Managing Service Quality: An International Journal

The adoption of mobile value-added services: Investigating the influence of IS quality and perceived playfulness

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Abstract

Purpose – Mobile telecommunication service providers endeavor to mitigate the declining voice service revenue through popularization of mobile value-added services (MVASs). To understand determinants that influence mobile phone subscribers' intentions to use MVASs, this study aims to investigate the influences of perceived playfulness and information systems (IS) quality on mobile phone subscribers' intentions to use MVASs.

Design/methodology/approach – An online survey involving 304 subjects was conducted, followed by a partial least squares (PLS) analysis, which yielded strong evidence in support of our proposed research model.

Findings – The results confirmed that information quality, system quality, and service quality serve as important antecedents of perceived ease of use and usefulness among mobile phone subscribers. Additionally, the authors found that the perceived playfulness of MVASs mediates the influence of perceived ease of use on intentions of mobile phone subscribers to adopt the services. The comparison between experienced and inexperienced users also suggests that inexperienced subscribers are attracted to MVASs that satisfy their need for information or play, whereas experienced subscribers tend to take into account system and service qualities.

Research limitations/implications – Self-selection within the online data collection process was unavoidable; in addition, this study was unable to perform a comparison across different mobile phone subscriber groups and was limited to those MVASs available at the time of data collection.

Practical implications – The results of this study can assist mobile telecommunication service providers in understanding the critical determinants that influence mobile phone subscribers' decisions to adopt MVASs. Besides IS quality factors, the results suggest that service providers should also value the quality of perceived playfulness, which reflects user engagement and enjoyment of the services, beyond usefulness alone.

Originality/value – This study contributes to the understanding of MVAS adoption by introducing IS quality factors and perceived playfulness to current theoretical models; and, furthermore, provides sound evidence that information quality, system quality, service quality, and perceived playfulness are critical factors that influence consumer decisions to adopt these services.

Keywords Information quality, System quality, Service quality, Perceived playfulness, Mobile value-added services, Information, Customer services quality

Paper type Research paper

This research is supported by the National Science Council (NSC 98-2410-H-390-022), Taiwan (ROC). The authors would like to thank the anonymous reviewers for their valuable comments and suggestions to improve the quality of this paper.

Managing Service Quality
Vol. 22 No. 2, 2012
pp. 184-208

0960-4529
DOI 10.1108/09604521211219007

1. Introduction

According to International Telecommunication Union (ITU), The global mobile phone subscriber base reached nearly 5.3 billion by the end of 2010 (with 940 million subscriptions for 3G services), corresponding to a worldwide penetration rate of 90 percent (ITU, 2010a). The growth in developing countries, meanwhile, more than doubled from 22.9 percent in 2005 to 67.6 percent in 2010 (ITU, 2010b). The rapid increase in the number of mobile phone subscribers contribute to the popularization of mobile value-added services (MVASs) such as games, ringtones, mobile internet applications, multimedia messaging, mobile commerce, remote surveillance, and location-based services. (See Appendix 1 for a definitions of MVAs.) With the increasing importance of MVASs, researchers have begun to analyze the drivers of and barriers to the adoption of these services (e.g. Kuo and Yen, 2009; Liao *et al.*, 2007; Nysveen *et al.*, 2005; Wu and Wang, 2005).

Investigating users' intentions to accept technology has always been an important topic in information systems (IS) research. Among the many theoretical perspectives, the technology acceptance model (TAM) (Davis *et al.*, 1989; Davis, 1989) is the most widely accepted framework due to its parsimony and high explanatory power across a wide variety of contexts. However, TAM only employs two user beliefs, perceived usefulness and perceived ease of use, to explain users' behavioral intention. These two user beliefs are more associated with utilitarian information systems that increase users' task performance and encourage efficiency by providing instrumental values (Van de Heijden, 2004).

Different from utilitarian information systems, MVASs are now able to serve both hedonic and utilitarian purposes with the huge variety of applications available. Recreational enjoyment is closely tied to the value of perceived playfulness, which measures the degree of the users' engagement when interacting with services such as multimedia message service (MMS), games, ringtone and graphics downloads – all of which provide some form of hedonic or recreational value. In contrast, the utilitarianism of the service is determined by information system (IS) quality concerns, such as information quality, system quality, and service quality. Often, subscribers consider factors such as the availability of location-based services, wireless network access, or mobile secretaries to determine whether the service is a stable and reliable source for fulfilling their utilitarian demands.

Due to these very features of MVAS, intrinsic motivation (e.g. perceived playfulness) is believed to be influential when users decide whether or not to adopt a new system that addresses individual experiences (Lu *et al.*, 2009; Moon and Kim, 2001). Moreover, the quality antecedents based on DeLone and McLean's (1992, 2003) information system success model (D&M IS success model) have also indicated the growing importance of service in information systems use. A technology-focused perspective would see MVASs as an information system and focus on system and information quality, while a service-focused perspective would emphasize the service nature and include service quality (Ahn *et al.*, 2007). However, few researchers on MVAS adoption have attempted to integrate these determinants of MVAS adoption. This poses a research gap to be filled as well as a research opportunity to be addressed.

Besides the objective of understanding whether perceived playfulness and IS quality influence mobile phone subscribers' intentions to use MVASs, one other objective of this study is to analyze the relationships between these factors and the determinants of IT adoption. Further analysis of user experience with MVASs also

provides evidence of the relative importance of different quality factors in determining the intention to adopt MVASs.

In the next section, we will review prior research on TAM, IS quality, and perceived playfulness and derive our research hypotheses. Section 3 outlines the research model and describes the instrument validation and data collection processes. Section 4 presents the data analysis, and Section 5 follows up with a discussion of both theoretical and managerial implications of our findings. Section 6 concludes with suggestions for future research and research limitations.

2. Theoretical background and hypotheses

The research model is shown in Figure 1.

2.1 The technology acceptance model

TAM delineates how users come to accept and use a technology or a system. TAM posits that two particular beliefs – perceived usefulness and perceived ease of use – are of primary relevance to technology acceptance behaviors (Davis *et al.*, 1989; Davis, 1989). Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance," and perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320).

Prior research suggests that an extension of TAM can provide a stronger explanation for the behavior under study (Castañeda *et al.*, 2007; Dishaw and Strong, 1999; Hsu and Lu, 2004; Kuo and Yen, 2009; Venkatesh and Davis, 2000; Wu and Wang, 2005). Venkatesh and Davis (2000) also confirm the applicability of this model in both voluntary and mandatory contexts.

Based on the plethora of support from past studies, the core hypotheses posited by TAM and applied to the MVASs context are shown below and will be examined in this study:

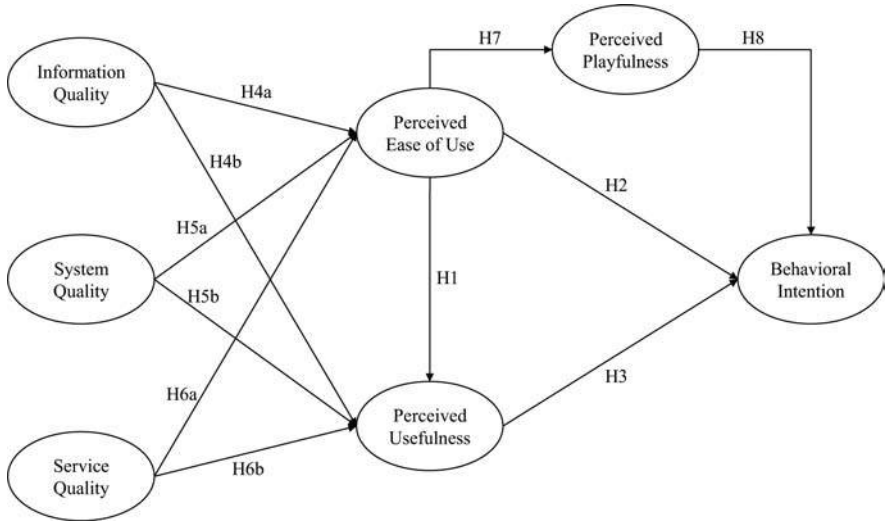


Figure 1.
Research model

H1. Perceived ease of use positively influences the perceived usefulness of MVASs.

H2. Perceived ease of use positively influences the behavioral intention to use MVASs.

H3. Perceived usefulness positively influences the behavioral intention to use MVASs.

TAM has been proven to be a parsimonious, inexpensive, and flexible model, making it ideal for explanatory purposes across a wide variety of contexts (Hong *et al.*, 2006; Kuo and Yen, 2009; Mathieson, 1991). However, as perceived ease of use and perceived usefulness offer useful yet limited views of technology acceptance, external variables are needed to make the model better fit for a larger variety of technological contexts (Dishaw and Strong, 1999; Igbaria *et al.*, 1995). The discussion of the incorporated factors in this study and the development of corresponding research hypotheses can be found in the sections that follow.

2.2 Quality and IS success

Quality is considered to be an important factor affecting the success of information systems. After an extensive literature review, DeLone and McLean (1992) proposed the D&M IS success model, which encompasses six interrelated dimensions of success; namely, system quality, information quality, system use, user satisfaction, individual impacts, and organizational impacts. In an updated model, DeLone and McLean (2003) proposed that service quality adds to the two original system characteristics – that is, system quality and information quality – to reflect the changes in the role of IS and to respond to the suggestions of other researchers (Kettinger and Lee, 1995; Pitt *et al.*, 1995; Wilkin and Hewitt, 1999). These three quality factors constitute the three major dimensions of quality in IS success.

2.2.1 Information quality. Information quality is the ability of the system to convey the intended meaning of information. Information quality captures success at the semantic level and includes features such as accuracy, completeness, meaningfulness, currency, and presentation format (DeLone and McLean, 1992; Nelson *et al.*, 2005). Prior research has increasingly recognized the importance of information quality in the effectiveness of IT (Cao *et al.*, 2005; Negash *et al.*, 2003). Moreover, information quality, referred to as "contents quality" in Cheong and Park (2005), has been found to positively impact perceived ease of use and perceived usefulness in several studies (Lin and Lu, 2000; Lin, 2007; Perkowitz and Etzioni, 1999; Seddon, 1997).

For users who use MVASs to obtain information such as weather forecast, news report, or movie show times, the accuracy, completeness, and currency of information retrieved would be critical. Moreover, information presentation must also effectively facilitate users' interpretation and understanding to aid the completion of a task (Ahn *et al.*, 2007; Lin, 2007). The issue of information quality is thus crucial to the success of MVASs. For example, location-based services would need to provide accurate, current, and easy-to-understand information to subscribers searching for useful recommendations for dinner within a particular area at a particular time. User perceptions of the quality of the information provided therefore determine whether the service or system is useful and easy to use (Lin and Lu, 2000). Thus, we propose the following hypotheses:

H4a. Information quality positively influences the perceived ease of use of MVASs.

H4b. Information quality positively influences the perceived usefulness of MVASs.

2.2.2 System quality. In contrast to information quality, system quality focuses on the technical level of success of a system with respect to information production (DeLone and McLean, 1992). Although researchers have recognized the role and importance of system quality in contexts such as e-commerce and virtual communities (Ahn *et al.*, 2007; Liu and Arnett, 2000; Teo *et al.*, 2003; Yoo *et al.*, 2002), few have attempted to investigate its role in MVAS adoption.

Usability, availability, reliability, adaptability, accessibility, and response time are examples of system qualities demanded by users (DeLone and McLean, 2003; Lin and Lu, 2000). System quality is one of the most useful predictors of perceived ease of use and perceived usefulness (Lederer *et al.*, 2000; Liao and Cheung, 2001; Lin and Lu, 2000; Seddon, 1997). For example, it leads to b a better perceived ease-of-use and perceived usefulness of mobile internet (Cheong and Park, 2005). Igbaria *et al.*'s (1995) and Kulkarni *et al.*'s (2006) studies also support the positive effect of system quality on perceived ease of use and perceived usefulness. As high levels of system quality provides users with more convenience and faster responses (Ahn *et al.*, 2007), system quality is considered to be an important factor in affecting the beliefs of subscribers regarding MVASs. High-quality MVAS could create a context in which subscribers would be provided not only easy configuration and operation, but also assurance as to the usability and reliability of the system to produce or exchange the required information. Based on the above arguments and findings from prior research, we believe that positive relationships exist between system quality, perceived ease of use, and perceived usefulness. This leads to the following two hypotheses:

H5a. System quality positively influences the perceived ease of use of MVASs.

H5b. System quality positively influences the perceived usefulness of MVASs.

2.2.3 Service quality. The emergence of end-user computing in the mid-1980s placed IS organizations in the dual roles of information provider as well as service provider (DeLone and McLean, 2003). Service quality is thus a vital construct affecting IS success, without which researchers would be unable to correctly measure IS effectiveness (Pitt *et al.*, 1995). As the concept of service quality continues to shift from the traditional view of IS from support for internal users to support for external users, service providers should place more emphasis on providing services that reflect the values of trustworthiness, responsiveness, personalization, and attentiveness (Cao *et al.*, 2005; DeLone and McLean, 2003) – all of which are key features of MVASs.

Service quality is conceptualized as the service supplier's effectiveness in providing service (Saeed *et al.*, 2003; Seddon, 1997). In the context of MVASs, service quality directly influences users' perceptions of their service experience and is thus a crucial concern for mobile service providers because subscribers can easily switch to another provider with very low switching costs due to the mobile number portability (MNP) policy. Service quality positively influences both perceived value and customer satisfaction (Cao *et al.*, 2005; Lin, 2007; Saeed *et al.*, 2003), which leads to stronger customer loyalty and post-purchase intention (Kim *et al.*, 2004; Kuo *et al.*, 2009).

Moreover, previous studies have demonstrated that service quality does have a positive influence on perceived ease of use and perceived usefulness (Ahn *et al.*, 2007; Cao *et al.*, 2005; Lin, 2007; Saeed *et al.*, 2003). High service quality – demonstrated by effective user support, prompt response, and trustworthy and personalized information processing (Cao *et al.*, 2005; DeLone and McLean, 2003) – encourages subscribers to feel that these services are both flexible and easy to use. For example, a MVAS with high service quality that provides an easy means for subscribers to connect with friends and/or receive location-based recommendations would be perceived as highly beneficial and useful for fulfilling the subscribers' needs. This response would then positively enhance the user beliefs with respect to the acceptance of MVASs. We thus propose the following hypotheses:

H6a. Service quality positively influences the perceived ease of use of MVASs.

H6b. Service quality positively influences the perceived usefulness of MVASs.

2.3 Perceived playfulness

Moon and Kim (2001) extended TAM to the web and defined three interdependent dimensions of perceived playfulness: concentration, curiosity, and enjoyment (Moon and Kim, 2001, p. 219). These represent "the extent to which the individual":

(1) perceives that his or her attention is focused on the interaction with the WWW;

(2) is curious during the interaction; and

(3) finds the interaction intrinsically enjoyable or interesting.

The concept of playfulness in IT usage has been investigated in past research (Igbaria *et al.*, 1994; Sun and Zhang, 2006; Van der Heijden, 2004). Information systems may serve either utilitarian or hedonic purposes (or both); however, it is the nature of the system that determines whether perceived usefulness or perceived playfulness takes precedence (Van der Heijden, 2004). Atkinson and Kydd (1997) found that playfulness is positively associated with the web for both entertainment and coursework purposes. Atkinson and Kydd (1997) and Cheung *et al.* (2000) have also illustrated the importance of playfulness as the dominant intrinsic motivator underlying hedonic systems.

For MVASs, which emphasize intensive subjective experiences during interaction and usage, the effect of playfulness on individual attitudes toward and behavioral intentions to accept the technology must be further investigated (Kuo and Yen, 2009). Based on earlier research on playfulness, subscribers who fall into a playful state during their interaction with an MVAS will find their attention and curiosity aroused and will become further enticed to continue using these services for the sake of pleasure and enjoyment (Malone, 1981; Moon and Kim, 2001). The current study suggests that perceived playfulness is a salient factor based on subjective evaluations of interaction experiences with MVASs. Because perceived ease of use contributes to a positive interaction experience, enhanced perceptions of playfulness can be expected. Following this, the positive perceived playfulness experienced by MVAS subscribers will lead to stronger behavioral intentions to use MVASs. Lin *et al.*'s (2005) study has supported the positive relationship between playfulness and users' behavioral intention in the context of web sites. Thus, we propose the following hypotheses:

H7. Perceived ease of use positively influences the perceived playfulness of MVASs.

H8. Perceived playfulness positively influences the behavioral intention to use MVASs.

3. Research methodology

3.1 Construct operationalization

The operationalization of research constructs was implemented by using validated items from prior research. Perceived ease of use was measured by seven items developed by Davis (1989) and Venkatesh and Davis (2000), and perceived usefulness measured by the five items of Van der Heijden (2004). The measurement of behavioral intention was adapted from Taylor and Todd (1995) and Venkatesh and Davis (2000). The items measuring information quality were adapted from Rai *et al.* (2002). System quality and service quality were measured using items adapted from Ahn *et al.* (2007). Last, measures of perceived playfulness were adapted from Moon and Kim (2001). The items measuring each construct are summarized in Appendix 2.

3.2 Instrument validation

The questionnaire was designed using a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Because the items were originally developed in English, the items were first translated into Chinese by an IS professor and then translated back into English by another translator with special training in English-Chinese translation. Because the questionnaires were to be distributed in Taiwan, the translation into Chinese allowed the respondents to read the items with no difficulty. The two-way translation also ensured that no loss of information occurred during the translation process.

The draft version of the translated questionnaire was reviewed by two experts (one IS professor and one industry analyst) and two users of MVASs. Based on the four reviewer's suggestions, the following modifications in wording or expressions were made.

- The definition of short message services (SMS) and multimedia message services (MMS) was appended at the end of the questionnaire.
- "More" was deleted from "I find mobile value-added services to be more flexible to interact with" (perceived ease-of-use).
- The Chinese translation for "Is the information provided helpful regarding your questions or problems?" (information quality) was rephrased to improve readability.
- The translated term for "error-free" was rephrased to avoid confusion with "flawless" (system quality).

A pilot test was then performed by distributing the questionnaire to a sample of 165 students from five departments at three different universities in Taiwan. Of the 165 responses, 39 were discarded because the answers were either incomplete or invalid. The remaining 126 responses were preserved, resulting in an effective response rate of 76.4 percent.

A confirmatory factor analysis was performed to examine the measurement model. The partial least squares (PLS) method using SmartPLS 2.0 (M3) Beta (Ringle *et al.*, 2005) was chosen because it presumes no distributional form for measured variables, nor does it posit a strong requirement for large sample sizes (Chin *et al.*, 2003; Chin, 1998). PLS supports both exploratory and confirmatory research (Gefen *et al.*, 2000) and gives optimal prediction accuracy because it is prediction-oriented (Fornell and Cha, 1994). The composite reliability values of the constructs all surpassed 0.7 (Hair *et al.*, 1998; Nunnally, 1978). Since the average variance extracted (AVE) values were larger than 0.5 (Fornell and Larcker, 1981) and the factor loadings of the all items were significant and higher than 0.5 (Nunnally, 1978), our results demonstrate a satisfactory convergent validity of measurement. Because the smallest square root value of the AVEs was 0.748 (perceived playfulness) and the largest correlation between the constructs was 0.741 (between system quality and service quality), the discriminant validity of our results was deemed adequate (Chin, 1998; Fornell and Larcker, 1981).

3.3 Data collection

Because the population in this study consisted of all MVAS subscribers, the ability to reach a wider population of users is especially important. Thus, an online mode of data collection allowed us to reach MVAS subscribers of different demographics and to reduce the possible bias resulting from distributing paper questionnaires, which would confine respondents to a specific group of subscribers. The announcement for the survey was posted on the largest bulletin board system (ptt.cc) and the largest online community portal (wretch.cc) in Taiwan. To increase the number of survey participants, those who completed the questionnaire were entitled to enter a lottery. In order to avoid duplicate registrations and to identify attempts at opportunism, the IP address of each respondent was recorded.

A total of 389 responses were collected, among which 85 were discarded for being either incomplete or invalid. The incomplete responses were those who had more than one unanswered items. The invalid responses were those received from the same IP address multiple times, or those whose answers demonstrated a predictable but unreasonable pattern;, e.g. the answers repeated from 1 (strongly disagree) through 7 (strongly agree) in a predictable manner for every seven consecutive items. Thus, 304 valid responses were collected, yielding a response rate of 78.1 percent.

4. Data analysis

4.1 Sample characteristics

The 304 respondents consist of 149 females and 155 males (see Table I). The percentages of female and male respondents are very close to the gender profile of internet users in Taiwan, where female users account for 49.6 percent and male users account for 50.4 percent (InsightXplorer, 2011). A large portion of these respondents hold Bachelor's or Master's degrees (74.3 percent and 22.7 percent, respectively), and they mainly range from 21 to 30 years old (86.2 percent). Of all the respondents, 34.2 percent report having less than one year of experience with MVASs, and the rest (65.8 percent) have more than one year of experience. Additionally, nearly 60 percent of the respondents spend NT$301 to NT$1,000 on their monthly bills, while 7.9 percent spend over NT$1,000 (US$1 is equal to approximately NT$30).

From this sample group, we found that SMS were the most common type of MVAS adopted (75.0 percent), followed by ring-back tone downloads (57.9 percent), ringtone

	Frequency	Percentage
Gender		
Female	149	49.0
Male	155	51.0
Educational background		
Junior high school	4	1.3
Senior high school	5	1.6
College	7	2.3
University	219	72.0
Graduate school	69	22.7
Age		
11-15	2	0.7
16-20	31	10.2
21-25	192	63.2
26-30	70	23.0
31-40	7	2.3
41-50	0	0.0
Over 51	2	0.7
Experience with MVASs (years)		
Less than 1	104	34.2
1-2 years	104	34.2
2-3	34	11.2
More than 3	62	20.4
Monthly bill (NT$)		
Less than 100	9	3.0
101-300	89	29.3
301-600	121	39.8
601-1,000	61	20.1
1,001-1,500	20	6.6
1,501-2,000	1	0.3
Over 2,001	3	1.0
MVAS		
Short message service	228	75.0
Ring-back tone downloads	176	57.9
Ringtone downloads	140	46.1
Multimedia message service	57	31.3
Wallpapers and graphics downloads	95	18.8
Game downloads	54	17.8
GPRS	60	19.7
M-newsletter	13	4.3
Mobile instant messaging	19	6.3
Others	14	4.6

Table I.
Demographic characteristics

downloads (46.1 percent), MMS (31.3 percent), and wallpapers and graphics downloads (18.8 percent). This finding echoes DLRG's (2010) survey on MVAS usage in Taiwan. Although some of the MVAS categories in the current research were not included in DLRG (2010), a similar pattern exists in the overlapping categories. For example, ring-back tone downloads and ringtone downloads are among the top five adopted

MVASs. Moreover, the adoption of MMS remains higher than that of wallpapers and graphics downloads. The other adopted MVASs are listed in descending order in Table I, which elaborates on sample characteristics in more detail.

4.2 The measurement model

The composite reliability values of each construct are shown in Table II. Because all of the values are above the recommended level of 0.7 (Hair *et al.*, 1998; Nunnally, 1978), the reliability of the measures is assured.

The AVE values for all constructs are larger than 0.5 (see Table II). All of the factor loadings of the items are significant and greater than 0.6 as well (see Table III). The convergent validity of these measures is therefore supported.

As shown in Table IV, the square roots of all the AVE values are larger than all the correlation coefficients shown, which again indicates the appropriate discriminant validity of these measures. To sum up, the positive evidence supporting the reliability, convergent validity, and discriminant validity of these measures demonstrates the appropriateness of this measurement model for use in subsequent hypothesis testing.

This study has taken both procedural and statistical remedies to mitigate possible common method biases. Regarding the procedural remedies, the researchers first followed Tourangeau *et al.* (2000) suggestions to construct the questionnaire items to reduce method biases. The expert review described earlier also served to assist this purpose. Reminding respondents to answer questions as honestly as possible by assuring them there were no right or wrong answers would also help reducing method biases (Podsakoff *et al.*, 2003). The online questionnaire, though being short, included multiple pages to temporally separate the measurement of not only predictor and criterion variables (Podsakoff and Organ, 1986; Podsakoff *et al.*, 2003) but also all research constructs. Regarding the statistical remedy, the Harmon's single-factor test shows that each principal factor explains roughly equal variance (4.39 percent-16.21 percent), suggesting that no substantial common method bias exists.

4.3 Structural model

4.3.1 The original model. To test our hypotheses, a bootstrap re-sampling procedure was used to examine the stability of the PLS estimates (Chin, 1998), using re-samples of 500.

Figure 2 shows the results of the structural model analysis. Overall, the research model is supported and explains 50.3 percent of the variance in behavioral intentions to adopt MVASs. In addition, the model explains 26.6 percent of the variance in perceived playfulness, 44.6 percent of the variance in perceived ease of use, and 55.9 percent of

	Mean	SD	AVE	Composite reliability	Cronbach's alpha
IQ	4.72	0.85	0.659	0.906	0.871
SYQ	4.51	0.94	0.685	0.866	0.769
SVQ	4.58	0.87	0.660	0.886	0.829
PEOU	5.01	0.89	0.669	0.934	0.917
PU	4.72	0.94	0.718	0.927	0.901
PP	4.49	0.91	0.560	0.919	0.900
BI	4.85	1.04	0.765	0.942	0.923

Table II. AVE, composite reliability, and Cronbach's alpha

Construct	Item	Mean	SD	Loading	*t*-statistics
Information quality	IQ1	4.73	1.07	0.795	29.750
	IQ2	4.79	1.06	0.794	26.615
	IQ3	4.60	1.03	0.827	44.889
	IQ4	4.77	1.03	0.840	44.083
	IQ5	4.71	1.04	0.803	30.905
System quality	SYQ1	3.93	1.30	0.740	22.318
	SYQ2	4.77	1.08	0.884	64.173
	SYQ3	4.83	1.05	0.852	45.903
Service quality	SVQ1	4.52	1.05	0.776	26.244
	SVQ2	4.47	1.01	0.847	40.928
	SVQ3	4.44	1.14	0.827	40.705
	SVQ4	4.89	1.10	0.798	37.984
	SVQ2	4.47	1.01	0.847	40.928
	SVQ3	4.44	1.14	0.827	40.705
	SVQ4	4.89	1.10	0.798	37.984
Perceived ease of use	PEOU1	4.96	1.10	0.726	21.548
	PEOU2	5.14	1.14	0.849	43.043
	PEOU3	4.91	1.09	0.844	54.045
	PEOU4	4.92	1.08	0.846	45.617
	PEOU5	4.83	1.05	0.763	27.395
	PEOU6	5.15	1.05	0.856	43.278
	PEOU7	5.14	1.09	0.832	33.136
Perceived usefulness	PU1	4.74	1.12	0.832	36.675
	PU2	4.51	1.23	0.866	51.231
	PU3	4.73	1.06	0.877	57.345
	PU4	4.82	1.03	0.847	46.817
	PU5	4.78	1.11	0.812	30.474
Perceived playfulness	PP1	4.34	1.35	0.626	13.560
	PP2	4.85	1.12	0.792	25.515
	PP3	4.26	1.21	0.731	17.838
	PP4	4.30	1.22	0.656	15.490
	PP5	4.35	1.21	0.821	39.779
	PP6	4.79	1.12	0.816	34.314
	PP7	4.67	1.25	0.810	36.202
	PP8	4.91	1.15	0.832	38.929
	PP9	3.98	1.46	0.607	12.905
Behavioral intention	BI1	5.07	1.11	0.855	39.961
	BI2	5.10	1.09	0.842	31.074
	BI3	4.63	1.31	0.862	37.344
	BI4	4.65	1.17	0.906	84.882
	BI5	4.80	1.27	0.907	71.392

Table III.
Factor loadings

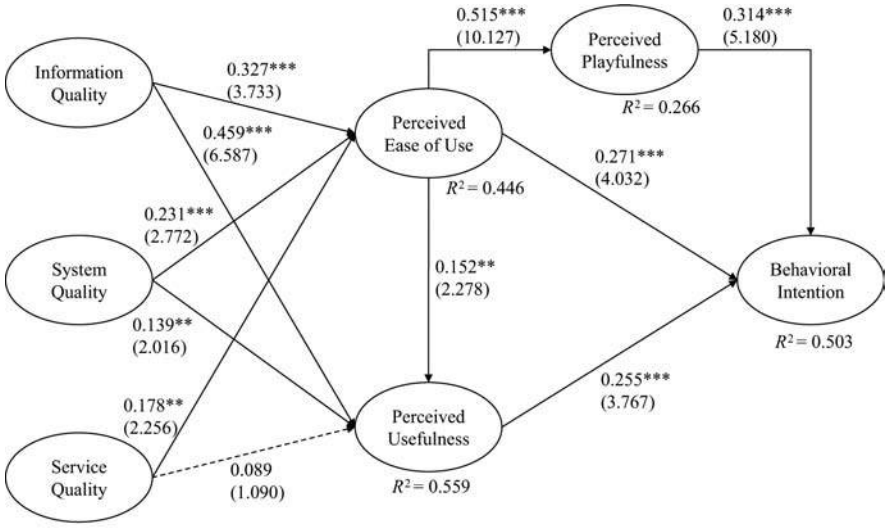
the variance in perceived usefulness. These results show that the proposed research model has a rather high explanatory power and provides substantial support for *H1* through *H8*, with the exception of *H6b*.

Our results are as follows: first, we found the hypotheses commenting on the relationships pertaining to the original TAM were supported. The positive effect of

	IQ	SYQ	SVQ	PEOU	PU	PP	BI
IQ	*0.812*						
SYQ	0.721	*0.827*					
SVQ	0.724	0.741	*0.812*				
PEOU	0.622	0.598	0.586	*0.818*			
PU	0.718	0.627	0.613	0.573	*0.847*		
PP	0.614	0.542	0.573	0.515	0.613	*0.748*	
BI	0.641	0.624	0.565	0.579	0.603	0.610	*0.875*

Note: Diagonal items show the square root of the AVE. Off-diagonal items show the correlations between constructs

Table IV.
Correlation matrix and AVE



Notes: *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$. The values within parentheses denote corresponding *t*-values

Figure 2.
Structural model analysis

perceived ease of use on perceived usefulness (*H1*) was significant at the $p < 0.05$ level, and the two determinants of behavioral intentions to adopt MVASs (namely, perceived ease of use (*H2*) and perceived usefulness (*H3*)) were found to be significant at the $p < 0.01$ level.

Second, the positive effects of information quality on perceived ease of use (*H4a*) and perceived usefulness (*H4b*) were significant at the $p < 0.01$ level, while the effects of system quality on perceived ease of use (*H5a*) and perceived usefulness (*H5b*) were significant at the $p < 0.01$ and $p < 0.05$ level, respectively. Moreover, the effect of service quality on perceived ease of use (*H6a*) was significant at the $p < 0.05$ level, while the effect on perceived usefulness (*H6b*) was not supported.

Last, we found that perceived playfulness mediates the relationship between perceived ease of use and behavioral intentions to adopt MVASs (*H7*, *H8*, $p < 0.01$).

4.3.2 Exploratory analysis for subscriber experience with MVASs. Because *H6b* was not supported, an exploratory multi-group analysis was performed by dividing the respondents into groups of experienced and inexperienced subscribers. Those who had less than one year of experience with MVASs were placed in the inexperienced group, whereas those with experiences of over one year represented the experienced group. The focus here was to perform group comparison of the research model in an exploratory sense. If significant difference existed between the two groups, user experience with MVASs might help understanding why *H6b* was not supported in the combined dataset.

This study followed Keil *et al.*'s (2000) procedure for performing multi-group comparison using PLS. Having made parametric assumptions about the distributions of the parameter standard errors, one uses the standard errors for the structural paths obtained from bootstrapping to calculate the *t*-tests for the difference in paths between groups. The test statistic can be calculated as follows (Keil *et al.*, 2000, p. 315):

$$S_{pooled} = \sqrt{\frac{N_1-1}{N_1+N_2-2} \times SE_1^2 + \frac{N_2-1}{N_1+N_2-2} \times SE_2^2}$$

$$t = \frac{PC_1 - PC_2}{S_{pooled} \times \sqrt{\frac{1}{N_1}+\frac{1}{N_2}}}$$

where:

S_{pooled} = pooled estimator for the variance.

t = *t*-statistic with $N_1 + N_2 - 2$ degrees of freedom.

N_i = sample size of dataset for group i.

SE_i = standard error of path in structural model of group i.

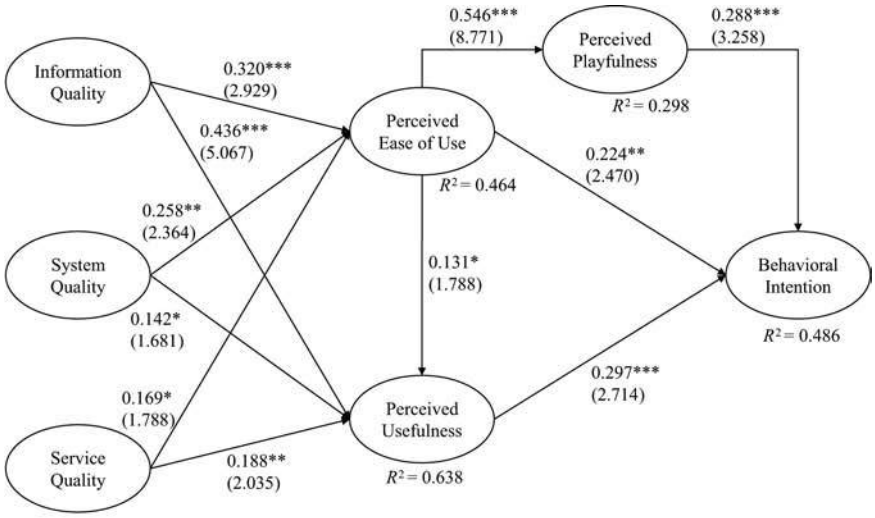
PC_i = path coefficient in structural model of group i.

The structural models in Figure 3(a) and 3(b) show that the influences of system quality and service quality on both perceived ease of use and perceived usefulness of MVASs were significant for the experienced group, but not for the inexperienced group. Further comparison of the corresponding path coefficients in the two models showed significant difference in the path coefficients from system quality to perceived ease of use ($t = 6.323, p < 0.01$) and service quality to both perceived ease of use ($t = -1.870, p < 0.1$) and perceived usefulness ($t = 5.681, p < 0.01$). This added further information to this study and will be discussed in further detail in the next section.

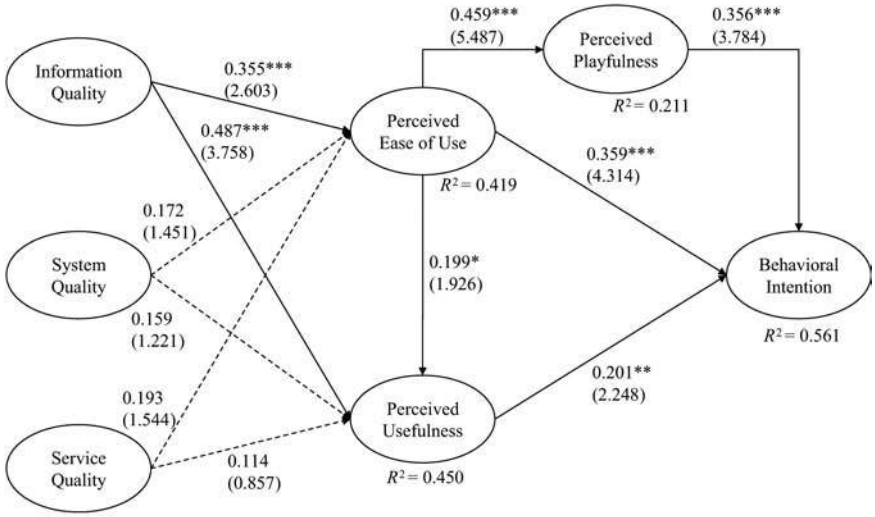
5. Research implications

5.1 Theoretical implications

This study reveals several important and interesting findings. First, researchers have attempted to extend TAM with external variables or apply TAM to various IT adoption contexts (Hong *et al.*, 2006; Hsu and Lu, 2004; Liao *et al.*, 2007; Moon and Kim, 2001; Taylor and Todd, 1995; Venkatesh and Davis, 2000; Wu and Wang, 2005). Past studies, however, have seldom addressed IT systems or services such as MVASs, which serve both utilitarian and hedonic purposes. Take for example the use of 3.5G mobile internet access service. Depending on the needs of subscribers, use may be either utilitarian or hedonic. If one intends to use 3.5G mobile



(a) Experienced group



(b) Inexperienced group

Notes: *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$. The values within parentheses denote corresponding *t*-values

Figure 3.
Structural model analysis for experienced and inexperienced groups

internet access to check for movie show times, the use is hedonic; however, if he/she needs to access the internet to check for, say, the latest stock quotes to ensure the profitability of personal investment, the use is largely utilitarian.

This study, in contrast, extends and supports the applicability of TAM to IT services that are more complex and contingent in nature in comparison to the relatively pure-purpose systems or services such as word processing programs, online games, or mobile commerce (Davis *et al.*, 1989; Hsu and Lu, 2004; Yang, 2005). Furthermore, this study extends this line of research by investigating the influence of IS quality factors and perceived playfulness on the adoption of MVASs. From our findings, perceived playfulness was found to be the strongest predictor of behavioral intention, followed by perceived ease of use and perceived usefulness. This may be due to the higher adoption rate of hedonic MVASs in the survey sample (see Table I) and is consistent with the findings of prior research on hedonic IT (Hsu and Lu, 2004; Van der Heijden, 2004). That is, the findings of this study not only echo past research regarding the role of playfulness as an important determinant of hedonic IT usage, but also demonstrate the relative strength of perceived ease of use and perceived usefulness in different IT adoption contexts.

The three quality factors were also found to be important external variables that demonstrated the appropriateness of extending TAM. For example, the path from information quality to perceived usefulness was stronger than the path from information quality to perceived ease of use. Higher information quality improves the fit between content provided by MVASs and subscriber information requirements by ensuring the accuracy, meaningfulness, and timeliness of the information provided. Enhanced information quality improves MVAS utility, which in turn allows subscribers to feel more comfortable using services that provide better ease of use and usefulness.

System quality is an important factor influencing both the perceived usefulness and perceived ease of use of services. Higher system quality increases the ease of use of MVASs by enabling subscribers to easily interact with and/or freely exchange information with each other via the system platform. The positive effect of system quality on perceived usefulness also demonstrates the ability of MVASs to provide subscribers with a stable and reliable system and/or platform on which their utilitarian (e.g. acquiring the latest stock quotes) and hedonic (e.g. picture exchanging with colleagues) needs can be satisfied. Hence, system quality can improve or strengthen the beliefs of subscribers regarding the use of MVASs and thus can subsequently influence their intentions to adopt it.

Service quality was found to positively influence perceived ease of use, indicating that MVAS providers that provide high levels of service quality make subscribers feel that these services are easy to use. This finding is consistent with Lin (2007), who examined the impact of online and offline features on the sustainability of virtual communities. Overall, a general conclusion can be drawn that the influence of service quality on perceived ease of use also extends to the context of MVASs. Therefore, MVASs that have better service quality features (e.g. trustworthiness, responsiveness, and personalized presentation) are more likely to be accepted, as these features improve subscribers' confidence regarding the ease of use of the services by requiring minimum or flexible learning and configuration efforts, consequently contributing to higher acceptance. Additionally, when combining this finding with the fact that information quality may also have a direct effect on perceived ease of use and

perceived usefulness, these results confirm past research on the dual roles of MVASs as information providers and service providers.

The lack of evidence in support of a relationship between service quality and perceived usefulness, in contrast to those presented by Ahn *et al.* (2007), may stem from the contextual factors of this particular study. Ahn *et al.*'s (2007) study was conducted in an online retailing context, whereas this research concerns the use of MVASs, which are much more complex and difficult to quantify than the transaction-oriented online retailing web sites. For example, MVASs such as ringtone downloads are usually for hedonic purposes; location-based recommendations are usually for utilitarian purposes; and m-newsletters could be used for either purpose. An inexperienced MVAS user would therefore have difficulty evaluating the quality of these various services, which would result in an insignificant relationship between service quality and perceived usefulness. Section 4.3.2 highlights the significant role of user experience in MVAS adoption. Inexperienced subscribers are attracted to MVASs that satisfy their need for information or play, about which judgments can be made easily and intuitively, whereas experienced subscribers, who have the necessary knowledge to perform in-depth service evaluations, tend to take into account system and service qualities as well. These findings are consistent with the heuristic-systematic model (Chen and Chaiken, 1999), which postulates that as users gain sufficient ability (experience) and more in-depth motivations, the focus of their evaluations shifts from heuristic aspects, which are easier to evaluate, to systematic aspects, which require more complex processing. Past studies have pointed out that inexperienced users tend to evaluate the use of a system superficially, whereas experienced users proceed in a more in-depth way (Castañeda *et al.*, 2007; Koufaris *et al.*, 2002). The current research provides evidence in support of the "heuristic vs. systematic" view of MVAS adoption. Inexperienced users' adoption decisions regarding MVASs are intuitively formed based on the "easy-to-tell" nature of the service (i.e. information quality and playfulness), while evaluations made by experienced users take into account other features covering system quality and service quality for the purpose of making in-depth and systematic evaluations.

Finally, the empirical findings of this study demonstrate the role of perceived playfulness as an important mediator between perceived ease of use and behavioral intention. The direct effect of perceived ease of use on behavioral intention is 0.271, while the indirect effect through perceived playfulness is 0.162, accounting for a total effect of 0.433. The influence of perceived playfulness on the behavioral intention to use MVASs is stronger than that of either perceived ease of use or perceived usefulness. Past studies have emphasized the importance of employing perceived playfulness in TAM (Ahn *et al.*, 2007; Atkinson and Kydd, 1997; Cheong and Park, 2005; Moon and Kim, 2001; Teo *et al.*, 1999; Van der Heijden, 2004). This research heightens and expands these studies by applying TAM to MVASs, which serve both utilitarian as well as hedonic purposes as discussed earlier.

Overall, the results of this study have demonstrated that employing IS quality factors and perceived playfulness would be a worthwhile extension of TAM, as these factors have been found to be influential in predicting the behavioral intention to use MVASs. Thus, extending TAM has helped to pinpoint the key factors that determine the behavioral intention to adopt MVASs and to identify the role of these factors in understanding comprehensive causal relationships.

5.2 Managerial implications

With the gradual decline of voice service tariffs, mobile telecommunications service providers have urgently sought other sources of revenue. Under such intense pressure, MVASs have become a promising opportunity for revenue growth. Therefore, it is crucial to determine how to convince current subscribers to use MVASs in a sustained manner. There are four methods to do this.

First, providing subscribers with information products that support high accuracy, meaningful service, and timeliness will allow users to convey required content in a clear and intentional manner. For example, location-based dining recommendation services that provide only the longitude and latitude, or only brief descriptions of the restaurant's name, address, and phone number will most likely be perceived negatively by users. The reason is that the former, though accurate, is difficult to interpret and is thus meaningless, and the latter does not help much in the decision of choosing a dining establishment given the lack of information such as reviews and price lists; thus, providing clear, understandable, and meaningful information quality should be a priority for mobile service providers.

Second, mobile phone subscribers will desire MVASs that provide high availability, reliability, adaptability, accessibility, and quick response time. Mobile telecommunications service providers are expected to provide dense coverage of signals and highly responsive and available hosts, especially during peak hours, so that the MVASs will function without interruption, for example, avoiding lagged video transmissions, long download time for ringtones, or delayed delivery of requested information. Thus, system quality, which relates to the desired characteristics of the system that produces the information or service, should be emphasized, as subscribers who perceive the system to be easy to use and useful will be more willing to continue their subscriptions to these services.

Third, giving subscribers a positive service experience will also be beneficial to the adoption of MVASs. Examples of this include: easy access to online help, prompt responses from customer service agents, periodical upgrades of services, including the addition of new features. When executed correctly, these services will give subscribers a sense of positive satisfaction and leave them with the impression that the service provider will be willing to continually work with them to maintain and improve its services. Mobile phone subscribers that experience effective, prompt user support, in addition to trustworthy, attentive, and responsive services will be more willing to continue to adopt MVASs.

Researchers and practitioners have focused on improving user friendliness to enhance ease of use, execution time, and error-free rates to gain a technology-centered view of a system's usability (Moon and Kim, 2001). Although ease of use and usefulness have been conceived as important issues in traditional IS contexts, playfulness will play an important role in the popularization of MVASs. Subscribers motivated by playfulness will tend to experience a feeling of flow or enjoyment with the easy-to-use user interface, thus making them more willing to adopt services and introduce the adopted services to more of their colleagues.

6. Conclusion

While prior research on technology adoption primarily focuses on "pure-purpose" IT systems/services such as online retailing, word processing programs, or online games (Ahn *et al.*, 2007; Davis *et al.*, 1989; Hsu and Lu, 2004), this study further contributes to

the literature by focusing on IT services that are more complex and contingent in nature, such as MVAS. The positive support demonstrates that it would be worthwhile to apply IS quality factors and perceived playfulness to technology adoption research because these factors have been found to be influential in predicting behavioral intentions to use MVASs. Although the evidence does not support a relationship between service quality and perceived usefulness, further analysis of subscribers' experience with MVASs has highlighted the "heuristic vs. systematic" decision making regarding MVAS adoption. The research model not only offers theoretical implications for MVAS research, but also indicates important determinants of MVAS adoption for mobile telecommunication service providers.

Future research to address other important theoretical constructs relating to technology acceptance would be greatly beneficial to increasing our understanding. Suggested directions for research are as follows:

First, a number of MVASs, such as SMS, ringtone downloads, mobile instant messaging, and mobile chat rooms, aim to facilitate group communication or fulfill interaction needs. It is possible that subscribers adopt these services not only because the services are of high quality or engender playfulness, but also because they want to be liked or accepted by their colleagues. Therefore, an analysis of the adoption of MVASs with respect to group identification, conformity, and social influence issues will need to be investigated beyond the current research model. The consumer conformity model advanced by Lascu and Zinkhan (1999) and past research from media choice paradigms that attempt to integrate normative and utilitarian determinants (Kraut *et al.*, 1998; Webster and Trevino, 1995) would be a suitable foundation on which this direction of research could be based. Second, a longitudinal study that observes the use of MVASs over time is suggested. This direction of research could consider the temporal dynamics of the determinants of user adoption of MVASs; hands-on experience or mood, for example, might affect the stability of the strength of the determinants. Third, this study determined experienced and inexperienced subscribers based on how many years' experience they had with MVASs. Other criteria exist that may suggest other ways of making such decision. For example, a subscriber who has been using MVASs for six months on a daily basis may be considered more experienced than a subscriber who has one year's experience but uses MVASs only on a weekly basis. Detailed subscriber profiles in future research may provide further analysis on this point. Last, additional research is needed to elucidate the issue of media richness in the context of MVASs. Interesting issues such as the information display capabilities of MVASs on handheld devices and how media richness affects the use of MVASs would be of particular interest to mobile telecommunications service providers, as well as content developers eager to determine trends in user needs and preferences.

The present research, however, has several limitations that must be noted. First, to provide a stronger incentive for participation in the online survey, a lottery was carried out for all participants who completed the process. Therefore, self-selection within the data collection process was unavoidable. In addition, 85 out of 389 responses were discarded because of incomplete or invalid answers. One possible reason for the invalid responses is that the respondents participated in the survey primarily because of the chance to win the lottery. Repeated participation is one of the methodological threats to online questionnaires (Birnbaum, 2004). Moreover, responses that demonstrated a predictable but unreasonable pattern of answers also needed to be filtered out. The

tradeoff between the expediency, ease in tabulating the data, and ability to reach a wide population of users of online surveys (Bhattacherjee, 2002) and data quality should be carefully balanced. Second, if real subscriber data could be obtained from mobile telecommunications service providers, further analysis across different mobile phone subscriber groups would be possible. Third, as new MVASs are continuously being launched, this study is limited to only those services available at the time of data collection.

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Appendix 1. Definition of mobile value-added services

Mobile value-added services (MVASs) refer to all user-paid, value-added services excluding traditional voice communications services. MVASs cover a wide variety of services or applications such as message services, games, graphics or ringtone downloads, and electronic transactions, and they are provided by mobile telecommunications service providers in voice, digital, or other forms by charging subscribers directly or indirectly (FIND, 2007). These services entice subscribers into downloading or accessing various voice and digital objects or services through mobile devices.

The MVASs provided by mobile telecommunications service providers can be broadly grouped into four types:

(1) *Communication services*: Services that, excluding conventional voice call services, allow users to communicate through text, image, or video formats. Examples of communication services include short message service (SMS), multimedia message service (MMS), and videophone service.

(2) *System-side services*: Services provided through setup at the system side of service providers. Services pertaining to this category include ring-back tones, mobile secretaries, phonebook backup, mobile anti-virus programs, and two-phone ringing.

(3) *Download and subscription services*: Download services provided on a subscription basis. This category of services includes download services for ringtones, wallpapers/graphics, and mobile games as well as subscription services for fortune telling and newsletters.

(4) *Network access services*. Services that enable network access of mobile phones and are commonly provided through WAP, GPRS, PHS, or 3G. Internet access for portable devices through APN configuration, wireless network access, and dial-up also belong to this category.

Although mobile telecommunications service providers offer different kinds of MVASs to their subscribers, not all services are unique. For example, subscribers can access text and multimedia message services and ringtone downloading from nearly all mobile telecommunications service providers. Regardless of whether the service is unique or common, it can be categorized into one of the four types discussed above. This study therefore defines MVASs based on the above framework of FIND (2007).

Appendix 2. Measurement items

Perceived ease of use

(1) I find mobile value-added services to be easy to use.

(2) I find mobile value-added services to be flexible to interact with.

(3) I find it easy to get mobile value-added services to do what I want them to do.

(4) Interacting with mobile value-added services does not require a lot of mental effort.

(5) It would be easy for me to become skillful at using mobile value-added services.

(6) Learning to operate mobile value-added services would be easy for me.

(7) My interaction with mobile value-added services is clear and understandable.

Perceived usefulness

(1) By using mobile value-added services, I am better informed about information updates.

(2) By using mobile value-added services, I can decide more quickly and more easily whether I want to use the information obtained.

(3) By using mobile value-added services, I can better decide whether I want to use the information obtained than I could in the past.

(4) By using mobile value-added services, I can decide more quickly and more easily whether I want to use the information obtained than I could in the past.

(5) By using mobile value-added services, I can better decide whether I want to use the information obtained.

Behavioral intention

(1) Given that I have access to mobile value-added services, I predict that I would use it.

(2) Assuming that I have access to mobile value-added services, I intend to use it.

(3) I intend to use mobile value-added services frequently.

(4) I intend to use mobile value-added services in the near future.

(5) I intend to use mobile value-added services.

Information quality

(1) Is the information provided helpful regarding your questions or problems?

(2) Are the output options (print types, page sizes, and so on) sufficient for your use?

(3) Are you satisfied with the accuracy of mobile value-added services?

(4) Do mobile value-added services provide the precise information you need?

(5) Do mobile value-added services provide sufficient information to enable you to do your tasks?

System quality

(1) Mobile value-added services keep transactions error-free.

(2) Mobile value-added services offer easy navigation to retrieve information.

(3) Mobile value-added services have fast response times and transaction processing.

Service quality

(1) Mobile value-added services can be depended upon to provide what is promised.

(2) Mobile value-added services instil confidence in users, reducing their uncertainty.

(3) Mobile value-added services understand and adapt to the user's specific needs.

(4) Mobile value-added services exhibit a professional and competent image.

Perceived playfulness

(1) When using mobile value-added services, I do not realise how much time has elapsed.

(2) When using mobile value-added services, I am not aware of any noise.

(3) When using mobile value-added services, I often forget the work I must do.

(4) Mobile value-added services provide enjoyment in my task.

(5) Mobile value-added services provide fun in my task.

(6) Mobile value-added services keep me happy in my task.

(7) Mobile value-added services stimulate my curiosity.

(8) Mobile value-added services lead to exploration.

(9) Mobile value-added services arouse my imagination.

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