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Unleash the power of mobile word-of-mouth: An empirical study of system and information characteristics in ubiquitous decision making

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An empirical study of system and information characteristics in ubiquitous decision making

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Abstract

Purpose – This study aims to examine the effects of system and information characteristics in developing users' perceptions towards ubiquitous decision support systems (UDSS).

Design/methodology/approach – The research model is empirically examined with survey data from 218 mobile users who have adopted a UDSS, i.e. mobile Dianping.com. A structural equation modelling approach is employed to assess the hypotheses.

Findings – The findings demonstrate that system characteristics of wireless networks, mobile devices and mobile applications significantly predicted system quality, which in turn determined system usefulness. Localisation, immediacy and customisation of mobile word-of-mouth were the major predictors of information quality, which in turn determined information usefulness.

Originality/value – This study contributes to our current understanding of ubiquitous commerce, especially mobile word-of-mouth, by presenting an integrated research framework, identifying system and information characteristics that are specific to the ubiquitous era, extending system quality and system usefulness from a single system to a combination of systems, and empirically examining the crossover effects between system and information factors.

Keywords System quality, Information quality, Mobile word-of-mouth, Ubiquitous commerce, Customer reviews, Crossover effect, Decision making, Mobile communication systems

Paper type Research paper

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Introduction

The proliferation of ubiquitous devices and the advancement in wireless networks have created an "always-on society", sometimes also called the "ubiquitous society". Anytime-anywhere services offered through ubiquitous devices have huge potential to provide consumers with an enhanced, more convenient and personalised shopping experience, facilitate a seamless interaction, and ultimately influence consumers' purchase behaviour. In this sense ubiquity is often regarded as the unique value of ubiquitous commerce (Lee *et al.*, 2009). Apart from that, ubiquitous commerce can offer contextually-relevant information or services that will better satisfy users' actual demands (Lee, 2005). It is predicted that by 2015, the global mobile phone market will be worth US$341.4 billion and the mobile application market will reach US$25 billion (Markets & Markets, 2010, 2011). This can also be regarded as another confirmation of the worldwide diffusion trend of ubiquitous commerce.

With more consumers increasingly relying on mobile devices to communicate with their peers, send and receive information, stay informed and to make business decisions, mobile word-of-mouth gains considerable importance in the consumer awareness, trialling, and purchase of a new product. On the one hand, consumers generally have negative attitudes toward mobile advertising received directly from advertisers (Tsang *et al.*, 2004). On the other hand, mobile word-of-mouth increases the impact of marketing communication at little cost to the company, and reduces perceived risk and uncertainty for potential consumers (Palka *et al.*, 2009). The ubiquitous connectivity of mobile devices also allows mobile service providers to send location, situation or event-related information to targeted consumers at the "point of purchase" (Lee, 2005). Point-of-purchase promotion is important because it can reach the customer at the time and place where a decision is made. In this regard mobile word-of-mouth overcomes the shortcomings of electronic word-of-mouth communication and helps marketers realise the full potential of mobile marketing by offering the consumers context-sensitivity and time-critical recommendations (Okazaki, 2009).

Although the importance of mobile word-of-mouth seems obvious and is frequently emphasised, research on this topic is still relatively scarce (Bauer *et al.*, 2005; Okazaki, 2005). The academic literature on mobile viral marketing has focused more on the outcomes and potential of marketing strategies, and in this regard, a systematic empirical investigation into customers' motivations behind their decisions to engage in mobile word-of-mouth communication has been highly recommended in some recent studies (Okazaki, 2009; Palka *et al.*, 2009). This study thus represents an effort to address this research gap. Grounded in the IS success model, technology acceptance model and information adoption model, as well as the human-computer interaction literature, the current study tries to build a solid understanding of consumers' intention to use mobile applications and intention to adopt mobile word-of-mouth. The research goal, therefore, is to provide a deeper empirical analysis of factors influencing consumers' participation in mobile word-of-mouth communication.

The remainder of this study is organised as follows. The next section provides a literature review covering the theoretical background of this study. The following section introduces the research model and the associated hypotheses. The subsequent two sections describe the research methods and analysis results. The last section summarises the key findings of this study, and highlights the implications for both research and practice.

Theoretical background

In this section we will provide an overview of the theoretical foundations of this study. Specifically, the IS success, technology acceptance and information adoption models are discussed.

IS success model

As an attempt to identify the factors that contribute to IS success, DeLone and McLean (1992) presented an integrated and multidimensional view of the concept of IS success. At the core of this model, system and information quality were identified as the key initial antecedents of system usage and user satisfaction. Recently, the IS success model has been successfully adapted to investigate mobile business related phenomena. Both system quality and information quality were found to be significantly related to mobile website usefulness (Zhou, 2011), attitude towards mobile browsing services (Yun *et al.*, 2011), mobile data service usage change (Lee *et al.*, 2009), use of mobile technology and users' satisfaction (Chatterjee *et al.*, 2009). However, previous studies mostly treated system quality as the performance of a single system. With the close connectedness among wireless networks, mobile devices and mobile applications in predicting users' overall usage experience, it is necessary and useful to consider the quality of such a system combination instead (Lee *et al.*, 2009; Yun *et al.*, 2011), and therefore, system quality includes the above three dimensions in this study.

Technology acceptance model

The Technology Acceptance Model (TAM) is an information systems theory that adapted the Theory of Reasoned Action to the field of IS (Davis, 1989). This model posits that perceived usefulness and perceived ease of use determine intention to accept and use an information system. Due to its solid theoretical foundation, the TAM has been widely accepted and used as a robust and parsimonious model across a wide range of computer systems and user groups. This theory has also recently been empirically examined within different mobile settings (e.g. Lee *et al.*, 2007; Zhou, 2011).

Information adoption model

Sussman and Siegal (2003) developed the information adoption model to explain how people are influenced to adopt advice or recommendations in computer-mediated communication. This model highlights information usefulness as a mediator between information adoption and the influencing processes. Source credibility and argument quality are regarded as two distinct processes that affect users' perception of information usefulness. The information adoption model has recently been further examined in different online communities (Cheung *et al.*, 2008, 2009; Shen *et al.*, 2013). However, there is a lack of research devoted to understanding the adoption of contextually-relevant information in the ubiquitous environment. Unlike information received from websites, optimal information can be delivered to potential consumers based on their spatial, temporal, and personal contexts through ubiquitous devices (Lee, 2005). In this regard we consider the above three facets in this study.

Research model and hypotheses

Figure 1 presents the research model, which is built on the models of IS success, technology acceptance, and information adoption, and the human-computer interaction

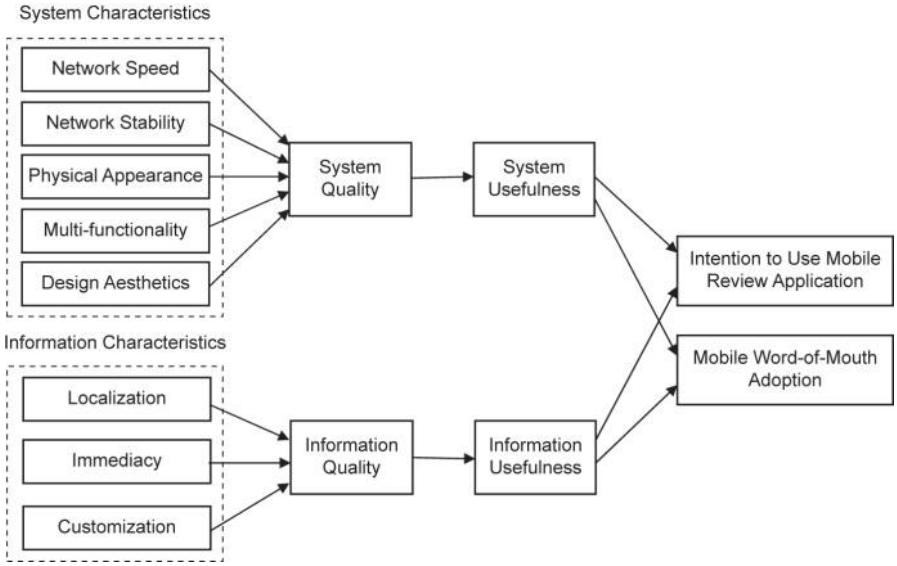


Figure 1.
Research model

literature. Further analysis regarding the constructs and their relationships will be discussed in detail in the following sections.

System quality and system usefulness

Since mobile systems involve multiple vendors, including wireless network service vendors, mobile device manufacturers and content service providers, system characteristics include these three dimensions. In particular, network speed and stability are used to reflect the quality of wireless networks, physical appearance and multi-functionality measure the quality of mobile devices, and design aesthetics are employed to evaluate the quality of mobile applications. Lee *et al.* (2009) have demonstrated that perceived system quality greatly depends on the overall integrity of technical architecture in the mobile environment. It is thus believed that the three dimensions of system characteristics predict users' overall perception of system quality. In the current study network quality refers to the extent to which a wireless network provides speedy and stable data accessibility. Wireless access with high speed and constant stability would enhance customers' positive perceptions toward system performance. In this regard prior studies on mobile internet have also found that speed and stability predicted users' perceived value (Kim and Kim, 2003). Therefore:

H1. Wireless network speed will positively influence users' overall perception of system quality.

H2. Wireless network stability will positively influence users' overall perception of system quality.

In addition to the network quality, hardware quality is another concern, and thus mobile users may pay special attention to the extent to which their mobile devices can

support various mobile activities. Compared to e-commerce the mobile computing environment has its own characteristics because mobile devices have smaller output screens and inferior input functions. Moreover, mobile users are often simultaneously engaged in multiple tasks and the mobile device constraints are regarded as the main challenge in designing customer interfaces for mobile commerce (Lee and Benbasat, 2004). In this study the physical appearance and multi-functionality of a mobile device are used to evaluate the two aspects previously mentioned. Physical appearance is defined as the degree to which the input functions, resolution, and screen size of mobile devices is good enough (Yun *et al.*, 2011), while multi-functionality is defined as the diversity of functionalities performed by a mobile device (Hoehle and Scornavacca, 2008). Prior studies have found that physical appearance is highly valued by mobile handset users (Singh and Goyal, 2009), and positively related to users' attitude toward mobile web browsing services (Yun *et al.*, 2011). Multi-functionality of mobile devices has also demonstrated its significance in increasing users' perception of observability and the relative advantage of smart products (Rijsdijk and Hultink, 2009), and significantly relating to overall evaluation of mobile technology (Gebauer *et al.*, 2008). In this study we hypothesised that:

H3. The physical appearance of a mobile device will positively influence users' overall perception of system quality.

H4. The multi-functionality of a mobile device will positively influence users' overall perception of system quality.

Interface design is an important issue constantly addressed by IS researchers (Lee and Benbasat, 2004; Venkatesh and Ramesh, 2006). Specifically, design aesthetics refers to "the balance, emotional appeal, or aesthetic of a website" (Cyr *et al.*, 2006, p. 951) and is a construct frequently adopted to measure website design (Cyr, 2008; Li and Yeh, 2010). Elements of design aesthetics include colours, shapes, font type and layout. With the rise and spread of mobile commerce, some researchers started to investigate the impact of design aesthetics in the mobile setting (Cyr *et al.*, 2006; Li and Yeh, 2010). In the current study design aesthetics capture the design features of a mobile customer reviews application. Well-designed mobile applications will undoubtedly improve the usability and overall performance of the system. Therefore:

H5. The design aesthetics of a mobile application will positively influence users' overall perception of system quality.

Perceived usefulness as a general perceptual measure of the net benefits of IS use has been regarded as the outcome of system quality in the literature (Seddon, 1997). Recent works in mobile commerce also validated the relationship between system quality and perceived usefulness. For example, Cheong and Park (2005) have found that system quality significantly determines the perceived usefulness of mobile internet. A recent study by Zhou (2011) also reported a similar result regarding mobile website adoption. Taken together, the aforementioned findings lead to the following hypothesis:

H6. Users' overall perception of system quality will positively influence system usefulness.

Information quality and information usefulness

The ubiquity of mobile commerce enables consumers to access information at the point-of-need, regardless of where they are and what they are doing. More importantly, specific and pinpointed information can be transferred to potential consumers based on the spatial, temporal, and personal context in which the user accesses a mobile service. Such characteristics are often referred as "situation dependency" (Figge, 2004) or "contextual offer" (Lee, 2005, pp. 170-71) in the literature. Figge (2004) first introduced situation dependency as a new concept in mobile commerce, and modelled it as a three-dimensional space involving access position, access time, and user identity. Based on this space contextual offers can be directly sent to potential consumers. Contextual offers in mobile commerce refer to "the extent to which marketers provide consumers with optimal information or service that is contextually relevant to them based upon customer profile and position, time information" (Lee, 2005). In the current study we use localisation, immediacy and customisation to reflect the three aspects previously mentioned.

Localisation refers to users' perceptions that the information is specific to their current location. Immediacy represents users' perceptions of the degree to which the information is updated in real-time and time-sensitive. Customisation means users' perceptions of how well the information is customised based on their real identity and profile. Specifically, location-based information can be offered to the users to meet their needs for localised content, while immediate information is closely related to the "anytime" feature of mobile commerce, and ensures the real-time provision of the information (Tiwari *et al.*, 2006). Moreover, customised information, i.e. tailored to individuals, will allow users to quickly get the information they want. Based on the previous discussion, we hypothesise that localisation, immediacy and customisation of the information obtained from a mobile customer reviews application would enhance users' overall evaluation of information quality:

H7. The localisation of the information obtained from a mobile customer reviews application will positively influence users' overall perceptions of information quality.

H8. The immediacy of the information obtained from a mobile customer reviews application will positively influence users' overall perceptions of information quality.

H9. The customisation of the information obtained from a mobile customer reviews application will positively influence users' overall perceptions of information quality.

In the original information adoption model, information quality represents the central influence that affects people's attitudes and behaviours (Sussman and Siegal, 2003). The central influence captures the nature of argument in the information and the recipients are influenced by carefully analysing the information content (Cheung *et al.*, 2008). When customers perceive that the received information meets their needs and requirements, they will be more likely to perceive the information as useful. In this regard users' perceptions of information usefulness can be largely explained by the informational influence. Therefore:

H10. Users' overall perceptions of information quality will positively influence information usefulness.

Mobile application usage intention and mobile word-of-mouth adoption

The relationship between perceived usefulness and adoption intention has been firmly established in IS theories. When considering information and systems together, it is useful to regard the information as the output from a particular system and the system as the information processing system that produces information (Nelson *et al.*, 2005). In this regard prior studies demonstrated that crossover effects might exist between system and information factors (Nelson *et al.*, 2005; Wixom and Todd, 2005). Based on this consideration the study includes the crossover relationships from system/information usefulness to intention to adopt system/information:

H11. Users' perceptions of system usefulness will positively influence intention to use a mobile customer reviews application.

H12. Users' perceptions of system usefulness will positively influence mobile word-of-mouth adoption.

H13. Users' perceptions of information usefulness will positively influence intention to use a mobile customer reviews application.

H14. Users' perceptions of information usefulness will positively influence mobile word-of-mouth adoption.

Research methodology

This study represents an attempt to investigate the factors affecting participation in mobile word-of-mouth communication. A number of research hypotheses have been proposed and need to be empirically tested. As such, a quantitative survey research strategy appears appropriate in conducting this study. Details about data collection methods, measures and demographic characteristics will be reported in the following sections.

Data collection methods

Survey data were collected at the mobile Dianping.com application. Initiated in 2003 Dianping.com is an online restaurant ratings and group-buying site. As an extension of its local information service to mobile platforms, Dianping.com launched a mobile internet service in 2008. Today Dianping.com is one of the most popular sites for public consumption in China. In September 2011 Dianping.com had more than 42 million active users and approximately 20 million reviews, which cover 1.2 million member merchants across 2,300 Chinese cities (additional information is available at: www.dianping.com/aboutus/intro). The target respondents of this study were consumers who have used mobile Dianping.com to obtain peer recommendations regarding local vendors. A web-based online survey was used and invitation messages containing the online questionnaire URL were distributed among potential respondents. We reached the potential respondents in two ways. First, we sent invitation messages to registered users of Dianping.com through the message systems provided by the website. Second, we compiled an email list of the hundreds of Dianping.com users who have participated in one of our previous studies. An invitation email describing the objective of this study and a link directed to the online questionnaire was sent to them. Finally, a total of 218 valid responses were received.

Measures

All the constructs in this study were measured using multi-item scales adapted from rigorously validated measures in prior studies (as shown in the Appendix). Minor changes were made to the wording were made in order to fit the specific investigation context of mobile Dianping.com. We adapted items of network speed, network stability and physical appearance from Yun *et al.* (2011), items of multi-functionality from Rijsdijk and Hultink (2009), items of design aesthetics from Cyr *et al.* (2006), items of system quality and information quality from Nelson *et al.* (2005), items of system usefulness from Wu and Wang (2006), items of localisation and immediacy from Lee and Benbasat (2004), Lee (2005) and Mahatanankoon *et al.* (2005), items of customisation from Li and Yeh (2010) and Lee (2005), items of information usefulness from Cheung *et al.* (2008), items of mobile word-of-mouth adoption from Sussman and Siegal (2003), and items of intention to use a mobile reviews application from Kim and Han (2009). In addition, measurements for all the constructs were given seven-point Likert scales, from 1 = strongly disagree to 7 = strongly agree.

Demographic characteristics

Among the respondents the gender ratio was 54.13 per cent male and 45.87 per cent female, with 79.82 per cent of the respondents having attained an education level of undergraduate or above. A large majority of them (71.10 per cent) were aged between 20 and 30. In terms of their experience with the internet and mobile Dianping.com, around 93.12 per cent of the respondents had used the internet for more than five years and 41.74 per cent of the respondents had used mobile Dianping.com for more than six months. Generally, nearly 90 per cent of the respondents used mobile Dianping.com at least once a week, and 51.8 per cent of them stayed on the mobile application for 6 to 15 minutes each time they visited.

Results

PLS-Graph version 3.00 was used to validate the integrity of the proposed research model and the significance of our hypotheses. The Partial Least Squares procedure (Wold, 1989) is a second-generation multivariate technique that can assess the measurement model and the structural model simultaneously in one operation. Following the two-step analytical procedures (Hair *et al.*, 1998) we first examine the measurement model and then the structural model.

Measurement model

Convergent validity indicates the extent to which the measures of a construct that are theoretically related are also related in reality. It can be demonstrated if the items' factor loadings are greater than 0.70, the values of composite reliability are greater than 0.70 and the values of average variance extracted are more than 0.50 (Fornell and Larcker, 1981). Table I summarises the item loadings, the associated *t*-value, composite reliability (CR) and average variance extracted (AVE) of the measures. All the items load significantly on their anticipated constructs and all the measures exceed the recommended thresholds, with the CR ranging from 0.906 to 0.946 and the AVE ranging from 0.775 to 0.891.

Discriminant validity indicates the extent to which a given latent variable is different from other latent variables. Evidence of satisfactory discriminant validity of

Construct	Item	Loading	*t*-value	Mean	SD
Network speed	NSP1	0.94	74.37	5.10	1.26
CR = 0.934; AVE = 0.877	NSP2	0.94	60.54	5.32	1.13
Network stability	NST1	0.95	93.55	5.11	1.23
CR = 0.943; AVE = 0.891	NST2	0.94	55.86	5.04	1.33
Physical appearance	PA1	0.92	83.71	5.15	1.23
CR = 0.939; AVE = 0.838	PA2	0.92	67.68	5.22	1.11
	PA3	0.91	51.13	5.23	1.17
Multi-functionality	MF1	0.90	55.94	5.62	1.06
CR = 0.938; AVE = 0.834	MF2	0.92	60.73	5.50	1.17
	MF3	0.91	52.77	5.47	1.22
Design aesthetics	DA1	0.91	55.03	5.33	1.07
CR = 0.933; AVE = 0.822	DA2	0.91	53.99	5.25	1.06
	DA3	0.90	68.42	5.32	1.07
System quality	SQ1	0.93	5.40	5.36	1.04
CR = 0.936; AVE = 0.879	SQ2	0.94	31.70	5.33	0.95
System usefulness	SU1	0.91	57.21	5.42	0.98
CR = 0.906; AVE = 0.829	SU2	0.91	83.10	5.33	1.06
Localisation	LO1	0.89	59.74	5.27	1.10
CR = 0.921; AVE = 0.796	LO2	0.88	46.53	5.31	1.02
	LO3	0.90	55.32	5.27	1.01
Immediacy	IM1	0.93	91.41	5.42	1.07
CR = 0.946; AVE = 0.855	IM2	0.93	89.56	5.39	1.12
	IM3	0.91	73.09	5.39	1.08
Customisation	CU1	0.86	43.53	5.42	1.07
CR = 0.912; AVE = 0.775	CU2	0.89	50.74	5.29	1.06
	CU3	0.89	47.01	5.26	1.11
Information quality	IQ1	0.95	41.11	5.49	1.00
CR = 0.942; AVE = 0.891	IQ2	0.94	6.68	5.44	1.01
Information usefulness	IU1	0.93	17.52	5.59	0.94
CR = 0.930; AVE = 0.869	IU2	0.93	4.50	5.57	1.04
Intention to use mobile application	INTU1	0.89	54.94	5.54	1.18
	INTU2	0.93	7.03	5.66	1.07
CR = 0.940; AVE = 0.839	INTU3	0.92	70.20	5.66	1.06
Mobile word-of-mouth adoption	MWA1	0.89	57.31	5.15	1.14
	MWA2	0.92	91.58	5.27	1.01
CR = 0.925; AVE = 0.804	MWA3	0.89	39.53	5.42	1.09

Table I.
Psychometric properties of measures

the measurement can be demonstrated if the square root of the average variance extracted for each construct is greater than the correlations between that construct and all other constructs (Fornell and Larcker, 1981). Table II presents the correlation matrix of the constructs and the square root of the average variance extracted for each construct (in italics on the diagonal). The results demonstrate satisfactory discriminant validity of the measurements.

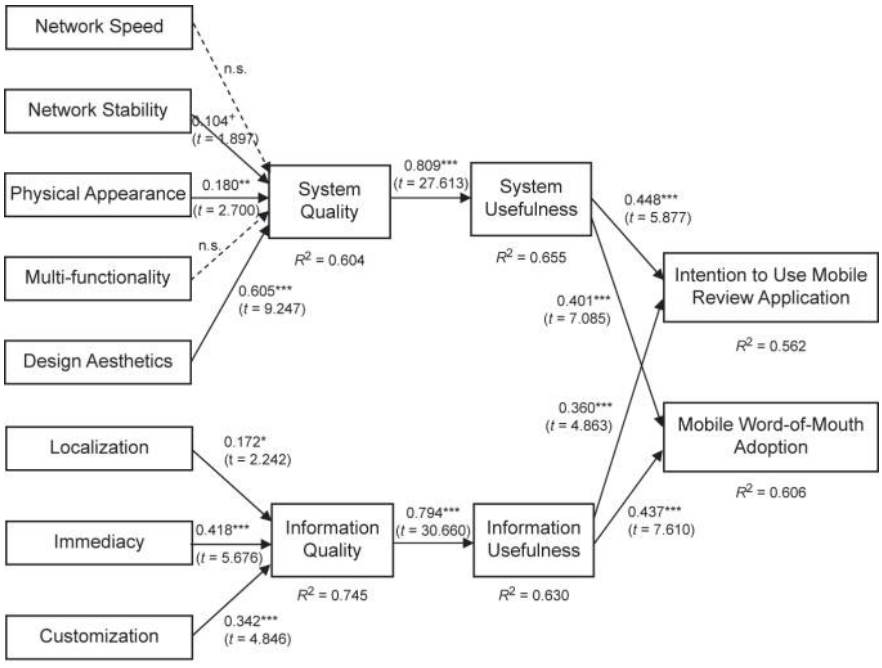
Structural model

The results of the analysis are depicted in Figure 2, which presents the overall explanatory power, the estimated path coefficients (all significant paths are indicated with asterisks) and the associated *t*-value of the paths. Tests of significance of all paths were performed using the bootstrap re-sampling procedure.

	NSP	NST	PA	MF	DA	SQ	SU	LO	IM	CU	IQ	IU	INTU	MWA
NSP	*0.94*													
NST	0.72	*0.94*												
PA	0.63	0.50	*0.92*											
MF	0.59	0.42	0.72	*0.91*										
DA	0.52	0.51	0.62	0.60	*0.91*									
SQ	0.44	0.46	0.59	0.55	0.76	*0.94*								
SU	0.47	0.41	0.65	0.65	0.75	0.81	*0.91*							
LO	0.55	0.51	0.62	0.64	0.70	0.67	0.75	*0.89*						
IM	0.61	0.56	0.68	0.64	0.73	0.69	0.73	0.78	*0.92*					
CU	0.54	0.54	0.68	0.67	0.78	0.73	0.79	0.80	0.76	*0.88*				
IQ	0.51	0.50	0.69	0.62	0.72	0.69	0.75	0.77	0.81	0.80	*0.94*			
IU	0.52	0.51	0.66	0.62	0.68	0.67	0.72	0.70	0.80	0.70	0.79	*0.93*		
INTU	0.50	0.40	0.66	0.65	0.72	0.66	0.71	0.64	0.70	0.67	0.66	0.68	*0.92*	
WMA	0.52	0.43	0.72	0.65	0.70	0.67	0.72	0.73	0.74	0.74	0.73	0.73	0.73	*0.90*

Notes: Network speed = NSP; Network stability = NST; Physical appearance = PA; Multi-functionality = MF; Design aesthetics = DA; System quality = SQ; System usefulness = SU; Localisation = LO; Immediacy = IM; Customisation = CU; Information quality = IQ; Information usefulness = IU; Intention to use mobile application = INTU; Mobile word-of-mouth adoption = MWA

Table II.
Correlation matrix of the constructs



Notes: $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$; n.s.-not significant at the 0.1 level

Figure 2.
Results of the research model

The results illustrate that the exogenous variables explain 56.2 per cent of the variance in intention to use a mobile customer reviews application, 60.6 per cent of the variance in mobile word-of-mouth adoption, 63 per cent of the variance in information usefulness, 60.4 per cent of the variance in system quality, 65.5 per cent of the variance in system usefulness, and 74.5 per cent of the variance in information quality. All of the structural paths were statistically significant except for the paths from network speed and multi-functionality to system quality (*H1* and *H4* thus were not supported). The results also demonstrate that design aesthetics had the biggest impact on system quality, with a path coefficient of 0.605 (*H5* was supported), followed by physical appearance and network stability, with path coefficients of 0.180 and 0.104 respectively (*H2* and *H3* were supported). System quality had a significant effect on system usefulness, with a path coefficient of 0.809 (*H6* was supported). Localisation, immediacy and customisation of information have been found to exert significant positive impacts on information quality, with path coefficients of 0.172, 0.418 and 0.342 respectively (*H7-H9* were supported). In addition information quality had a statistically significant effect on information usefulness, with a path coefficient of 0.794 (*H10* was supported). Finally, system usefulness and information usefulness exhibited strong direct effects on intention to use a mobile customer reviews application and mobile word-of-mouth adoption (*H11-H14* were supported).

Discussion and conclusion

Mobile word-of-mouth marketing has already shown its significance in terms of driving business growth and effectiveness. However, empirical investigation of this subject is rare in the literature. This study thus represents an attempt to understand the motivations behind people's decisions to engage in such communication. In particular, we interpret this phenomenon from the mobile word-of-mouth recipient's perspective, and examine the factors determining users' adoption of a mobile review application and mobile word-of-mouth. In the following sections we will discuss the key findings, and then address the limitations of this study, followed by a discussion of the implications for both research and practice.

Discussion of key findings

In this study we proposed an integrated model to examine the roles of system and information characteristics in predicting users' engagement in mobile word-of-mouth communication. Network stability, physical appearance of mobile devices and design aesthetics of mobile applications have been proven as the three most important antecedents of users' overall perception of system quality. This finding parallels those from prior studies, demonstrating that system quality is dependent on the overall integrity of technical architecture, including network service, mobile terminals, and user applications and interfaces (Lee *et al.*, 2009). However, network speed and multi-functionality were not statistically significant in determining system quality. This may be due to users' low expectations of network speed in a relatively immature mobile market (Yun *et al.*, 2011). In addition, the benefits of multi-functionality in mobile devices are actually limited (Rijsdijk and Hultink, 2009), and the cognitive constraint caused by a lack of physical controls on mobile devices' multiple functions (Matei *et al.*, 2010). Similar to the findings from previous studies integrating the IS

success model with the technology acceptance model (e.g. Zhou, 2011), system quality significantly predicts users' overall perceptions of system usefulness.

Another important finding from this study concerns the significance of localisation, immediacy and customisation in determining users' overall perceptions of information quality. In particular, the three contextually relevant factors capture the distinctive characteristics of mobile customer reviews. Consistent with prior research demonstrating that marketers should offer optimal information based on customers' spatial, temporal, and personal contexts (Figge, 2004; Lee, 2005), the findings confirmed the importance of the three dimensions in developing users' positive perceptions towards the quality of the information obtained with mobile devices. Moreover, our findings confirmed the relationship between information quality and information usefulness, which was originally proposed in the information adoption model (Sussman and Siegal, 2003).

Our findings also demonstrated the crossover effects between system and information factors, which did respond to the call by Nelson *et al.* (2005) for greater attention on this issue. Both system usefulness and information usefulness have exerted significant impacts on users' intentions to adopt a mobile reviews application (system adoption) and mobile word-of-mouth (information adoption). However, system usefulness had a stronger effect on intention to use a mobile reviews application, whereas information usefulness had more effect on intention to adopt mobile customer recommendations.

Limitations of this study

Before highlighting the implications for research and practice, this section lists the limitations of this study that could be addressed in future research. First of all, this study was conducted in mainland China, where the mobile services market continues to expand but is still immature. Thus, the generalisation of our findings to other economic contexts should be made with great caution. Second, we used a web-based online survey for data collection. Prior studies have questioned the appropriateness of web-based surveys in conducting mobile research (Okazaki, 2005). In this regard the distribution of questionnaires via mobile devices is strongly recommended. Third, actual usage and information adoption behaviour were not examined in the current study. A longitudinal study is strongly recommended in future research to determine the effects of intention on actual behaviour. Finally, due to the scope and size of this study, some other important factors may have been neglected. For example, information credibility is a frequently cited factor in examining information quality and word-of-mouth communication (Cheung *et al.*, 2008). In this study we have not included these dimensions of information quality, which are relevant in a more general context, because we focused on information characteristics unique to ubiquitous computing systems. In addition, product type may be a concern. The moderating effect of product type has been demonstrated in prior word-of-mouth studies (e.g. Wright and Lynch, 1995). We acknowledge that it deserves closer attention, but the focus of this study is placed on the system and information dichotomy in the ubiquitous environment. Thus, we leave this task for future research.

Theoretical implications

This study contributes to the existing literature in several important ways. First, this study is one of the first attempts to empirically investigate mobile word-of-mouth, and

develops an integrated model, which explained 56.2 per cent of the variance in intention to use a mobile reviews application and 60.6 per cent of the variance in mobile word-of-mouth adoption. The findings have shown the robustness of our model and the effectiveness of an integrated method in mobile research. We have chosen a single mobile application for investigation, which reduces the bias effects of criteria for different mobile reviews platforms. However, we suggest future research re-examines the model in other mobile contexts to determine whether it can be modified or improved.

Second, this study identifies some system and information characteristics that are unique to mobile commerce. Specifically, network stability, physical appearance and design aesthetics were proven to be the key determinants of users' overall perceptions of system quality, while users' overall perceptions of information quality are predicted by three dimensions of information characteristics: localisation, immediacy and customisation. Both system and information characteristics were identified based on the unique features of the ubiquitous computing environment, and thus can be easily adopted and used for future mobile commerce research.

Third, this study extends current understanding of system quality/usefulness from a single system to a system combination, including a wireless network, mobile device and mobile application. As noted in prior studies the mobile system environment includes multiple vendors such as network service providers, mobile device manufacturers, and content service providers, and as a result, the system quality dimension should be further separated and divided (Lee *et al.*, 2009; Yun *et al.*, 2011). Users' overall perceptions of system quality are thus largely determined by a seamless integration of different service providers.

Last, but not least, the crossover effects found in this study also shed light on our further understanding of the complex and ambiguous relationship between system and information that was highlighted in some prior studies (e.g. Nelson *et al.*, 2005). Additional research could be conducted to validate the findings of this study and further explore this interesting issue.

Practical implications

The rapid proliferation of mobile phones and other mobile devices has created a new channel for marketing in the ubiquitous environment. Although the findings of this study bring some useful implications for researchers, several practical implications can also be drawn for practitioners.

First of all, this study shed some light on the possibility of increasing system quality in the ubiquitous era. In order to improve users' overall perceptions of system quality, it is thus necessary to strengthen the co-operation and collaboration among multiple vendors, i.e. wireless telecommunication, hardware manufacturers and content service providers. In addition, stability of mobile networks, physical appearance (i.e. screen size, input functions, etc.) of mobile devices and design aesthetics (i.e. colour, layout, etc.) of mobile applications are especially valued by mobile users. Mobile device producers could also consider introducing their products into the market with a moderate increase in multi-functionality, which would enhance users' perceptions of complexity and risk (Rijsdijk and Hultink, 2009).

Another implication for practitioners is the need to provide customers with optimal contextually-relevant information. According to the findings of this study content

service providers should offer mobile users location-based, immediate and customised information in order to meet their actual demands and specific needs. The contextually relevant information not only offers users the necessary details for effective decision-making at the point of need, but also promotes so-called "point of purchase" (Lee, 2005). Therefore, practitioners should exploit the full potential of mobile marketing by providing location- and time-sensitive, as well as situation- or event-related information to targeted potential consumers.

The findings of this study also have considerable practical implications regarding how to accelerate consumers' adoption of mobile applications and mobile word-of-mouth. Although both system usefulness and information usefulness exerted statistically significant effects on users' adoption of the system and information, the strengths of the effects are different. System usefulness had a stronger effect on users' intentions to accept the mobile reviews application, whereas information usefulness had more effect on mobile word-of-mouth adoption. Therefore, mobile service providers could choose different strategies based on the ends they seek to attain first, either promoting system usage or encouraging mobile word-of-mouth adoption.

Conclusion

In summary, this study provides several valuable insights in understanding the effects of system and information characteristics in ubiquitous decision making. With the proliferation of mobile devices such as the iPhone and iPad, mobile word-of-mouth has shown its value for business growth. In this regard a deeper understanding of consumers' motivations behind their decisions to engage in mobile word-of-mouth communication is useful, and even necessary. System and information factors specific to the ubiquitous environment have been identified and empirically examined in this study. Future research could continue to enrich this line of research by considering the impacts of system/information characteristics on mobile word-of-mouth effectiveness from both recipient and sender perspectives.

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Appendix. Constructs and measurement items

Network speed

NSP1: I feel the wireless network is fast.

NSP2: The speed of the wireless network is convenient.

Network stability

NST1: The wireless network is stable.

NST2: The wireless network always provides stable connections.

Physical appearance

PA1: The input function of my mobile device is convenient for using mobile Dianping.com

PA2: The resolution of my mobile device is high enough to use mobile Dianping.com

PA3: The screen size of my mobile device presents no difficulty in using mobile Dianping.com

Multi-functionality

MF1: My mobile device has multiple functions.

MF2: My mobile device can perform multiple tasks.

MF3: My mobile device fulfils multiple functional needs.

Design aesthetics

DA1: The screen design (i.e. colours, boxes, menus, etc.) of mobile Dianping.com is attractive.

DA2: Mobile Dianping.com looks professionally designed.

DA3: The overall look and feel of mobile Dianping.com is visually appealing.

System quality

SQ1: In terms of system quality I would rate the whole system (i.e. wireless network, mobile device and mobile Dianping.com) highly.

SQ2: Overall the whole system (i.e. wireless network, mobile device and mobile Dianping.com) is of high quality.

System usefulness

SU1: The whole system (i.e. wireless network, mobile device and mobile Dianping.com) helps me effectively find local business vendors suited to me.

SU2: The whole system (i.e. wireless network, mobile device and mobile Dianping.com) enables me to find local business vendors more efficiently.

Localisation

LO1: Mobile Dianping.com provides me with information and services based on my location.

LO2: Mobile Dianping.com provides me with location-specific packets of information.

LO3: I can receive location-sensitive information from mobile Dianping.com

Immediacy

IM1: Mobile Dianping.com provides me with real-time information and services.

IM2: Mobile Dianping.com offers timely packets of information to me.

IM3: I can receive time-sensitive information from mobile Dianping.com

Customisation

CU1: I feel that my personal needs have been met when using mobile Dianping.com

CU2: Mobile Dianping.com provides me with information according to my preferences.

CU3: The information that mobile Dianping.com sends to me is tailored to my situation.

Information quality

IQ1: Mobile Dianping.com provides me with high-quality information.

IQ2: I would give the information from mobile Dianping.com high marks.

Information usefulness

IU1: The information from mobile Dianping.com is valuable.

IU2: The information from mobile Dianping.com is helpful.

Intention to use mobile review application

INTU1: I intend to use mobile Dianping.com in the future.

INTU2: I expect that I would use mobile Dianping.com in the future.

INTU3: I plan to use mobile Dianping.com in the future.

Mobile word-of-mouth adoption

MWA1: I agree with the information recommended on mobile Dianping.com

MWA2: I closely followed the information from mobile Dianping.com

MWA3: The information from mobile Dianping.com would motivate me to take action.

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