Introduction to the Special Issue: Mobile Commerce Applications

Ting-Peng Liang and Chih-Ping Wei

ABSTRACT: With the rapid proliferation of mobile devices, including mobile phones, PDAs, and handheld computers, mobile commerce is widely considered to be a driving force for next-generation e-commerce. Many attempted m-commerce applications have failed to meet expectations, however, with the notable exceptions of I-Mode in Japan and the explosive growth of Short Messaging Service in China. It is important to understand why promising technologies fail and what factors contribute to their failure. This paper proposes a fit-viability framework for assessing the likely success or failure of m-commerce applications. For fit, criteria for measurement are identified based on task-technology fit theory. For viability, financial and managerial criteria are identified. The papers in this Special Issue address factors related to the framework, and m-commerce applications in procurement and travel agencies, to demonstrate its value.

KEY WORDS AND PHRASES: Application framework, electronic commerce, fit-viability framework, mobile commerce, task-technology fit.

The rapid proliferation of wireless devices, including mobile phones, personal digital assistants (PDAs), and other handheld devices, has made mobile commerce (also called *m-commerce*) a major driving force for the next wave of electronic commerce (e-commerce). Although there is as yet no standard definition, the term "m-commerce" generally refers to the use of wireless devices (particularly mobile phones) to conduct electronic business transactions, such as product ordering, fund transfers, and stock trading [2, 9]. (A more philosophical definition of mobile business is provided by Mylonopoulos and Doukidis [12].) Its applications vary from personal e-payment services and intra-business operations to inter-business supply-chain integration [2, 9, 20].

The power of m-commerce is primarily due to the anytime-anywhere connectivity of wireless devices, which provides enormous opportunities for business process innovation and location-sensitive services [29]. Many believe that m-commerce is going to substantially extend current operations in e-commerce. Unfortunately, many attempts in m-commerce have so far failed to meet expectations. Especially disappointing was the failure of WAP (Wireless Application Protocol) as a platform for Web access from wireless devices. This failure has significantly slowed down the linkage between m-commerce and Internet-based e-commerce.

Nonetheless, there have also been a few very successful personal applications, such as ring tone downloads in DoCoMo's I-Mode, the Octopus card for e-payment in Hong Kong, and the turnaround of portals in China by integrating Short Messaging Services (SMS) into traditional portal services. Location-based business applications, such as targeted advertising and the use of GPS (Global Positioning System) to route trucks and monitor systems, are gaining popularity. Time-critical applications such as stock quotes and trading are also increasing. Radio Frequency Identification (RFID) technology

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is revolutionizing the collection of product data. Therefore, it is not technology per se, but the proper use of technology, that decides the success or failure of an application. The challenge when applying mobile technology to support business transactions is to determine whether a particular application is suitable for m-commerce. Or, more specifically, what are the major factors that affect the outcome of m-commerce applications? What criteria can be used to assess the suitability of m-commerce applications?

Types of Mobile Commerce Applications

In general, m-commerce applications have two major attributes: mobility and reachability. These attributes, in turn, can be classified into the following six categories:

Time-Critical Services

This category of application exploits the *reachability* property of mobile users for providing emergency and time-critical services [16]. For example, SMS-based notifications or alerts (e.g., airline flight schedule changes, stock price alerts and quotations, home burglar alarms) provide time-critical value to users [15, 27]. On the other hand, real-time wireless communications between permanent command centers, field command posts, and field resources (e.g., field crews, helicopters, and other mobile equipment) are a necessity for emergency management and coordination [6].

Location-Aware and Location-Sensitive Services

The ability to identify the location of a mobile user or a moving target at a particular moment also creates significant value for mobile services [1, 16]. If the necessary location information is available, *location-aware* or *location-sensitive* services can be provided. Here, a location-aware service is one for which the location information of moving targets is important to the delivery of the service. For example, mobile allocation devices can be used to track trucks, stolen cars, psychiatric patients, children, or other moving targets [21, 27]. The PDA-linked package-tracking and locator service used by United Parcel Service is an example of a location-aware service [15]. Location-sensitive services rely on the location information about moving targets for delivering "relevant" and "appropriate" services. For example, the MapInfo® (www.mapinfo.com) location-management platform enhances a carrier's 911 service by automatically routing 911 calls from mobile phones to an appropriate public safety answering point for emergency handling and dispatch [8, 22, 27]. Travelers can be assisted by location-sensitive services such as road condition reporting, driving direction assistance, and local tour guides [15]. Location-sensitive services can also help mobile users locate nearby restaurants and shops carrying products with certain specifications [17, 22]. The ability to identify the location of

mobile users can make the delivery of location-sensitive advertisements more effective [22, 25].

Identity-Enacted Services

Mobile devices can also be used to identify users. Examples of identity-enacted services include mobile financial applications (e.g., mobile banking and brokerage services, mobile money transfer, mobile micro-payments) that allow customers to conduct financial transactions [23, 24, 25]. Nordea Bank in Finland worked in association with Nokia and Visa International to create a dual-chip concept that consists of a plug-in-size smart card issued by a bank and a GSM SIM card. With this technology, customers can use the smart card inside the mobile phone to pay their bills [13]. User-sensitive mobile advertising is another interesting identity-enacted service. The use of demographic information collected by wireless service providers and of the purchasing histories of mobile users increases the feasibility of user-sensitive advertising (i.e., advertisements tailored to the preferences or needs of a particular mobile user) [22, 23, 24, 25].

Ubiquitous Communications and Content Delivery Services

Mobile communications facilitate personal contact anytime, anywhere. While voice and short messages are currently the primary form of mobile communication, future mobile devices such as 3G phones are capable of handling much more information and providing broader bandwidth. As a result, ubiquitous communications and content delivery can become an important component in m-commerce. These services may include mobile marketing and advertising, portable entertainment services (e.g., video-on-demand, audio-on-demand, interactive games), mobile distance education, and mobile news delivery services (e.g., the CNN Wireless news subscription service) [10, 15, 23, 24, 25].

Business Process Streamlining

Mobile services can also be used to enhance the efficiency of business processes that include location-sensitive or time-critical activities to reduce transaction costs or improve service quality. An interesting scenario was discussed by Varshney and Vetter [25]. Claim payment by insurance companies often takes a long time and is very inefficient, but the process can be streamlined with the proper use of mobile devices. For example, a claims adjuster meets with the customer and uses mobile devices to upload damage pictures or other case-related digitizable evidence to the central database. Once approval is obtained, the adjuster can download customer profile and coverage information from the company's database and print a pay check from a printer attached to the mobile device. In this scenario, the claim payment process is streamlined, allowing on-the-spot claim adjustment and payment.

Mobile Offices

Mobile devices may be used in offices. With the help of mobile devices, the productivity of office workers can be improved. Mobile workers (i.e., workers equipped with mobile applications) are able to retrieve critical information from the central office system, perform job assignment, scheduling, and dispatch, and collaborate with others (mobile or not) in a wireless environment [23, 24, 25, 27]. For example, more than 100 public safety agencies, including police departments in Florida and Michigan, are using the Xplore system (a mobile device larger than a standard PDA) to access federal and state databases and to file reports [7].

The Fit-Viability Framework

Although there are many potential applications for m-commerce, implementing them successfully is a challenge. Many factors may affect the success or failure of m-commerce applications. For example, the success of I-Mode can be attributed to the special commuting pattern in Tokyo, where people have to spend a long time on commuter trains every day. Digital content offered through mobile phones is valuable to bored passengers. The success of the Octopus card in Hong Kong is attributed to the large population of Mass Transit Railway (MTR) users (millions of people take MTR every day). The contactless smart card was used as an MTR pass to begin with and has now been expanded to other uses, such as a payment tool at vending machines, convenience stores, and even copy machines in the library.

The turnaround story of Internet portals in China is an example of the successful integration of m-commerce with traditional e-commerce. Netease, Sina, and Sohu are the top three portals for Internet access in China. They were losing money and had been threatened with removal from Nasdaq when they mimicked Yahoo's business model to seek their fortunes. Their stock prices plummeted to pennies in 2001. The successful introduction of SMS into their services, however, brought about a dramatic turnaround. Revenues skyrocketed, and profits were soon in the black. The net income of Netease has changed from a loss of $20 million in 2000 to a profit of $27 million for the first three quarters of 2003. Its stock prices rose from less than $1 per share to almost $70 in October 2003.

Unfortunately, the models cited above are unique. I-Mode has never been successful outside Japan. The Netease model cannot be duplicated even in culturally similar regions such as Taiwan or Hong Kong. These cases strongly indicate that the success of m-commerce depends not only on the capability of wireless technology, but on how the technology is used.

In other words, it is necessary to identify the factors that affect the success of m-commerce applications and to develop guidelines for assessing the potential of particular applications. The framework must address task requirements, technology, and the environment in which the technology is applied. A two-dimensional matrix that uses *fit* and *viability* to evaluate Internet investment portfolios can be modified to serve this purpose. Tjan proposed

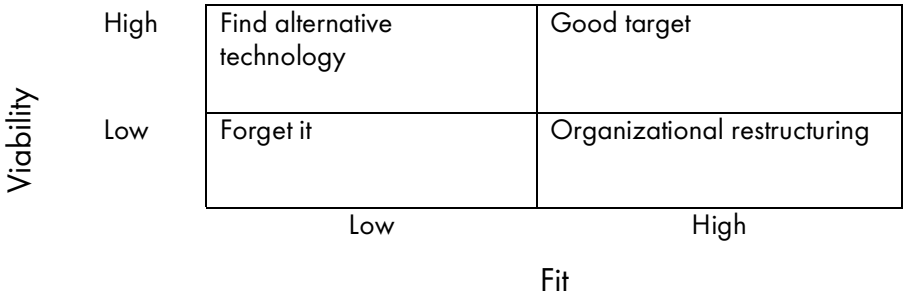

Figure 1. The Fit-Viability Framework

the use of these two dimensions in evaluating Internet initiatives and suggested that the investment focus on the high fit and high viability category [18]. With a similar ideology, these two dimensions can be adapted to build a framework for m-commerce applications: *fit* measures the extent to which the capabilities of mobile technology meet the requirement of the task, and *viability* measures the extent to which the environment or organization is ready for the application. Using I-Mode as an example, there is a good fit between mobile technology and the task of downloading music because music is a digitizable product. The viability is high in Tokyo but low in the United States. Therefore, I-Mode has a strong likelihood of success in Japan but may not be as successful in the United States.

For m-commerce, applications can be divided into four categories, as shown in Figure 1. The target applications should be the ones that have a good fit between task and technology, and strong viability within the organization. For applications with good fit but poor organizational viability, the manager may examine whether organizational restructuring would help enhance the viability before implementation. For low-fit applications, the organization should find technology that is viable in the organization, rather than rush onto the bandwagon of m-commerce.

Task-Technology Fit

The first dimension in the framework is the fit between mobile technology and the task. In fact, the importance of task-technology fit for information system success has long been known. In 1995, Goodhue and Thompson reviewed earlier studies of the topic and proposed a framework for assessing performance [4, 5]. They argued that the fit between task characteristics and technology characteristics affected individual performance. Zigurs and Buckland applied the theory to explain the effectiveness of group support systems [28]. For mobile technology, the major characteristics are mobility and reachability [9, 20]. Turban and King dentify five value-added attributes [20]:

- *Ubiquity:* Available at any location at any time.
- *Convenience:* Convenient for users to operate.
- *Instant connectivity:* Easily connected to the target.

- *Personalization:* Allows for preparation of personalized information.
- *Localization:* Location-specific information and products.

These five attributes address three major criteria: location-sensitive, time-critical, and personal. If a task's requirements meet these criteria, its fit with mobile technology would be high. If the requirements do not meet these criteria, the fit is low. Therefore, the task-technology fit can be assessed by asking:

- Does the user need the product or service when on the move to different places?
- Will the value of the product or service decay substantially, or will the outcome will be disastrous, if users do not get the product or service on time?
- Is the product or service different for different users?

For each question, a scale from 1 to 10 can be used to assess its value.

Viability

Viability is another dimension that must be taken into consideration. A task that is suitable for one organization may not be appropriate for another. In other words, viability assesses the fit between a mobile application and its associated users. In order to assess the viability of a mobile application, one needs to consider the general economic environment and social infrastructure and the readiness of the organization. For example, using PDAs to support insurance agents is popular in many countries, but may be not so in China. This is not because the PDA does not fit the task, but because the behavior does not fit the social and cultural environment.

A viability assessment needs to include three aspects: *economic*, *organizational*, and *societal*. The economic assessment determines whether a particular application is cost-beneficial, which includes whether it reduces the user's transaction cost and whether it provides an acceptable return on investment. Transaction costs include monitoring and coordination costs in a business process. Major factors affecting transaction costs are transaction frequency, uncertainty, and asset specificity. Based on the transaction cost theory, therefore, the following questions can be asked:

- Is the target application a frequent business process?
- Does the transaction process involve high uncertainty?
- Is the current equipment and technological architecture adequate for supporting the application?
- Is the cost for using wireless services high or low?

The organizational aspect primarily focuses on the user's willingness and ability to use the technology. Questions in this category may include:

- How much time and effort are necessary for the user to learn the application?

- Does the application require a reallocation of resources?
- Does top management support the application?

The societal aspect covers the maturity of the general environment in which the application is implemented. This may include the penetration of mobile devices, culture, and other issues. The following questions are relevant:

- Is the popularity of the intended mobile devices high?
- Do people like to use the intended mobile device?
- Are there popular substitute services available?

The preceding ten questions constitute a guideline for assessing the viability of a mobile application. If the application is a good fit with the task and is highly viable in the organization or society, then it is likely to succeed.

Overview of the Special Issue

The four papers in this Special Issue cover user interface design and a range of mobile commerce applications, including e-procurement, mobile advertising, and travel services. They were chosen from the papers presented at the First Workshop on e-Business, held in December 2002 in Barcelona.

In the first paper, "Success Factors and Impacts of Mobile Business Applications: Results from a Mobile e-Procurement Study," Gebauer and Shaw propose a research framework that combines the theory of task/technology fit with the general notion of the organizational impact of information technology and results from an exploratory case study to assess the success factors and impacts of mobile technology in e-procurement [3]. They argue that the fit between the characteristics of technology and of the task affects the usage of mobile business applications. System usage will subsequently generate impacts on organizational operations and flexibility. Based on the framework, they address three major research issues: (1) the impact of mobile technology characteristics on system usage, (2) the impact of task characteristics on system usage, and (3) the impact of system usage on business processes.

Gebauer and Shaw conducted a case study on a Fortune 100 company that is currently developing and introducing a WAP-enabled mobile application to enhance its procurement system. Their empirical results suggest that poor technology characteristics, as perceived by potential users, inhibit system usage. Regarding the impact of task characteristics on system usage, their study finds that users value two things most: notification (especially in connection with high mobility) and support for simple activities (e.g., tracking), as opposed to handling more complex processes completely on-line. Moreover, system usage could have significant effects on operational efficiency as well as on organizational flexibility. Their study concludes with the observation that it is necessary to develop simple yet functional solutions. Mobile technology can complement existing applications and infrastructure by adding an ad hoc element for data processing, information access, communication, and notification.

Wang and Cheung investigate the factors affecting the adoption of e-business

and m-commerce by travel agents [26]. Drawing on the innovation adoption literature, institutional theory, strategic orientation theory, and upper-echelons theory, their paper, "E-Business Adoption by Travel Agencies: Prime Candidates for Mobile e-Business," proposes a multi-level explanatory model to investigate e-business adoption by travel agencies. The discussion considers environmental factors (including institutional pressure and competitive pressure), organizational factors (i.e., innovation orientation of a firm, financial slack, IT resources, perceived advantages of e-business), and managerial factors (specifically, CEO risk-taking propensity) as determinants of a firm's e-business adoption.

Findings from the study support some of the hypotheses derived from the proposed model. Specifically, all independent variables except institutional pressure are found to have significant positive correlations with the intention to adopt e-business and the implementation of e-business. The empirical result also indicates that e-business adoption is not a decision driven merely by technological readiness. Managers' perceptions of the environmental and organizational conditions as well as the CEO's risk-taking propensity also affect a firm's decision to adopt e-business. A questionnaire survey shows that most agents do not have immediate plans to implement m-commerce, even though the fit between task and technology is good. The fit-viability model explains that this is because the viability is low for the time being, even though the fit between task and technology is high.

In "Consumer Attitudes Toward Mobile Advertising: An Empirical Study," Tsang, Ho, and Liang report factors affecting consumer attitudes and usage behavior in respect to mobile advertising [19]. Earlier research on Internet advertising suggests that consumers generally have favorable attitudes toward Internet advertising. Mobile advertising shares many features with Internet advertising, but its unique characteristics, such as the personal, intimate nature of mobile devices, may result in different consumer attitudes toward mobile advertising.

Four main constructs are included in the attitude framework: entertainment, informativeness, irritation, and credibility. Two other factors included in the model are *permission* and *incentive*. Empirical results show that respondents were generally negative about receiving a mobile ad. This could be because the mobile ad is thought of as irritating, given the personal, intimate nature of mobile phones. However, the respondents had favorable attitudes if the ad was sent with their prior permission. This implies that permission-based advertising may be an important trend in the future.

"A Framework for the Study of Customer Interface Design for Mobile Commerce" by Lee and Benbasat proposes an extended framework for user interface design [11]. Lee and Benbasat emphasize that, because of the unique characteristics of the computing environment and device constraints in m-commerce applications, e-commerce interface design principles should not be directly applied to m-commerce interface design. They adapt and extend Rayport and Jaworski's 7C framework for the customer interface design of e-commerce applications by adding two M elements that are specific to m-commerce applications. The resulting guidelines suggest that the design must consider context, content, community, customization, communication,

connection, commerce, mobile setting, and mobile device constraints. The framework provides useful guidelines for user interface design for m-commerce.

Conclusion

It is widely believed that mobile commerce is a promising technology for driving the second wave of e-commerce. Many applications are under development or being incorporated into business processes. In order for an application to be successful, however, one needs to evaluate not only the fit between task and technology but also its organizational viability. The framework proposed here is useful for this purpose. For example, the failure to adopt the I-mode in Europe occurred because of its low viability outside a commuter-train environment. The four papers chosen for this Special Issue from the Workshop on e-Business 2002 are related to either the technical or managerial implications of m-commerce applications, and show the applicability of the fit-viability framework.

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REFERENCES

1. Clarke, I. Emerging value propositions for m-commerce. *Journal of Business Strategies, 18,* 2 (2001), 133–148.
2. Coyle, F.P. *Wireless Web: A Manager's Guide.* Boston: Addison-Wesley, 2001.
3. Gebauer, J., and Shaw, M.J. Success factors and impacts of mobile business applications: Results from a mobile e-procurement study. *International Journal of Electronic Commerce, 8,* 3 (2004), 19–42.
4. Goodhue, D.L. Understanding user evaluation of information systems. *Management Science, 41,* 12 (1995), 1827–1844.
5. Goodhue, D.L., and Thompson, R.L. Task-technology fit and individual performance. *MIS Quarterly, 19,* 2 (1995), 213–236.
6. Hargreaves, D.; Knight, T.; and Brownsword, P. MacDonald Dettwiler real-time emergency management via satellite: Status update and future directions. *ISPRS Journal of Photogrammetry and Remote Sensing, 57,* 4 (February 2003), 273–280.
7. Holloway, A.; Kirby, J.; and Wahl, A. Wireless that works. *Canadian Business, 18* (February 2002), 25–30.
8. Jones, J. Vendors walk thin line. *Info World, 22,* 50 (December 2000), 1–27.
9. Kalakota, R., and Robinson, M. *M-Business: The Race to Mobility.* New York: McGraw-Hill, 2002.

10. Kavassalis, P.; Spyropoulou, N.; Drossos, D.; Mitrokostas, E.; Gikas, G.; and Hatzistamatiou, A. Mobile permission marketing: Faming the market inquiry. *International Journal of Electronic Commerce, 8,* 1 (fall 2003), 55–79.
11. Lee, Y.E., and Benbasat, I. A framework for the study of customer interface design for mobile commerce. *International Journal of Electronic Commerce, 8,* 3 (spring 2004), 79–103.
12. Mylonopoulos, N.A., and Doukidis, G.I. Mobile business: Technological pluralism, social assimilation, and growth. *International Journal of Electronic Commerce, 8,* 1 (fall 2003), 5–22.
13. Nokia Mobile Phones. M-commerce tested in Finland. *Card Technology Today, 15,* 10 (October 2003), 4–5.
14. Roussos, G.; Peterson, D.; and Patel, U. Mobile identity management: An enacted view. *International Journal of Electronic Commerce, 8,* 1 (fall 2003), 81–100.
15. Senn, J. A. The emergence of m-commerce. *Computer, 33,* 12 (December 2000), 148–150.
16. Siau, K., and Shen, Z. Mobile communications and mobile services. *International Journal of Mobile Communications, 1,* 1/2 (2003), 3–14.
17. Tewari, G.; Youll, J.; and Maes, P. Personalized location-based brokering using an agent-based intermediary architecture. *Decision Support Systems, 34,* 2 (January 2003), 127–137.
18. Tjan, A.K. Finally, a way to put your Internet portfolio in order, *Harvard Business Review, 79,* 2 (February 2001), 76–85.
19. Tsang, M.L.; Ho, S.C.; and Liang, T.P. Consumer attitudes toward mobile advertising: An empirical study. *International Journal of Electronic Commerce, 8,* 3 (spring 2004), 65–79.
20. Turban, E., and King, D. *Introduction to E-Commerce.* Upper Saddle River, NJ: Prentice Hall, 2003.
21. Turban, E.; King, D.; Lee, J.; Warkentin, M.; and Chung, H.M. *Electronic Commerce: A Managerial Perspective.* Upper Saddle River, NJ: Prentice Hall, 2002.
22. Varshney, U. Location management support for mobile commerce applications. In *Proceedings of the 1st International Workshop on Mobile Commerce*. New York: ACM Press, 2001, pp. 1–6.
23. Varshney, U. Mobile and wireless information systems: Applications, networks, and research problems. *Communications of the Associations for Information Systems, 12* (2003), 155–166.
24. Varshney, U., and Vetter, R. A framework for the emerging mobile commerce applications. In R.H. Sprague Jr. (ed.), *Proceedings of the 34th Hawaii International Conference on System Sciences.* Los Alamitos, CA: IEEE Computer Society Press, 2001, pp. 3516–3525.
25. Varshney, U., and Vetter, R. Mobile commerce: Framework, applications and networking support. *Mobile Networks and Applications, 7,* 3 (June 2002), 185–198.
26. Wang, S., and Cheung, W. E-business among travel agencies: Prime candidates for mobile commerce. *International Journal of Electronic Commerce, 8,* 3 (spring 2004), 43–64.
27. Yuan, Y., and Zhang, J.J. Towards an appropriate business model for m-commerce. *International Journal of Mobile Communications, 1,* 1/2 (2003), 35–56.

28. Zigurs, L., and Buckland, B.K. A theory of task/technology fit and group support systems effectiveness. *MIS Quarterly, 22,* 3 (1998), 313–334.
29. Zwass, V. Electronic commerce and organizational innovation: Aspects and opportunities. *International Journal of Electronic Commerce, 7,* 3 (spring 2003), 7–37.

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