Taylor & Francis
Taylor & Francis Group

Exploring factors influencing mobile users' intention to adopt multimedia messaging service

Shuchih Ernest Chang* and Ying-Hui Vera Pan

Institute of Technology Management, National Chung Hsing University, 250 Kuo Kuang Road, Taichung City 402, Taiwan

While short messaging service (SMS) is discussed often in recent literature, multimedia messaging service (MMS), a media rich successor of SMS, is seldom heard or understood by mobile users in Taiwan. The adoption rates of MMS are far from satisfactory, implying that there might be some factors keeping the potential users away from using MMS. This research integrates a qualitative method, the Zaltman Metaphor Elicitation Technique, with the quantitative questionnaire survey to elicit and validate underlying factors which influence potential users' attitude and intention toward the adoption of MMS. A research model together with eight hypotheses was formulated, and a questionnaire based survey was administrated to mobile users knowledgeable about mobile messaging services for empirically validating the research model and testing the hypotheses. Our research findings show that relative advantage and ease of use are important factors significantly influencing mobile users' adoption of MMS but the other two antecedents, facilitating conditions and previous experience, do not have significant and direct impacts on mobile users' intention to use MMS. These study results can be referenced by service providers for designing and developing successful business applications to catch the valuable opportunity and benefit of MMS.

Keywords: multimedia messaging service; mobile commerce; information and communication technology; technology management; Zaltman Metaphor Elicitation Technique (ZMET)

1. Introduction

The rapid advancement of information and communication technology (ICT) has a profound effect upon people's lifestyle throughout the world. Particularly, mobile communications provide people with not only the anytime, anywhere voice communications but also the evolving and exciting multimedia functions. Multimedia messaging service (MMS), a service to send messages comprising a combination of text, sounds, images and videos to MMS capable handsets, has been available in Taiwan and other countries for years. However, we do not know whether consumers appreciate its value or not. For example, we have no idea about whether consumers prefer MMS to the short messaging service (SMS), an older but much more popular messaging technology limited to short text messages, ring tones and small graphics. In what perspectives do consumers like or dislike MMS technology? This study aims to find out valuable answers related to these questions for enhancing the business potential of MMS, by conducting a thorough literature survey and a subsequent user study. Pura (2005) pointed out that one of the main challenges facing mobile services providers is to promote awareness and trial, thereby attracting the potential customers who will use the services in the future. Before

designing and implementing effective marketing strategies, the prerequisite is to identify and validate the key factors leading to the acceptance of MMS. This research attempted to investigate what factors would affect mobile users' intention to adopt MMS.

Instead of describing technology usage through perceived usefulness (PU) and perceived ease of use (PEOU), as suggested by the technology acceptance model (Davis 1989), to explain the adoption of technology, the User Cost Benefit Analysis (UCBA) model suggests an alternative and yet effective way of investigating perceived benefits and costs (Nathwani and Eason 2005). Although the benefit refers to the application-oriented advantages, the cost refers to various disadvantages including financial expenses, usage complexity, and other concerns. UCBA proposes that there are a number of stages leading to system acceptance and it is based on a theory that 'hands on' experience will be the only way of making an informed judgment – to move from rough expectations to realistic perceptions. A hybrid approach using both the qualitative and the quantitative research methods was adopted in this research to study consumers' intention to use MMS. Initially, our research adopted a qualitative case study approach utilising UCBA concepts for the purpose of allowing

*Corresponding author. Email: eschang@dragon.nchu.edu.tw

users to nominate any advantage or disadvantage they perceive about MMS. Specifically, the Zaltman Metaphor Elicitation Technique (ZMET) developed by Zaltman (1996) was adapted into our case study for eliciting latent factors influencing consumers' thought and behaviour. The elicited factors were used to design a quantitative research framework and develop a questionnaire. Afterwards, a quantitative data analysis of the samples collected from a subsequent questionnaire survey was performed to validate and assess mobile users' in-depth feelings. Our findings can be referenced by MMS service providers for the purpose of the design and development of successful business applications to catch the revolutionary opportunity and benefit of MMS.

2. Research background

2.1. Multimedia messaging services

The advance of telecommunication technology together with the launch of mobile handsets with MMS capability has made it possible to digitally capture and instantly send multimedia information. This innovation has a profound effect on our life. For example, a multimedia messaging telemedicine system may facilitate the rapid and cost-effective management of musculoskeletal limb injuries, by allowing high quality medical care to be delivered immediately, anytime and anywhere (Archbold *et al.* 2005). The primary benefit of an MMS telemedicine system over the Internet-based system is that MMS is a mobile system which facilitates early health-care decisions to be made as the handheld MMS device can be carried by the surgeon at all times. The mobile messaging client is designed to run on portable computing devices. Currently, there are two major types of mobile messaging clients: the notebook computer, and the handheld computer such as the personal digital assistant (PDA) and the mobile phone (Tan *et al.* 2001). Apart from text data, mobile messaging clients support the sending of popular attachment types such as images, photos, audios and videos (Olla and Atkinson 2004). Several techniques including compression, on-demand retrieval, multipart retrieval, attachment conversion and content summarisation enable mobile users to access unified messaging services efficiently over the wireless network (Tan *et al.* 2001). These techniques have been incorporated into the wireless messaging gateway system that supports various messaging services such as email, fax, voice mail, paging, and SMS over the integrated Internet and wireless environment. In this integrated environment, the elements of an MMS message may be in the format of music, voice, image, text, video, graphics, streaming media, or their combinations, and they are all across a common timeline instead of being delivered as attachments (Novak and Svensson 2001).

According to a study from Telecom Trends International (De Grimaldo 2004), the number of mobile commerce users will increase from 94.9 million in 2003 to 1.67 billion in 2008 worldwide, and global revenues generated from mobile commerce are expected to expand from \$6.86 billion in 2003 to \$554.37 billion in 2008. It is also projected by Pyramid Research, a market research firm, that MMS revenues would grow from \$4.7 billion in 2005 to \$9.4 billion in 2010 as the number of people with camera-phones grows and service quality improves (The Economist 2006). As a matter of fact, MMS offers a complete development and billing environment along with a chance to create compelling applications, thus providing potential opportunities to foster an industry where all players in the value chain of MMS may benefit from its business growth.

When customer needs are fulfilled or facilitated by mobile technology, the technology would not only become more satisfying but also expand in real usage, and the communications through such mobile technology may actually change how people connect to one another (Nysveen *et al.* 2005). In Taiwan, mobile phone is the most popular mobile communication devices with a penetration rate of 111.3% (i.e. 25.67 million active mobile phone subscriptions), and it has a significant impact on mobile users' lifestyle and business operations, specifically with 16.17 million mobile users who are capable of accessing mobile Internet services (Institute for Information Industry 2009). According to Institute for Information Industry (2008), 90.7% of online population in Taiwan have experience using mobile data services, and among those mobile users, 89.9% have experience using SMS, but only 34.7% have experience using MMS and even less (8.8%) are frequent users using MMS at least once a week. As suggested by Institute for Information Industry (2008), MMS service charge in Taiwan is relatively high, so the penetration rate of MMS in Taiwan is low. However, there might be other important factors affecting potential users' intention to use MMS, and it would be highly interesting and valuable to find out those important factors explaining Taiwanese situations in a more comprehensive way.

On a basis of qualitative analysis on the Fortune Global 500 websites and quantitative interviews with European experts, Scharl *et al.* (2005) investigated the adoption of mobile business models and technologies by region and industry. Considering SMS as the most successful form of mobile communication and the most popular mobile application, Scharl *et al.* proposed an effective SMS advertising model which contained two categories of success factors, message

characteristics (content, personalisation and consumer control) and media characteristics (device technology, transmission process, product fit and media cost). It is plausible that a successful design and implementation of MMS applications can be built by following the footprint of the success of SMS business development, mainly because both SMS and MMS share the similar characteristics of asynchronous, digital and interactive communication. Considering MMS as a successor of SMS in regard to the state-of-the-art mobile telecommunication services, our research tried to identify important factors affecting the intentions of potential users to adopt MMS applications.

2.2. The Zaltman Metaphor Elicitation Technique

In consumer and marketing research, it might be more difficult to help consumers express their real demands, feelings, and thoughts than to make them understand product and service offering, because most of such underlying meaning is exchanged nonverbally (Zaltman 1996, Catchings-Castello 2000). It is recognised that eliciting and compiling nonverbal communications, such as facial expression, physical gesture, attire, scent and so on, are crucial in understanding customers' true meanings. When customers are able to represent their thought in nonverbal terms, they are closer to the state in which thoughts occur, and therefore we can understand them better (Zaltman 1996). On the basis of these findings, the Zaltman Metaphor Elicitation Technique (ZMET) was developed by Zaltman in early 1990s for eliciting interconnected constructs that influence the thought and behaviour (Catchings-Castello 2000). ZMET is a qualitative approach that integrates a variety of behavioural/social research methods including the visual projection technique, in-depth personal interview, and a series of qualitative data-processing techniques such as categorisation, abstraction of categories, comparison with each respondent's data and extraction of key issue from these data.

The main concepts of ZMET are image-based and metaphor-focused, and the typical application of ZMET usually includes the activities of interviewing, constructs and consensus mapping, and results presenting. In addition to explicit knowledge, ZMET can draw out implicit imagery that represents the respondent's deep thoughts and feelings related to the research topic, by assisting respondents to express their in-depth, latent and undisclosed perceptions and recognitions via verbal and non-verbal metaphor elicitation and storytelling (Coulter *et al.* 2001, Zaltman 2003). Generally speaking, ZMET is a good choice when the researcher wants to investigate some consumer behaviours but just has little prior research

as reference. However, there is no standard procedure for ZMET, and the specific steps involved in implementing ZMET vary according to the project focus (Zaltman 1996, Catchings-Castello 2000). ZMET has been used in various studies to investigate mobile consumer behaviour, such as exploring barriers to the adoption of mobile 3G banking services (Lee *et al.* 2003), and conducting cross-cultural comparisons with mobile consumers (Sugai 2005). More information about ZMET can be found in the work done by Zaltman (1996), Catchings-Castello (2000), Coulter *et al.* (2001) and Zaltman (2003).

Specifically, ZMET interviews and corresponding qualitative case study techniques were used in our study to extract critical success factors and develop a proposed research framework (which would be subsequently reinforced by the important findings and suggestions from prior studies) for investigating potential users' intention to adopt MMS. More details about our ZMET approach and corresponding results are described in Sections 3.1 and 4.1.

3. Research methodology

3.1. The qualitative approach adapted from ZMET

Case study is useful in the early stage of research for clarifying the description of research problem and fostering the development of related concept, particularly in the situation of no previous research frameworks or prior study findings for guidance. Various methods and tools such as interviews, questionnaires and observations can be used by a typical case study to collect data. The use of case study is advocated in the situation when sufficient constructs are not established through prior studies and the information of 'what and how' about the research problem are still not clear (McCutcheon and Meredith 1993). Since the MMS deployment in Taiwan is still in its early stage, it would be highly valuable to conduct case studies to develop our understanding of underpinning issues of MMS business development in this market. For this reason, we decided to conduct a case study with ZMET to extract the critical success factors of MMS business development. To take advantage of the ability of obtaining a deep and rich understanding of potential MMS users' perceptions, we conducted ZMET interviews in this study to capture respondents' requirements, opinions and objective comments from potential MMS users' perspectives. The captured information about users' needs and comments was subsequently analysed by using qualitative data-processing techniques to extract factors explaining mobile users' intention to the adoption of MMS.

As suggested by Lee *et al.* (2003), we separated ZMET into two processes, the data collection through

interviews and the data analysis by coding. There are four steps in our data collection process. Firstly, the researcher needs to develop a purposive sampling plan and clearly specify the issue or question about MMS. Secondly, the researcher prepares interview instructions for guiding interviewees to think of any feeling or comment that might be associated with MMS issues/questions. Thirdly, interviewees arrive for the interviews with the benefit of considerable conscious and unconscious reflection about MMS issues/questions. Although the researcher would conduct a one-on-one interview in the format of a guided conversation, the specific steps for implementing the ZMET procedure might vary according to each project's focus. Fourthly, interviewees are shown the selected pictures/images and then asked to explain their thoughts and feelings about MMS issues/questions. Through this projective ZMET technique, consumers may create collage characteristics of their feelings and experiences about a product or research topic (Kleef *et al.* 2005). When the planned interviews are completed, transcripts of the interviews are produced for the data analysis.

Participants (i.e. interviewees) are selected by convenience sampling to recruit mobile users who are not currently MMS subscribers but knowledgeable about the context of MMS. Actually, most recruited participants in this study are young college/graduate students or professionals. This is because in Taiwan a survey revealed that 75% of SMS messages were sent by users between 20 and 39 years old and most SMS messages were sent by two user groups – students and professionals (Taiwan Mobile 2007). Some pictures were presented to the participants for guiding them to think of any factors that might be associated with using MMS. We went through the following four ZMET steps to uncover the in-depth hidden knowledge (i.e. consumers' underlying beliefs and feelings) and sort out important factors influencing the behavioural intention of potential MMS users:

(1) Tell stories. Interviewees were asked to describe the content of each picture provided by the interviewer. Figure 1 shows two examples of such pictures.
(2) Summarise images. Interviewees were asked to describe any impression or opinions they felt about these pictures.
(3) Sort issues. Interviewees' opinions were sorted into meaningful categories and generalised to produce influential factors that would influence users' intention to adopt MMS.
(4) Elicit constructs. An attempt was made to elicit the underlying beliefs and feelings from the interviewees. This study analysed the interview results of twelve potential MMS users, sorted the issues mentioned in every interviewees' descriptions into various category items, counted the frequency of each item mentioned, and classified these items into basic constructs.

Originally, participants were asked to collect 8 to 10 pictures that represented their thoughts and feelings about MMS and brought the pictures to the interview, but most participants had difficulty in collecting pictures by themselves. Thus, we modified this part a little bit by preparing pictures for participants. Overall, five pictures, which were recommended by experts from a major MMS company in Taiwan, were shown to the participants. Eventually, respondents would discuss their thoughts and feelings represented by each picture. Each interview lasted between 45 and 60 min. All interview results were recorded into useful transcripts, and each transcript was assigned meaningful codes created to represent the thoughts and ideas

Figure 1. Two pictures shown to the interviewees.

outlined during each interview. We summarised participants' issues into meaningful factors (i.e. category items) and generalised the factors derived from ZMET interviews. For example, the quotation 'We can send out the photos to friends immediately through MMS' was given the unique codes 'send out', 'photos', 'friends, 'immediately'. After the coding process was done, similar codes were grouped into a 'code family' with a descriptive construct name. For example, the similar codes 'quickly', 'on time', 'immediately', and 'real time' were grouped into a code family with the construct name of 'real time'. After the summarising, sorting, and coding processes, we were able to extract the major concepts reflected in the interviews as described in the next subsection.

3.2. The quantitative approach through a questionnaire survey

An approach integrating ZMET and a questionnaire based survey was used in this study. After the important factors for the intention to adopt MMS were extracted from ZMET, the identified factors were used to form a research framework and postulate research hypotheses. On the basis of the hypotheses, the questionnaire was then designed as an instrument of data collection. The questionnaire included three major parts: (1) the demographic information, (2) factors affecting the intention to adopt MMS and (3) the intention to adopt MMS. The demographic characteristics included gender, age, education level, internet experience and mobile service experience. Part 2 covered the factors extracted from the previous ZMET processes. Part 3 surveyed on users' intention to adopt MMS. Except for the demographic related questions, the questionnaire items were measured using a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. To ensure that the items would be understood and measured validly, a pretest was conducted in a small group. On the basis of the findings from the pretest, modifications were made to the questionnaire for improving its readability and reliability before it was used in the formal survey. This integrated approach could remove the deficiency of small sample size in the ZMET stage by conducting the second stage of questionnaire based survey, because the research model, hypotheses, questionnaire items, and collected data would be checked to assure their corresponding reliability and validity statistically.

Empirical data were collected by conducting a field survey of using online questionnaire. The survey subjects were supposed to have experience using mobile services (such as voice mobile phone and SMS). In the formal survey, the questionnaire was placed on my3q. com, a free online questionnaire website. The invitation messages were placed on popular mobile communications related blogs and websites to collect the responses mainly from the young and well-educated mobile users (college/graduate students or professionals) who were not MMS subscribers but knowledgeable about MMS. The messages outlined the aim of this research and provided a hyperlink to the survey form. After the characteristics of respondents were described using descriptive statistics methods, the collected samples were analysed and interpreted through a two-stage approach using the partial least squares (PLS) technique. First, the scale psychometric characteristics were tested to ensure the reliability and validity of the measurement model. Second, the structural model was tested by estimating the path coefficients, and the bootstrap re-sampling procedure was applied to evaluate the statistic significance of the path coefficients.

4. Creating a research framework from ZMET results

4.1. The results from ZMET

As mentioned in the previous section, we used the adapted ZMET to interview 12 mobile users knowledgeable about MMS. Those mobile users were supposed to possess relatively higher levels of knowledge and experiences in MMS product/service than the general public, and hopefully their ZMET interviews might provide a relevant source of meanings for us to elicit. Among them, four were females and eight were males, their ages ranged from 23 to 45 years old, and their occupations varied from the graduate student, engineer, manufacturing worker, office clerk, to management department head. Following the ZMET processes including story telling, image summarising, issue sorting, coding and construct elicitation, we initially extracted 32 concepts (with codes ranging from 1 to 32), and quickly eliminated 10 of them that were considered as less important because they were low occurrence items mentioned by only one out of the 12 interviewees/respondents whom were labelled ranging from A to L. In addition, eight other concepts were deemed as the description terms of MMS functions (such as 'taking photos' and 'exchange of photos and data'). Those eight function-description terms were eliminated because they were not obviously related to either advantages or disadvantages of MMS. As shown in Table 1, the remaining 14 concepts were further grouped into four constructs (i.e. coding families), including *ease of use, facilitating conditions, relative advantage* and *previous experience*.

4.2. The research framework and hypotheses

Based on the aforementioned findings of our ZMET based qualitative research, a conceptual framework for

Table 1. The list of concepts and constructs derived from ZMET processes.

Code	Concept	Respondents	Count	Construct
5	User-friendly	ABCDEFGHJKL	11	Ease of use
6	Enabling immediate delivery or feedback easily	ADEFGHIJL	9	
9	Ease to use	ACFJL	5	
24	Compatible for personal use	FH	2	
10	Interoperability situation	AK	2	Facilitating conditions
11	Service fee	AIK	3	
17	Concern of network speed	CFGH	4	
2	To share and connect with people	ABDEFGIJKL	10	Relative advantage
15	Stylish and fashionable	BFL	3	
16	No limitation to place	BD	2	
23	Entertainment	ACDFGL	6	
27	Time saving	GHL	3	
4	Compared to SMS, MMS has advanced functions	ABEGIK	6	Previous experience
22	Similar to Bluetooth	DFGHJKL	7	

quantitatively studying mobile users' intention to adopt MMS can be formulated to investigate how the four constructs extracted from ZMET affect the *intention* construct. For providing additional support to the conceptual framework derived from our ZMET results, we endeavoured to survey relevant literatures, and through this effort, important findings and suggestions from prior research were pulled out to reinforce our proposed research framework as detailed below.

4.2.1. *Operational definitions and hypotheses*

Ease of use is defined in this study as the degree of difficulty mobile users perceived in using MMS. If a technology is easy to use, potential adopters would become relatively more willing to use it, and therefore 'ease of use' has been pointed out by prior research as an important factor influencing users' intention to adopt information technology (IT) innovations (Davis 1989, Moore and Benbasat 1991, Venkatesh and Davis 2000). This is consistent with our ZMET finding that *ease of use* may influence mobile users' *intention* to adopt MMS. Our research incorporated the relationship between *ease of use* and *intention* to use MMS to explore mobile users' usage intention, and therefore, the following hypothesis was posited:

> **H1**: *Ease of use* has a direct effect on mobile users' *intention* to adopt MMS.

Facilitating conditions can be viewed as an objective factor that would create or improve a usage environment with resources needed for users to make an act, and it may directly influence users' willingness to use communication media. The results from our ZMET processes suggested that *facilitating conditions*, such as higher connection speeds or lower

costs, might influence mobile users' MMS adoption intention. *Facilitating conditions* of using an IT innovation have also been pointed out by prior research to have significant impact on users' intention to adopt innovation (Venkatesh *et al.* 2003, 2008). In addition, it was empirically tested and found by prior technology acceptance studies that *facilitating conditions* would affect the *ease of use* and *relative advantage* perceived by the users (Venkatesh 2000, Venkatesh *et al.* 2003, 2008). Accordingly, *facilitating conditions* was incorporated into our empirical research framework and the following hypotheses were derived:

> **H2**: *Facilitating conditions* has a direct effect on mobile users' *intention* to adopt MMS.
> **H3**: *Facilitating conditions* has a direct effect on *ease of use*.
> **H4**: *Facilitating conditions* has a direct effect on *relative advantage*.

Relative advantage is defined in this study as the degree to which using MMS is superior to using other technologies, and it may directly influence users' willingness to use communication media. The relative advantage of an innovation over existing technologies is an important adoption driver. Our qualitative ZMET study found that *relative advantage* would be an important factor influencing mobile users' intention to adopt MMS. Prior research also suggested that *relative advantage* is an important factor affecting users' initial adoption of IT innovations (Moore and Benbasat 1991, Agarwal and Prasad 1998). Consequently, *relative advantage* was expected in our empirical study to positively influence mobile users' *intention* to adopt MMS, and our fifth hypothesis was postulated as follows.

> **H5**: *Relative advantage* has a direct effect on mobile users' *intention* to adopt MMS.

It is found that users' *previous experience* in computer technology is positively associated with their performance of using related technologies (Jacko *et al.* 2004), and customers' intention to use an IT innovation (such as the web-based service) is affected by their previous experience (Hong and Kim 2004). Our ZMET study results also suggest that users' *previous experience* might influence mobile users' intention to use MMS. In addition, as *previous experience* is an important determinant of future attitudes (Eagly and Chaiken 1993), a user's previous experience with a technology may lead to positive or negative impacts on one's PEOU and *relative advantage* to adopt that particular or related technology. In this respect, the following hypotheses were posited:

> *H6*: *Previous experience* has a direct effect on mobile users' *intention* to adopt MMS.
> *H7*: *Previous experience* has a direct effect on *relative advantage*.
> *H8*: *Previous experience* has a direct effect on *ease of use*.

4.2.2. The research framework and questionnaire

As shown in Figure 2, ease of use, facilitating conditions, relative advantage, previous experience and intention to adopt MMS were used as the variables to construct the research framework for evaluating how the four variables identified by ZMET would influence mobile users' MMS adoption intention. As described by the eight postulated hypotheses, in this proposed framework both facilitating conditions and previous experience were expected to directly affect ease of use, relative advantage, and intention to adopt MMS. Being directly affected by facilitating conditions and previous experience, both ease of use and relative advantage were supposed to directly influence mobile users' intention to adopt MMS.

Based on the research framework and the postulated hypotheses, a questionnaire was developed as the survey instrument to collect the consumers' opinions on 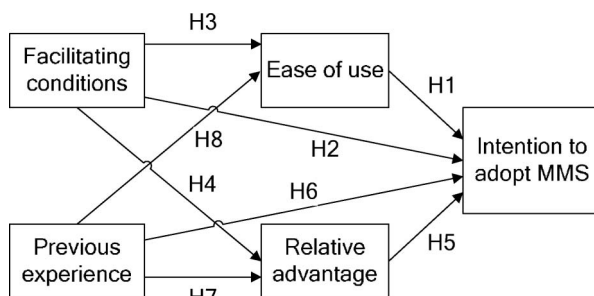using MMS. Other than demographic items, the derived questionnaire consists of 22 items, which correspond to five primary constructs including relative advantage (six items), facilitating conditions (four items), ease of use (six items), previous experience (four items) and intention to use MMS (two items). To ensure that the items could be understood and measured validly, a pretest was conducted (in a similar way how the formal survey was subsequently conducted) with a small group of 64 mobile users. Based on the findings from the pretest, modifications were made to the questionnaire for improving its readability and reliability before it was used in the formal survey. Specifically, we tried to purify the instrument by removing items with poor measurement properties from further consideration. For this purpose, the questionnaire was refined by standard procedures such as: deleting the items with low corrected item-to-total correlation values, and conducting exploratory factor analysis for deleting items that did not load on an appropriate high-level factor. Through this purification process, one item under facilitating conditions, one item under ease of use, and one item under previous experience were deleted and the remaining 19 items were used for the formal survey.

5. Empirical results and analysis

After a total of 125 responses were gathered, three invalid survey results were identified by techniques such as the use of reverse questions. In addition, 10 questionnaires were from respondents without enough knowledge about mobile messaging services, so they were removed. Overall, 112 valid questionnaires were collected and used for analysis. Among the 112 valid respondents, 54.5% were males, and 45.5% were females. Their ages ranged from 20 to 49 years old, and the majority (63.4%) of the collected samples was from 20 to 26 years old. As for the educational background, 25 of the 112 informants (22.3%) were at the postgraduate level, 68 (60.7%) were at the college level and 19 (17.0%) did not have college degrees. In terms of occupation, 48 (42.9%) were students, 13 (11.6%) worked in the electronics or IT related industries, 18 (16.1%) worked in educational organisations, and the rest worked for other various sectors including financial services, entertainment, media, government, health care, law office and others. Fifty-seven respondents (50.9%) spent US$10 to US$30 for their monthly mobile phone usage, and 14 (12.5%) spent US$30 to US$47. 54 respondents (48.2%) had IT experience using Bluetooth or infra-red technology and 62 (55.4%) respondents had been using mobile phones for more than 6 years.

As mentioned earlier, the questionnaire items other than the demographic related questions were measured

Figure 2.   Research framework.

using a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. The measurement scales including the mean value and standard deviation (SD) for the collected survey results are listed in Table 2.

5.1. Test for unidimensionality of all blocks

Partial least squares (PLS), a second-generation multi-variate analysis technique which has been gaining interest and increasing popularity among social science researchers in recent years, is suggested as a powerful path modelling tool requiring minimum restrictions on measure scales and sample size, i.e. it can be used to model latent constructs under conditions of non-normality and small to medium sample sizes (Chin et al. 2003, Tenenhaus et al. 2005). SmartPLS 2.0.M3 was used in this study to analyse collected samples and test the measurement model. It is important to assess the accuracy of the measurement model (i.e. the outer model which connects the manifest variables to the latent variables) in terms of the individual item reliability, construct reliability, convergent and discriminant validity of the variables in the model. However, before conducting the PLS analysis on the collected data and the proposed structure model, if the manifest variables in the model are connected to their latent variables in a reflective way, which is the measurement approach used in this study, it would be necessary to check for unidimensionality of each block (construct) in the proposed model (Tenenhaus et al. 2005). According to Tenenhaus et al. (2005), there are three tools available to check the unidimensionality of a block: principal component analysis of the block, Cronbach's alpha (α) and Dillon-Goldstein's

rho (ρ). From principal component analysis, a block of manifest variables is unidimensional if the first eigenvalue of the correlation matrix of the block is greater than 1 and the second eigenvalue is less than 1, or at least very far from the first one. Alternatively, a block is considered as unidimensional when its Cronbach's α value or Dillon-Goldstein's ρ value is larger than 0.7. As shown in Table 3, the statistics (except the Cronbach's α of previous experience) for this check satisfied the aforementioned standards. Nevertheless, the Dillon-Goldstein's ρ is considered to be a better indicator of the unidimensionality of a block than the Cronbach's α which represents a lower bound estimate of internal consistency due to its assumption of equal weightings of items (Chin 1998, Sánchez-Franco 2006). Regarding previous experience, its Dillon-Goldstein's ρ (0.831) is higher than 0.7 and its Cronbach's α (0.693) is also acceptable because it is very close to 0.7. Therefore, it was concluded that the unidimensionality of all blocks is supported by the test results from all three tools.

5.2. Test of the measurement model (outer model)

The outer model estimation results including outer weight, loadings, and the average variance extracted (AVE) measures are shown in Table 4. The outer loadings, which represent the loadings of the reflective manifest variables with their respective latent variable, can be used to assess individual item reliability, and it is considered by many researchers as acceptable when an item has a loading higher than 0.7 (Carmines and Zeller 1979, Hulland 1999). In this study, except for one item (FC3), all outer loadings were higher than

Table 2. Summary of measurement scales.

Construct	Item	Concept	Mean	SD
Relative advantage (RA)	RA1	MMS reduces the response time and place limitation	3.64	0.919
	RA2	MMS improves quality of personal records and documents	3.19	1.009
	RA3	MMS enhances personal connection and relationships	3.37	1.004
	RA4	MMS enables multimedia entertainment	2.96	0.981
	RA5	MMS leads to more stylish and fashionable life	3.71	0.832
	RA6	MMS helps improve the effectiveness of my work/task	3.66	0.876
Facilitating conditions (FC)	FC1	I think the service fee for using MMS should be concerned	3.74	0.846
	FC2	I think the interoperability in using MMS should be concerned	3.95	0.879
	FC3	I think the network speed of MMS should be concerned	4.29	0.740
Ease of use (EU)	EU1	It is easy to learn how to use MMS	2.96	0.967
	EU2	The service interface of MMS is user-friendly	2.96	0.924
	EU3	I feel that MMS applications/functions are appropriate	3.27	0.977
	EU4	It is easy to send immediate delivery or feedback via MMS	3.38	0.871
	EU5	MMS is suitable for personal use and it fits in my life well	2.90	0.759
Previous experience (PE)	PE1	I am knowledgeable in mobile services and mobile commerce	2.47	0.968
	PE2	I frequently use value-added mobile services	3.21	0.950
	PE3	I am experienced in using/operating several mobile technologies	2.78	1.046
Intention to use MMS (I)	I1	I am very interested in using MMS	3.52	0.910
	I2	I am willing to use MMS	3.32	1.024

0.7. The only exception item, FC3, was still retained in the subsequent analyses, mainly because it is important to retain as many items as possible from the original scale to preserve the integrity of the test (Barclay *et al.* 1995), and the loadings of FC3 (.604) was not too small. Yet, another reason to keep FC3 was that it actually resulted in acceptable construct reliability with a high Dillon-Goldstein's ρ score.

The AVE measures can be used to assess the convergent validity of the reflective constructs. In this study, all AVE scores ranged from 0.622 to 0.854, passing the threshold value of 0.5 suggested by Fornell and Larcker (1981). To assess the discriminant validity, the square root of the AVE measure on each construct must exceed the estimated correlations shared between the construct and other constructs in

Table 3. The statistics for checking the unidimensionality of all blocks.

Latent variable	First eigen-value	Second eigen-value	Cronbach's α	Dillon-Goldstein's ρ
Relative advantage	3.794	0.778	0.883	0.911
Facilitating conditions	2.120	0.657	0.787	0.868
Ease of use	3.142	0.783	0.852	0.894
Previous experience	1.876	0.756	0.693	0.831
Intention to use MMS	1.709	0.291	0.830	0.921

Table 4. The results from the outer model estimation (weight, loadings, and AVE).

Latent variable	Manifest variable	Outer weight	Loadings	AVE
Relative advantage (RA)	RA1	0.254	0.846	0.632
	RA2	0.213	0.814	
	RA3	0.218	0.820	
	RA4	0.179	0.729	
	RA5	0.190	0.825	
	RA6	0.200	0.727	
Facilitating conditions (FC)	FC1	0.522	0.924	0.694
	FC2	0.444	0.930	
	FC3	0.175	0.604	
Ease of use (EU)	EU1	0.246	0.784	0.628
	EU2	0.261	0.803	
	EU3	0.243	0.774	
	EU4	0.261	0.847	
	EU5	0.250	0.752	
Previous experience (PE)	PE1	0.360	0.780	0.622
	PE2	0.428	0.713	
	PE3	0.479	0.866	
Intention to use MMS (I)	I1	0.552	0.928	0.854
	I2	0.530	0.921	

the model (Fornell and Larcker 1981). The discriminant validity for the constructs used in our study was acceptable, as the square root of AVE on each construct (i.e. the diagonal elements in Table 5), was greater than the correlations of the construct with other constructs (i.e. those related off-diagonal elements in Table 5).

The matrix of loadings and cross-loading for all indicators is shown in Table 6, which shows that all reflective items have high loadings on their expected constructs and every item loads higher on its theoretical construct than on other constructs. Although cross-loadings derived from PLS procedure will be inevitably higher than those derived from exploratory factor analysis (Gefen and Straub 2005), in our study every cross-loading difference (i.e. the difference between the loading of each item on its expected construct and the loading of the item on every other construct) is higher than the threshold of 0.1 suggested by prior research (Gefen and Straub 2005, Hsieh *et al.* 2008). Thus, it is concluded that Table 6 provides additional evidence of convergent validity and discriminant validity.

5.3. Test of the structural model (inner model)

After the outer model was validated, the inner model which specified the relationships between latent variables was then estimated. The path coefficients for the endogenous latent variables and *R*-square statistics were derived, and then the bootstrap re-sampling algorithm with 200 re-samples were performed to determine the statistical significances (using *t*-values) of all path coefficients within the structural model. The inner model results including path coefficients, *t*-values/*p*-values, and the variances explained (*R*-square values) are presented in Figure 3 and Table 7.

It is important to note in the following discussions that the level of significance is set at 5% (i.e. $p < 0.05$) and the β value has nothing to do with error II type but

Table 5. Discriminant validity coefficients.

Latent variable	RA	FC	EU	PE	I
Relative advantage (RA)	*0.795*	–	–	–	–
Facilitating conditions (FC)	0.321	*0.833*	–	–	–
Ease of use (EU)	0.587	0.418	*0.793*	–	–
Previous experience (PE)	0.386	0.207	0.643	*0.789*	–
Intention to use MMS (I)	0.763	0.397	0.626	0.403	*0.924*

corresponds to the path coefficient. Our empirical results (shown in Figure 3 and Table 7) confirm that relative advantage has a significant direct effect on

mobile users' adoption of MMS ($\beta = 0.590$, $p = 0.0000$) and ease of use also has a significant direct effect on mobile users' adoption of MMS ($\beta = 0.230$, $p = 0.0306$). However, facilitating conditions does not have significant direct influence on mobile users' intention to adopt MMS ($\beta = 0.110$, $p = 0.0989$), and previous experience does not significantly and directly affect mobile users' intention to adopt MMS ($\beta = 0.005$, $p = 0.9546$). In addition, facilitating conditions significantly influence ease of use ($\beta = 0.298$, $p = 0.0001$), but it does not significantly influence relative advantage ($\beta = 0.252$, $p = 0.0542$). Finally, previous experience significantly influence both ease of use ($\beta = 0.581$, $p = 0.0000$) and relative advantage ($\beta = 0.334$, $p = 0.0013$). Hypotheses H1, H3, H5, H7 and H8 postulated in this study were supported by the empirical results, but hypotheses H2, H4 and H6 were not significantly supported.

The quality and predictive power of our model can be measured by the R-square values of the *intention* (I) construct. As shown in Figure 3 and Table 7, our model explained 64.00% of the variance ($R^2_{\mathrm{I}} = 0.6400$) in mobile users' intention to adopt MMS. As suggested by Chin (1998), the effect size of each independent construct can be calculated to estimate the predictive power of each independent construct. Cohen (1988) pointed out that the formula for calculating the effect size f^2 is $[(R^2_{\mathrm{full}} - R^2_{\mathrm{excluded}})/(1 - R^2_{\mathrm{full}})]$, and the operational definitions of small, medium and large effect sizes are 0.02, 0.15 and 0.35, respectively. The R-square values and the effect sizes derived in this study are presented in Table 8. It shows that the effect sizes of relative advantage and ease of use on the R-square value of intention to adopt MMS were large and small, respectively. In terms of the effect on ease of use, facilitating conditions had a medium effect size and previous experience had a large one. Finally, previous experience was found to have a small effect size on the R-square value of relative advantage.

Table 6. Matrix of loadings and cross-loadings.

Construct	Item	RA	FC	EU	PE	I
Relative	RA1	**0.846**	0.421	0.503	0.333	0.706
advantage	RA2	**0.814**	0.166	0.422	0.263	0.661
(RA)	RA3	**0.820**	0. 160	0.496	0.358	0.642
	RA4	**0.729**	0.112	0.536	0.372	0.499
	RA5	**0.825**	0.293	0.414	0.220	0.549
	RA6	**0.727**	0.340	0.432	0.292	0.543
Facilitating	FC1	0.322	**0.924**	0.463	0.187	0.397
conditions	FC2	0.269	**0.930**	0.384	0.212	0.352
(FC)	FC3	0.193	**0.604**	0.035	0.089	0.191
Ease of	EU1	0.549	0.251	**0.784**	0.479	0.534
use (EU)	EU2	0.403	0.300	**0.803**	0.627	0.441
	EU3	0.475	0.409	**0.774**	0.457	0.466
	EU4	0.454	0.395	**0.847**	0.466	0.543
	EU5	0.450	0.303	**0.752**	0.513	0.497
Previous	PE1	0.216	0.060	0.514	**0.780**	0.169
experience	PE2	0.374	0.183	0.405	**0.713**	0.416
(PE)	PE3	0.309	0.224	0.595	**0.866**	0.345
Intention to	I1	0.748	0.340	0.534	0.404	**0.928**
use MMS (I)	I2	0.661	0.395	0.626	0.341	**0.921**

Figure 3. The result of this empirical study.

Table 7. Structural model results.

H_0	Hypothesis	Path coefficient	t-statistic	p	Hypothesis test result
EU → I	H1	0.230*	2.178	0.0306	supported
FC → I	H2	0.110	1.658	0.0989	not supported
FC → EU	H3	0.298***	3.895	0.0001	supported
FC → RA	H4	0.252	1.937	0.0542	not supported
RA → I	H5	0.590***	8.510	0.0000	supported
PE → I	H6	0.005	0.057	0.9546	not supported
PE → RA	H7	0.334**	3.265	0.0013	supported
PE → EU	H8	0.581***	7.786	0.0000	supported

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
RA, relative advantage; FC, facilitating conditions; EU, ease of use; PE, previous experience; I, intention.
$R^2_{\mathrm{I}} = 0.6400$, $R^2_{\mathrm{EU}} = 0.4980$, $R^2_{\mathrm{RA}} = 0.2096$.

6. Discussion and conclusion

MMS is a mature product providing more multimedia effects and more functionalities than SMS. Mobile users are supposed to feel that MMS functionalities and services are useful, and MMS is expected to become a significant source of revenue for network operators, content providers and service vendors (Novak and Svensson 2001). However, MMS is still not as popular as SMS in Taiwan, although it is regarded as a natural evolution of SMS. A qualitative research approach, the ZMET, was adopted in this study to extract rich insights instead of general concepts of mobile service users through interviews. The ZMET part of our research approaches revealed that there were four major factors influencing mobile users' MMS adoption intention, and these factors included relative advantage, facilitating conditions, ease of use and previous experience.

Based on these identified factors, a conceptual model for investigating mobile users' intention to adopt MMS was formulated. The research model together with eight hypotheses was empirically tested using data collected from a questionnaire survey against mobile users in Taiwan. This hybrid approach, integrating the qualitative ZMET method with the quantitative data analysis of the samples collected from a subsequent questionnaire survey, was designed and implemented in this study to elicit and validate mobile users' true meanings (in terms of demands, feelings and thoughts). Our study results show that relative advantage and ease of use directly and significantly impact mobile users' intention to adopt MMS. However, the other two factors identified by this study, facilitating conditions and previous experience, were not significant in directly affecting MMS adoption intention. Instead, previous experience had indirect influence on intention through other factors, relative advantage and ease of use, and facilitating conditions only had indirect influence (via ease of use) on mobile users' intention to adopt MMS. The validated model and corresponding study results can be referenced by enterprise executives and decision makers to make favourable tactics for taking advantage of the opportunity available through MMS.

An MMS message can be a photo, a video clip annotated with texts, an audio clip, or a synchronised playback of audio, text, video and photo. The values provided by MMS are action and excitement in today's mobile lifestyle. Through MMS, mobile users may capture the valuable and appreciated moment of their lives anywhere and anytime, and share it instantly with friends and relatives. Actually, it is a simple, natural and attractive way for people to communicate via MMS. While providing such rich content with various multimedia formats, MMS needs to attract users with several desirable characteristics including ease of use and relative advantage (such as comfort, time saving, and flexibility). For example, the users should not have to do anything about MMS settings as they send something out through their MMS capable handsets. MMS may also need to take advantage of the personalisation features to better service each individual user with his/her preferred settings, which are expected to optimise the level of comfort and flexibility. Additional interface like infrared, Bluetooth or transmission line should not be needed for MMS users to communicate with other mobile users. Indeed, it is believed that MMS must possess these two important characteristics – ease of use and relative advantage.

Although the other two antecedents identified by this study, facilitating conditions and previous experience, are not statistically significant in directly influencing mobile users' usage intention in the MMS context, there are still some implications that need to be addressed and discussed. Since the application domain of our research, MMS, is a relatively new service in Taiwan, MMS adoption intention deserves investigation in its own right. Since the extant academic research of MMS adoption intention is limited, this study contributes to the field by proposing a research framework with eight hypotheses and conducting a corresponding empirical study.

Facilitating conditions may include price perceptions (regarding device costs and MMS service fees) representing monetary value a mobile user must give to a mobile device vendor or service provider for accessing MMS. In terms of price perceptions, the finding from Goldsmith and Newell (1997) stating that shopping innovators were less price sensitive than later buyers might provide possible explanations to why facilitating conditions such as the cost issue did not significantly affect mobile users' intention to adopt MMS. As mentioned earlier, MMS is an emerging application seldom heard or understood by the general public in Taiwan, and there are quite a few mobile users, around 10% of the potential MMS users as reported in our analysis results, are likely to be early adopters who are less sensitive to cost issues and other facilitating conditions. As shown in Table 7, the PLS path analysis results regarding H2 (FC → I) reported $\beta = 0.110$ and $p = 0.0989$. This particular p-value suggests that there might still be quite a few mobile users who would consider facilitating conditions as an important factor influencing their intention to subscribe MMS.

Previous experience is not a key factor significantly and directly influencing mobile users' intention to adopt MMS. Statistically, over 90% of the mobile

Table 8. The effect size.

R^2 full for I, EU, and RA	R^2 I, full = 0.6400		R^2 EU, full = 0.4980		R^2 RA, full = 0.2096
Excluded construct	EU	RA	FC	PE	PE
$R^2_{excluded}$	0.6214	0.4192	0.4153	0.1776	0.1059
f^2	0.0517	0.6133	0.1647	0.6382	0.1312
Effect size	small	large	medium	large	small

RA, relative advantage; FC, facilitating conditions; EU, ease of use; PE, previous experience; I, intention.

users do not consider previous experience would be important enough to affect their MMS adoption intention. This might be caused by the fact that people who live in Taiwan are highly confident in using mobile technologies offered by Taiwanese service providers. Particularly, mobile users in Taiwan are not only knowledgeable about the mobile phone (which has an extremely high penetration rate of 111.3%) but familiar with its use, so the related experience in using related mobile technologies would not significantly influence their intention to adopt MMS.

7. Limitation and future work

There exist limitations in our study of investigating the important factors to users' MMS adoption intention. Firstly, the participants of our ZMET interviews were selected by convenience sampling. As a matter of fact, the interviewees were from the group with college or higher degrees, and they tended to be more familiar with IT issues than the general consumer population. Future research may modify the sampling procedure and compare the findings with our results. Secondly, since the 3G mobile phone is still in its early stage in Taiwan, the insufficient understanding of MMS applications might be an overlooked factor impacting consumers' adoption intention. Future studies are recommended to take it into consideration. Thirdly, this research was carried out in Taiwan, and our findings only provided the perception specific to Taiwanese people. It would be interesting and valuable to conduct similar surveys in other regions for comparative studies. With respect to the aforementioned research limitations, it would be valuable to expand this study by using other sampling procedures, enhancing the research framework to cover other overlooked factors, and conducting comparable studies in other countries/regions. The reconfirmation from such expanded studies would make the research results and related implications more general in their nature.

It might be desirable to extend the research framework for increasing the explained variance of the *intention* to adopt MMS by incorporating other important factors in future studies. Based on prior studies regarding the adoption intention of innovative information technologies, additional factors which may be incorporated into the extended framework include subjective norm (or social pressure), fun (or enjoyment), system quality and others (Koivumäki *et al.* 2008, Chang *et al.* 2009, Chen and Cheng 2009, Shin 2009). In this article, we assume MMS will provide values to customers, but is it always true? Alternatives to MMS should also be included in future studies to find out, for example, whether the users prefer using Wi-Fi/Internet access to adopting MMS for sending/sharing pictures. Another example of investigating alternatives to MMS is to find out whether the use of Flash Lite may explain why MMS is not used. The excess of information and the usefulness of information provided by MMS may need to be researched further. Besides, as suggested by Chang *et al.* (2009) and Shin (2009), the impacts of socio-economic determinants (such as age, gender, education and others) on the *intention* to adopt MMS are also worth investigating.

References

Agarwal, R. and Prasad, J., 1998. A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research*, 9 (2), 204–215.

Archbold, H.A.P., *et al.*, 2005. The use of multi-media messaging in the referral of musculoskeletal limb injuries to a tertiary trauma unit using: a 1-month evaluation. *Injury*, 36 (4), 560–566.

Barclay, D., Higgins, C., and Thompson, R., 1995. The partial least squares (PLS) approach to casual modeling: personal computer adoption and use as an illustration. *Technology Studies*, 2 (2), 285–309.

Carmines, E.G. and Zeller, R.A., 1979. *Reliability and validity assessment, Sage University paper series on quantitative applications in the social sciences, No. 7–17.* Beverly Hills, CA: Sage.

Catchings-Castello, G., 2000. The ZMET alternative. *Marketing Research*, 12 (2), 6–12.

Chang, S.E., Chen, S.-Y., and Liu, Y.-H., 2009. A user study of accessing web applications via voice cellular phone: a model comparison approach. *Behaviour and Information Technology*, 28 (5), 471–484.

Chen, C.-W.D. and Cheng, C.-Y.J., 2009. Understanding consumer intention in online shopping: a respecification and validation of the DeLone and McLean model. *Behaviour and Information Technology*, 28 (4), 335–345.

Chin, W.W., 1998. The partial least squares approach for structural equation modeling. *In*: G.A. Marcoulides, ed. *Modern methods for business research*. Mahwah, NJ: Lawrence Erlbaum Associates, 295–336.

Chin, W.W., Marcolin, B.L., and Newsted, P.R., 2003. A partial least squares latent variable modeling approach for measuring interaction effects: results from a Monte Carlo simulation study and an electronic mail emotion/adoption study. *Information Systems Research*, 14 (2), 189–217.

Cohen, J., 1988. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum.

Coulter, R.A., Zaltman, G., and Coulter, K.S., 2001. Interpreting consumer perceptions of advertising: an application of the Zaltman Metaphor Elicitation Technique. *Journal of Advertising*, 30 (4), 1–21.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13 (3), 319–340.

De Grimaldo, S.W., 2004. *Mobile commerce takes off*. Virginia: Telecom Trends International. Available from: http://www.telecomtrends.net [Accessed 15 November 2005].

Eagly, A.H. and Chaiken, S., 1993. *The psychology of attitudes*. Fort Worth, TX: Harcourt College Publishers.

Fornell, C. and Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18 (1), 39–50.

Gefen, D. and Straub, D., 2005. A practical guide to factorial validity using PLS-graph: tutorial and annotated example. *Communications of the Association for Information Systems*, 16 (5), 91–109.

Goldsmith, R.E. and Newell, S.J., 1997. Innovativeness and price sensitivity: managerial, theoretical and methodological issues. *Journal of Product and Brand Management*, 6 (3), 163–174.

Hong, S. and Kim, J., 2004. Architectural criteria for website evaluation – conceptual framework and empirical validation. *Behaviour and Information Technology*, 23 (5), 337–357.

Hsieh, J.J.P.-A., Rai, A., and Keil, M., 2008. Understanding digital inequality: comparing continued use behavioral models of the socio-economically advantaged and disadvantaged. *MIS Quarterly*, 32 (1), 97–126.

Hulland, J.S., 1999. Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic Management Journal*, 20 (2), 195–204.

Institute for Information Industry, 2008. *Surveys on global mobile data services, Reports 1, 3, 5 & 6*. Taiwan: ACI-FIND, Focus on Internet News and Data, Institute for Information Industry. Available from: http://www.find.org.tw/find/home.aspx?page=many [Accessed 3 July 2009].

Institute for Information Industry, 2009. *Survey on mobile phone subscribers in Taiwan – Q1 2009*. Taiwan: ACI-FIND, Focus on Internet News and Data, Institute for Information Industry. Available from: http://www.find.org.tw/find/home.aspx?page=many [Accessed 3 July 2009].

Jacko, J., et al., 2004. The effects of multimodal feedback on older adults' task performance given varying levels of computer experience. *Behaviour and Information Technology*, 23 (4), 247–264.

Kleef, E.V., Trijp, H.C.M., and Luning, P., 2005. Consumer research in the early stages of new product development: a critical review of methods and techniques. *Food Quality and Preference*, 16 (3), 181–201.

Koivumäki, T., Ristola, A., and Kesti, M., 2008. The effects of information quality of mobile information services on user satisfaction and service acceptance – empirical evidence from Finland. *Behaviour and Information Technology*, 27 (5), 375–385.

Lee, M.S.Y., et al., 2003. Using ZMET to explore barriers to the adoption of 3G mobile banking services. *International Journal of Retail and Distribution Management*, 31 (6), 340–348.

McCutcheon, D.M. and Meredith, J.R., 1993. Conducting case study research in operations management. *Journal of Operations Management*, 11 (3), 239–256.

Moore, G.C. and Benbasat, I., 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2 (3), 192–222.

Nathwani, K. and Eason, K., 2005. Perceptions versus expectations of multimedia messaging service (MMS). *Personal and Ubiquitous Computing*, 9 (4), 191–197.

Novak, L. and Svensson, M., 2001. MMS-building on the success of SMS. *Ericsson Review*, 3, 102–109. Available from: http://www.ericsson.com/ericsson/corpinfo/publications/review/2001_03/140.shtml. [Accessed 12 June 2007].

Nysveen, H., Pedersen, P.E., and Thorbjørnsen, H., 2005. Explaining intention to use mobile chat services: moderating effects of gender. *Journal of Consumer Marketing*, 22 (5), 247–256.

Olla, P. and Atkinson, C., 2004. Developing a wireless reference model for interpreting complexity in wireless projects. *Industrial Management and Data Systems*, 104 (3), 262–272.

Pura, M., 2005. Linking perceived value and loyalty in location-based mobile services. *Managing Service Quality*, 15 (6), 509–538.

Sánchez-Franco, M.J., 2006. Exploring the influence of gender on the web usage via partial least squares. *Behaviour and Information Technology*, 25 (1), 19–36.

Scharl, A., Dickinger, A., and Murphy, J., 2005. Diffusion and success factors of mobile marketing. *Electronic Commerce Research and Applications*, 4 (2), 159–173.

Shin, D.H., 2009. An empirical investigation of a modified technology acceptance model of IPTV. *Behaviour and Information Technology*, 28 (4), 361–372.

Sugai, P., 2005. Mapping the mind of the mobile consumer across borders: an application of the Zaltman Metaphor Elicitation Technique. *International Marketing Review*, 22 (6), 641–657.

Taiwan Mobile, 2007. *SMS for everyone, record low price set by Taiwan Mobile – NT$1 per message (in Chinese)*. Taipei, Taiwan: Taiwan Mobile Co., Ltd. Available from: http://www.taiwanmobile.com/servlet/Satellite?cid=1106027924100&pagename=Corporate%2FPage%2FcorContentPageT&release_id=1195522104853. [Accessed 3 July 2009].

Tan, D.H.M., Hui, S.C., and Lau, C.T., 2001. Wireless messaging services for mobile users. *Journal of Network and Computer Applications*, 24 (2), 151–166.

Tenenhaus, M., et al., 2005. PLS path modelling. *Computational Statistics and Data Analysis*, 48 (1), 159–205.

The Economist, 2006. Lack of text appeal; picture messaging. *The Economist*, 380 (8489), 56. Available from: http://proquest.umi.com/pqdweb?did=1090457751&sid=2&Fmt=3&client-Id=44313&RQT=309&VName=PQD. [Accessed 5 May 2008].

Venkatesh, V., 2000. Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information System Research*, 11 (4), 342–365.

Venkatesh, V. and Davis, F.D., 2000. A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46 (2), 186–204.

Venkatesh, V., *et al*., 2008. Predicting different conceptualizations of system use: the competing roles of behavioral intention, facilitating conditions, and behavioral expectation. *MIS Quarterly*, 32 (3), 483–502.

Venkatesh, V., *et al*., 2003. User acceptance of information technology: toward a unified view. *MIS Quarterly*, 27 (3), 425–478.

Zaltman, G., 1996. Metaphorically speaking: new technique uses multidisciplinary ideas to improve qualitative research. *Marketing Research*, 8 (2), 13–20.

Zaltman, G., 2003. *How customers think: essential insights into the mind of the market*. Boston, MA: Harvard Business School Press.