discriminant validity of the measurement.

Finally, confirmatory factor analysis (CFA) was conducted on all constructs applied in

our research model. All factor loadings were above 0.7 (ranging from 0.76 to 0.96), except location independence (which was 0.69). Meanwhile, CFA on all items showed a good fit (x^2/df = 3.26, RMSR=0.038, RMSEA=0.066, NNFI=0.96, and CFI=0.97), thus providing strong evidence of convergent validity and construct validity of individual constructs.

Table 4.2 Analysis of inter-measurement correlation

	BI		PU				PEOU			T		L			P		
	1	2	1	2	3	4	1	2	3	1	2	1	2	3	1	2	3
BI1	**1.00**																
BI2	**0.91**	**1.00**															
PU1	0.53	0.51	**1.00**														
PU2	0.57	0.54	**0.85**	**1.00**													
PU3	0.51	0.50	**0.79**	**0.79**	**1.00**												
PU4	0.58	0.57	**0.72**	**0.73**	**0.76**	**1.00**											
PEOU1	0.52	0.51	0.55	0.58	0.56	0.53	**1.00**										
PEOU2	0.61	0.59	0.56	0.62	0.56	0.58	**0.78**	**1.00**									
PEOU3	0.61	0.61	0.51	0.56	0.51	0.52	**0.71**	**0.81**	**1.00**								
L1	0.34	0.32	0.44	0.42	0.40	0.41	0.34	0.38	0.32	**1.00**							
L2	0.26	0.25	0.30	0.29	0.28	0.29	0.31	0.30	0.25	**0.54**	**1.00**						
T1	0.35	0.36	0.53	0.51	0.55	0.48	0.42	0.43	0.35	0.38	0.38	**1.00**					
T2	0.40	0.41	0.53	0.51	0.48	0.47	0.44	0.46	0.38	0.59	0.54	**0.55**	**1.00**				
T3	0.32	0.33	0.53	0.50	0.56	0.46	0.38	0.39	0.34	0.41	0.40	**0.71**	**0.56**	**1.00**			
P1	0.61	0.61	0.51	0.51	0.50	0.56	0.42	0.49	0.46	0.42	0.31	0.39	0.48	0.43	**1.00**		
P2	0.59	0.58	0.56	0.56	0.51	0.55	0.50	0.54	0.53	0.43	0.31	0.41	0.51	0.45	**0.72**	**1.00**	
P3	0.59	0.60	0.50	0.52	0.50	0.52	0.47	0.51	0.51	0.40	0.26	0.37	0.45	0.37	**0.71**	**0.78**	**1.00**

4.2 Model testing

(a) Test of the core model

Structural equations modeling (SEM) techniques were used to test the core model (i.e., the model without the moderating variable). Although the focus of this study was on moderating effects (i.e., whether the users perceive differently in MC and EC context), a full direct-effects model was also worth tested. In fact, either direct or moderating effects will be stronger, moderating effects are expected to be more meaningful (Dabholkar & Bagozzi, 2002).

First of all, the fit for the core model was good (RMSR=0.05, RMSEA=0,074, NNFI=0.95, and CFI=0.96), except the index of x^2/df (3.88). Two determinants – time critical (T) and personalization (P) – had direct, positive effects on perceptions (i.e., PEOU and PU). Standardized beta coefficients of these two determinants on PEOU and PU ranged from 0.22

toward 0.50. However, the effects of the third determinant, location independence (L), on PEOU and PU were not significant.

Besides, with regard to the original TAM, perceptions (PEOU and PU) toward using electronic devices on commerce had direct, positive effects on the corresponding intentions (BI), with standardized beta coefficients of 0.29 and 0.49, respectively. Meanwhile, the causal impact of PEOU on PU was also positive and significant, with a standardized beta coefficient of 0.33.

(b) Test of moderating effects

To investigate whether users perceive the features of mobile devices, thus resulting in different patterns on their perceptions on MC and EC contexts, the sample was tested through the moderating effect examination by Dabholkar & Bagozzi's (2002) approach. More specifically, to see if moderating effects are present, two tests were conducted for the context variable based on four models being examined. The rationale was as follows. Model A had all factor loadings constrained across the groups, and error variances of the items for endogenous variables were also constrained. Model B had the factor loadings free but error variance constrained. Model C had both factor loadings and error variances free. Model D had factor loadings constrained but error variances free.

The first test compared Model A to Model D (and Model B to Model C). If Model A and Model D are different from each other (or if Model B and Model C are different from each other), this difference would be caused by error variances in dependent variables. In our case, Model A and Model D were essentially the same (i.e., the x^2 difference between the models was not significant); either were that of Model B and Model C. These findings indicated (and doubly verified) that error variances did not cause significances across MC and EC settings (Dabholkar & Bagozzi, 2002).

The second test compared Model A to Model B (and Model D to Model C). If these two models were different from each other, this difference would be caused by factor loadings. In other words, if the x^2 difference between these two models divided by the change in degrees of freedom (i.e., $\Delta x^2/\Delta df$) is significant, there are significant moderating effects across EC and MC contexts (Dabholkar & Bagozzi, 2002).

Results of the first and the second tests were shown in Table 4.3 and Table 4.4, respectively. In addition, the results for the hypotheses, in terms of changes in standardized beta coefficients in the presence of the context, were shown in Table 4.5 and Table 4.6. From the results, most hypotheses were supported, except for H1.

Finally, with regard to the explanation power, the three endogenous variables indeed helped explain the variance of the three dependent, latent variables (i.e., PEOU, PU, and BI). As shown in Table 4.7, the R^2 values for PEOU, PU, and BI in different cases ranged from 0.49 toward 0.72, illustrating the applicability of our model. Implications of the results were discussed next.

Table 4.3 The error variance effects of "EC versus MC" on SEM results

Model	X^2	Df	RMSEA	RMSR	NNFI	CFI	$\Delta x^2/\Delta df$	P-value
A	1109	260	0.079	0.1	0.88	0.89	2.71	ns
D	1054.90	240	0.081	0.083	0.88	0.89		

Table 4.4 The moderating effects of "EC versus MC" on SEM results

Model	X^2	df	RMSEA	RMSR	NNFI	CFI	$\Delta x^2/\Delta df$	P-value
A	1109	260	0.079	0.1	0.88	0.89	9.21	0.001
B	869.42	234	0.072	0.08	0.90	0.92		

Table 4.5 Structural equations results for hypotheses in the moderating effect model

	MC	EC	Comparison
L → PEOU	-0.61 (ns)	0.38	Change in the opposite direction
L → PU	-0.42 (ns)	0.50	Change in the opposite direction
T → PEOU	1.00	0.43	Supported
T → PU	0.90	-0.39	Supported
P → PEOU	0.25	0.05 (ns)	Supported
P → PU	0.22	0.20	No significant change as hypothesized
PEOU → PU	0.11	0.57	Supported
PEOU → BI	0.37	0.82	Supported
PU → BI	0.41	-0.03	Supported

Table 4.6 Overview results

Hypotheses	Results
H1: Effects of location independence (L) on perceptions ($MC_L>EC_L$)	Rejected
H1a: Effects of L on PU ($MC_L>EC_L$)	Rejected
H1b: Effects of L on PEOU ($MC_L>EC_L$)	Rejected
H2: Effects of time critical (T) on perceptions ($MC_T>EC_T$)	Supported
H2a: Effects of T on PU ($MC_T>EC_T$)	Supported
H2b: Effects of T on PEOU ($MC_T>EC_T$)	Supported
H3: Effects of personalization (P) on perceptions ($MC_P>EC_P$)	Supported
H3a: Effects of P on PU ($MC_P>EC_P$)	Supported
H3b: Effects of P on PEOU ($MC_P>EC_P$)	Not rejected
H4: Path coefficients of TAM are different ($MC_{TAM}\neq EC_{TAM}$)	Supported
H4a: The impact of PEOU on PU are different ($MC_{TAM}\neq EC_{TAM}$)	Supported
H4b: The impact of PEOU on BI are different ($MC_{TAM}\neq EC_{TAM}$)	Supported
H4c: The impact of PU on BI are different ($MC_{TAM}\neq EC_{TAM}$)	Supported

Table 4.7 R^2 value of constructs in the core and moderating models

R^2 value / Construct name	Pooled	MC case	EC case
PEOU	0.49	0.57	0.66
PU	0.69	0.67	0.72
BI	0.53	0.50	0.63

V. Discussion

5.1 Analysis of effects resulting from antecedents

From the above information, our extended TAM had outstanding explanation power on consumer behavior in both MC and EC contexts. As well, the differences between MC and EC were significantly distinguished by our model.

Firstly, if the focus was on the impacts of antecedents on MC, the three variables (i.e., location independence, time critical and personalization) were found playing the important roles in this regard. According to our results, features of time critical and personalization of MC were perceived by users, while the value of location independence was not. In particular, time critical plays as the most important factor affecting the perceptions of users. This finding is consistent with the pattern of how users adopt mobile phones. Due to the advantage of mobile phone penetration and the characteristics of convenience to carry, MC users would roam and hook online without the limitation of time. Thus, based on our finding, it is claimed that time flexibility is the major factor telling the differences between MC and EC applications from users' perceptions.

Secondly, our finding showed that effects of personalization on MC were stronger than that on EC. MC vendors need to focus and offer personalized services based on known user profile, and tailed the unnecessary information. On the contrary, EC vendors should tail the information by users themselves and need more freedom to browse websites. This finding, from the very nature, was in line with Lee & Benbasat (2003), which claimed that the design of user interface should rely heavily on features of applications.

Finally, our results showed that the value of location independence was not perceived by users in the MC context. From MC vendors' viewpoint, this was a quite surprisingly finding, because location-based services are the most important MC applications they are developing and delivering. However, IDC's recent comments were in line with our finding. IDC analyzed the market in US cellular location-based services in 2004-2008, and reported that yet the technology had dramatically improved, the business models are very immature. As a result, even if users have a high level of interest in location-enabled services, it does not necessarily mean that users will be used for business purposes. IDC believed that mass-market growth in location-based services is still a number of years away (Thorat & Waryasm 2004). In addition

to IDC's argument, an in-depth analysis on users' perceptions revealed that, because EC applications have provided functions for on-line purchasing and because many users do not regard creative, value-added information-oriented services (such as location-based services) as part of MC, the potential value of location independence offered by MC was not yet recognized or realized by mobile users. In one words, unless better marketing or differentiation strategies are created by MC vendors, MC is still in its infancy and its applications are limited when comparing to that of EC.

5.2 Contributions to TAM

(a) Contributions to the original TAM

Our results helped explain the possible gap between the viewpoints of vendors and that of users in terms of the growth pattern of MC applications usage. It, in term, provided evidence supporting the claim that TAM was capable applying in both EC and MC contexts.

(b) The success in extending TAM by adding antecedents

Our results showed that the extended TAM performed well in both MC and EC contexts, which then helped validate Davis et al.'s (1989) suggestions. Thus, the claim of adding external variables as antecedents to strengthen the explanatory power of TAM is worth further exploring; TAM II provided supportive evidence in this regard.

(c) The success of integrating the moderating effects into TAM

Due to great explanatory power and the goodness of model fit, the moderating effects were proved appropriately applied of the extended TAM in capturing the contextual differences perceived by users.

5.3 Implications to MC vendors: An TAM's perspective

Our results made it clear that there indeed exist differences between EC and MC. In particular, according to the casual effects, it was suggested that MC and EC vendors should apply different strategies in market penetration when trying to capture the awareness of users (e.g., MC vendors have better paid attention to both PU and PEOU, whereas EC vendors have to concentrate on PEOU).

In addition, our findings revealed that not all mobile factures were perceived or recognized significantly by users in MC context. This argument was particularly true for the concerns on location-based features. As a consequence, MC vendors may pay more attention to marketing location-based services through more creative or innovative manners, so as to speed up the growth and the value of MC applications.

VI. Conclusion

While mobile technologies are gradually utilized as the wide spread of EC applications,

surprisingly, the growth pattern of MC is not so rapid as that of EC. Consequently, it is of great interest in investigating whether MC can be appropriately projected and developed by adopting the business models of EC directly.

This study explored this research question through the viewpoint of users, based on TAM. To highlight the features of MC, local independence, time critical, and personalization were modeled as antecedents of our model. The research model (or the extended TAM) was applied in examining its applicability in both EC and MC contexts. The analysis of survey data was done by SEM techniques; major findings and contributions of this study could be summarized as follows: (1) analyzing the impacts of MC's features on both EC and MC contexts: our results helped identify the value of time critical and personalization are especially recognized by users in MC context, in comparison with that in EC context; (2) validating the applicability of TAM and the possible extension of TAM by adding antecedents and moderating variables: supportive evidence could be found in construct validity, the goodness of model fit, path coefficients, and R^2 of constructs; (3) providing possible reasons in explaining the gap between vendors' expectations and the reality (or the thought of users), which helped claim that TAM was worth taken or applied in this regard; and (4) implications to MC vendors: because not all features of MC were perceived by users (in particular the value of location independence), MC vendors should adopt different, or more creative, practices in developing and marketing MC applications.

However, the findings of this study were still with their limitation; cautions needed to be taken when generalizing our findings in real practice. First of all, owing to the restrictions of our survey samples and our research targets (on general concepts of MC and EC, rather on specific applications), together with less attention on individual characteristics, our findings call for further validation. Secondly, in terms of the paths of influences within TAM, our findings, in fact, were inconsistent with previous studies, such as Wu et al.(2005) and Ong et al. (2004). Although not well explained (owing to the fact that this was not the core of this study), further extensions of the survey or detailed comparisons through replication were worth applied. Finally, because this study was conducted with a snapshot research approach, additional efforts or longitudinal studies are worth applying for validation.

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