

Current Status of Mobile Commerce Research*

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I . Introduction

Considering the present world we are living now, the emergence of m-commerce is inevitable. The rapid global diffusion of mobile telephones, widespread use of the Internet and advances in wireless technologies established the foundation for this new concept and innovation. Mobile commerce is basically any e-commerce done in a wireless environment, especially via the internet (Kim et al., 2007). It is characterized by some

unique features that equip it with certain advantages which go beyond the traditional and electronic commerce, specifically ubiquity, convenience, interactivity, personalization and localization. Nowadays, the scope of m-commerce encompasses almost every walk of life. Mobile services are reported in the fields of content, entertainment, travel, banking, and marketing.

Mobile Commerce is an interesting area to research on because of its relative novelty, rapid

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growth and potential applications (Sadeh, N., 2002). In the past, Ngai and Gunasekaran (2007) had undertaken such endeavor reviewing 149 articles published between 2000 and 2003. Their study revealed that a large portion of the articles were related to m-commerce theory and research, especially the study of “m-commerce behavioral issues”, “m-commerce economics, strategy and business models”, and “m-commerce overview, context and usage”. During that period, the topic is fairly new and most of the m-commerce research began to be conducted.

This paper attempts to classify the literature on m-commerce research and offers a review of these studies, covering 173 online journal articles published between 2006 and 2009. The reason for selecting this period is that these are the recent years prior to this study. Also, this time is believed to be the start of growth for mobile commerce since its inception in 1997 as evidenced by the development of many m-commerce applications and services. The assessment of it after a decade is also one of the objectives. Moreover, it aims to present a list of references that will provide useful contributions to the study of m-commerce. More importantly, at this time of its growth, a compilation of researches would be a helpful source for those interested in this topic. It will supplement those existing studies by presenting the current issues in mobile commerce. For example, what applications are emerging now in the market.

Mobile commerce is such a broad topic and

covers a lot of interesting issues. A more specific research can be done in the future considering smart phones and social networking services, which are popular this time.

Our study is organized and discussed as follows: the theoretical background, criteria used for classifying the m-commerce literature, the research methodology used, the analyses and results and lastly, discussion and conclusions of the study.

Ⅱ . Theoretical Background

2.1 Definition and Features of Mobile Commerce

The literature gives us many definitions of the term mobile commerce, of which the common to all definitions is that a terminal or mobile device is employed to communicate over a mobile telecommunication network. Some definitions restrict m-commerce to transactions involving a monetary value, whereas other definitions generalize the term to services that involve communication, information, transaction, and entertainment. In summary, mobile commerce is defined as using a mobile device for business transactions performed over a mobile telecommunication network, possibly involving the transfer of monetary values.

Known as next generation e-commerce, m-commerce enables users to access the Internet

without needing to find a place to plug in. It is the use of information technologies and communication technologies for the purpose of mobile integration of different value chains and business processes, and management of business relationships. As viewed by Kannan et al., (2001) and Varshney and Vetter (2001), m-commerce is the use of wireless technology, particularly handheld mobile devices and mobile internet, to facilitate transaction, information search and user task performance in consumer, business-to-business, and intra-enterprise. The basic idea of it is to distribute information and generate business in a mobile way. The convergence of mobile phones and the web allows people, companies and organizations to be more connected than ever.

M-commerce is not just another application of

e-commerce but combines the advantages of mobile communications with existing e-commerce services. The major characteristics of m-commerce are mobility and reach ability. Mobility means that people can carry mobile devices to transact from anywhere in mobile network area while reach ability makes it possible for people to be contacted anytime and anywhere and provides users with the choice to limit their reach ability to particular persons or times (Perry et al., 2001). Meanwhile, Clarke (2001) mentioned unique features of m-commerce which includes ubiquity, convenience, personalization and localization as shown in Table 1.

2.2 Differences of M-commerce and E-commerce

<Table 1> Unique Features of Mobile Commerce (Clarke, 2001)

Feature	Definition
1. Ubiquity	The ability to receive information and perform transactions from virtually any location on a real-time basis. That is, m-commerce users will have a presence everywhere, or in many places simultaneously, with a similar level of access available through fixed-line technology. Communication can take place independent of the user's location.
2. Convenience	The agility and accessibility which makes people to be no longer constrained by time or place. m-commerce could be accessed in a manner which may eliminate some of the labor of life's activities. For example, consumers waiting in line or struck in traffic will be able to pursue favorite internet-based activities or handle daily transactions through m-commerce applications.
3. Personalization	Offers the opportunity to personalize messages to various segments, based upon time and location, by altering both sight and sound. New developments in IT and data-mining make tailoring messages to individual consumers practical and cost-effective. Mobile devices are typically operated by and configured for a single user.
4. Localization	Enables users to push, receive and access information and services specific to their location. Also, it is use in knowing where the user is located at any particular moment and matches services to the user's location.

M-commerce should not be viewed as electronic commerce with limitations, but rather as a unique form of e-commerce with its own unique benefits (Scornavacca and Barnes, 2006;

Zhang et al., 2003). Additionally, it is not a substitute for PCs but it is a new and much more powerful way to communicate with customers. The table below shows the summary

<Table 2> Major Differences between M-commerce and E-commerce (Zhang et al., 2004)

Category	E-commerce	M-commerce
Origin		
Sponsorship	Government-sponsored Internet	Private mobile phone industry
Business entry cost	Low	High
Customer access cost	Free or low cost Internet access	High mobile service charge
Customer base	Highly educated computer users	Less educated cell phone customers
Technology		
Message transmission	Packet switched data transmission	Circuit switched for streamlined voice communication
Protocol	TCP/IP, HTTPML	GSM, TDMA, CDMA, 3G
Standardization	Highly standardized	Multiple incompatible standards
Connectivity	Global	Mainly regional
Bandwidth	High	Low
Identity	URL with IP and domain name	Phone number
Application development	General computer applications	Device-specific applications
Interface device	Personal computers	Cell phones and PDAs
Mobility	Fixed location	Mobile
Display	Big screen	Small screen
Main input mode	Keyboard for full text input	Voice with small key pad
Main output mode	Text and graphics	Voice with small text display
Local processing power	Powerful CPU with large memory and disk space	Limited processing power with small memory chip
Software and Programming	Support a variety of programming languages	Java or specific script languages
Trend	Towards sophistication	Towards minimization
Services		
Service Range	Global	Regional
Delivery Destination	PC in office connected to the Internet	Person accompanied by a mobile device
Transaction Complexity	Complete and Complex Transactions	Simple transactions
Information Provided	Rich Information	Simple and short messages
Timing	Less-time critical	Time critical
Location-based Service	No	Yes
Target mobility	Service to a fixed point	Service to a moving target
Back-end business connection	Strong connection to back-end business information systems	Weak connection to back-end business information systems
Service Classification	B2C (business to consumer) and B2B (Business to Business)	P2P (Person to person) and P2S (person to system)

<Table 3> Similarities and Differences of M-commerce with E-commerce (Choi et al., 2008)

	E-commerce	M-commerce
1. Types of Product/ Service Transacted	Physical Products, Virtual products: digital content, information, etc.	
2. Transaction Process	Offline Delivery, Online Download	
3. Perceived level of Additional Cost to Use	Very Low	Relatively High and burdensome
4. Way of Connection	Directly connect to the Web Site	Mobile portal as a gateway
5. Device	Immovable or portable device, Public or private device (e.g. desktop, PC, notebook, etc.)	Portable/handheld device, Private Device (e.g. CP, PDA, etc.)

of the major differences between m-commerce and e-commerce according to Zhang et al. (2004).

In another paper by Choi et al., (2008), the similar and different aspects of m-commerce with e-commerce are summarized in Table 3.

2.3 Mobile commerce and Mobile business

Mobile business is the mobile counterpart to e-business. Typically, it includes m-commerce but also covers internal processes such as production, inventory management, product development, risk management, finance, knowledge management and human resources. An example of m-commerce strategy incorporated in m-business includes enterprise resource planning, customer relationship management and supply chain management. Some of the studies gathered in this study depict these topics.

III. Classification of M-commerce Literature

To help future applications and technologies handle m-commerce, Varshney and Vetter (2002) proposed a framework that allows developers and providers to strategize and effectively implement mobile commerce applications. The framework has four levels: m-commerce applications, user infrastructure, middleware, and network infrastructure. It shows that the design of new mobile commerce applications should consider the general capabilities of user infrastructure (mobile devices) and not the individual devices. With its ability to hide details of underlying wireless and mobile networks from applications while at the same time providing a uniform and easy to use interface, mobile middleware clearly is an extremely important component in developing new mobile commerce applications. The network infrastructure also plays an

important role in mobile commerce, as the user perceived service quality depends on available resources and capabilities of wireless and mobile networks. In summary, m-commerce applications require the support of technology from the foundation of wireless user infrastructure, mobile middleware, and wireless network infrastructure (Mennecke and Strader, 2003). In addition, Ngai and Gunasekaran (2007) proposed that corresponding theory and research activities are also essential to provide guidance for the development of m-commerce. And so, the framework is composed of five levels and is discussed as follows:

1. M-commerce theory and research: This is the lowest level of the framework. It includes articles describing the development of m-commerce applications and guidelines, behavioral issues such as consumer behavior, the acceptance of technology, and the diffusion of m-commerce applications and services. m-commerce economics, strategy, and business models; and legal and ethical issues such as privacy, regulations, and the legal environment when using m-commerce are included. Articles dealing with a general introduction to m-commerce, foundational concepts of m-commerce, and so forth were grouped under the heading “m-commerce overview, context and usage”.

2. Wireless network infrastructure: This is one of the pillar technologies of m-commerce that

supports the development of m-commerce applications. Wireless network infrastructure plays an important role in m-commerce as this is the core part of m-commerce technology. It provides wireless networks and network standards such as the Global System for Mobile Communication (GSM), Bluetooth, the wireless local area network (WLAN), radio frequency identification (RFID), the Third Generation (3G) network, etc. Articles describing these wireless networks or network standards are grouped under “Wireless and Mobile Network”. “Networking requirements” is also a part of this level which tackles articles on the wireless infrastructure requirements of m-commerce such as location management, multicast support, network dependability, quality of service, and roaming across multiple networks.

3. Mobile Middleware: It refers to the software layer between the wireless networks and the operating systems of the mobile devices to connect the m-commerce applications (Varshney et al., 2000). Articles included in here are those covering agent technologies, which are software or mobile agents that support m-commerce activities; database management, which covers articles on mobile database management; security issues, for instance, designing a secure wireless network infrastructure for m-commerce applications using public key infrastructure or other techniques (Chanson and Cheung, 2001; Hazari, 2002 and Shoniregun, 2003); wireless and mobile communication systems, which refers

to some techniques, algorithm, methods and components to connect and manage m-commerce applications; and, wireless mobile protocols, which covers articles describing the protocols for

<Table 4> Classification Scheme

Classification Criteria based on Varshney and Vetter (2002) and Ngai and Gunasekaran (2007) and Emerging issues in M-commerce
1. Mobile Commerce Theory and Research
1.1 Development of m-commerce applications and guidelines
1.2 M-commerce behavioral issues (consumer behavior, acceptance or diffusion of technology)
1.3 M-commerce economics, strategy, and business models
1.4 M-commerce legal and ethical issues
1.5 M-commerce overview, context and usage
2. Mobile Commerce Applications and Cases
2.1 Location-based Services
2.2 Mobile Advertising/Marketing
2.3 Mobile Financial Applications
2.4 Mobile Auctions
2.5 M-commerce in Groups or Countries
2.6 Mobile Entertainment Services and Games
2.7 Mobile Ticketing
2.8 Mobile Medical Information System/Healthcare System
2.9 Mobile Customer Relationship Management
2.10 Mobile TV
2.11 M-Library
2.12 M-Supply Chain Management
2.13 M-Learning
3. Mobile Middleware
3.1 Agent Technologies
3.2 Security Issues
3.3 Wireless and Mobile Protocols
3.4 Database Management
3.5 Wireless and Mobile Communication Systems
4. Wireless Network Infrastructure
4.1 Wireless and Mobile Network
4.2 Networking Requirements
5. Wireless User Infrastructure
5.1 Mobile Handheld Devices
5.2 Mobile Interfaces

m-commerce.

4. Wireless User Infrastructure: It consists of two parts: the software and hardware. Software refers to the operating systems and their interfaces while hardware refers to the mobile devices to communicate with the m-commerce applications, such as PDAs and mobile phones. Articles covering interface designs or issues relating to the mobile applications or devices are grouped under the heading "Mobile Interfaces". It is necessary to set guidelines for designing suitable mobile interfaces. "Mobile handheld devices" covers articles related to mobile devices. The handheld device is really the entry point for most mobile commerce systems. The capabilities or limitations of these devices will impact the type and frequency of which mobile commerce applications will be used.

5. Mobile Commerce Applications and Cases: Varshney and Vetter (2002) identified several important classes of m-commerce applications which include mobile financial applications, mobile advertising, mobile inventory management, locating and shopping for products, proactive service management, wireless re-engineering, mobile auctions or reverse auctions, mobile entertainment services and games, mobile offices, mobile distance education, and wireless data centers.

Prior to examining the articles gathered, the framework was established based on Varshney and Vetter (2002) and Ngai and Gunasekaran

(2007). Table 4 shows the classification scheme.

Some sub-categories were added based on emerging issues or topics especially on m-commerce applications and cases which includes Mobile Ticketing (Bauer et al., 2007; Mallat et al., 2009), M-commerce in Groups or Countries (Park, 2006; Varshney and Ravikumar, 2007; O'Donnell et al., 2007; Min and Ji, 2008), Mobile Medical Information System/Healthcare System (Han et al., 2006; Kung et al., 2006; Fitch and Adams, 2006; Anderson et al., 2007; Susilo and Win, 2007; Wickramasinghe and Goldberg, 2007; Gururajan et al., 2008; Jokela et al., 2009; Hafeez Biag and Gururajan, 2009), M-Customer Relationship Management (Rossi et al., 2007; Schierholzand et al., 2007; Lee and Jun, 2007; Sinisalo et al., 2007; Valsecchi et al., 2007), Mobile TV (Tjondronegoro et al., 2006), M-Library (Tung et al., 2007), and M-Supply Chain Management (Jankowska et al., 2007).

IV. Research Methodology

Up to the present time, m-commerce researches have been published by major e-commerce journals, mobile communications and some business and computer journals. Also, M-commerce articles are scattered across various journals in fields like management, marketing, engineering, and information technology and information systems. Thus, several online journal databases shown in Table 5 were selected and

searched to provide a substantial bibliography on m-commerce literature. The databases were chosen from those available from the university website. Moreover, it includes those that can retrieve papers and articles easily, like not needing to sign up for registration to view full papers. The literature search was based on the descriptor “mobile commerce” or “m-commerce”. Furthermore, we limit our search to articles from year 2006-2009. Conference papers, master’s thesis and doctoral dissertations, textbooks, editorials, news reports, book reviews and unpublished working papers were excluded. To easily facilitate the gathering of m-commerce researches to be included in the study, articles from the mentioned resources were immediately not considered at the first attempt of searching. A total of 180 online articles was found on the initial search. Each article was then reviewed to eliminate those articles that did not meet the selection criteria. After carefully examining the abstract and contents of the paper, a total of 173 articles from 17 online journals was gathered.

Each of the articles was thoroughly reviewed and classified into one of the five categories of m-commerce as set by Varshney and Vetter (2002) and Ngai and Gunasekaran (2007): m-commerce applications and cases, wireless user infrastructure, mobile middleware, wireless network infrastructure and mobile commerce theory and research. The articles were analyzed as to which category they belong to, considering the objectives and contents of the paper. One paper means one category. After classifying them into categories, the articles were grouped according to subheadings. For an efficient classification, the second author examined the articles at the beginning, then verified by the first author. Disagreements between the researchers were discussed and resolved. With regards to ambiguous articles which could have more than one classification, contents were carefully analyzed to assess its category by determining what is studied in those researches. For example, a study by Varshney (2008) entitled “A Middleware Framework for Managing

<Table 5> Selected online database for the m-commerce literature research

Online Database	Subjects Covered
ACM Digital Library	Computer Science
Inderscience Publishers	Environmental, Healthcare, Management, Technical
Science Direct	Chemistry and Chemical Engineering, Clinical Medicine, Computer Science, Earth and Planetary Sciences, Economics, Business and Management Science, Environmental Science and Technology, Life Sciences, Materials Science, Mathematics, Physics and Astronomy, Social Sciences
EBSCO	General
Springer Link Online Libraries	Business, Science, Engineering, Medical and Social Sciences

Transactions in Group-Oriented Mobile Commerce Services” can fall into two categories, either under M-commerce in Groups or Countries subheading of the M-commerce Applications and Cases or under Agent Technologies subheading of the Mobile Middleware category. After reviewing the contents of the paper, it is then decided it falls on the latter.

V. Results and Analysis of Classifications

The articles used in this study were analyzed by journal, year of publication, and topic. The details are presented below.

5.1. Distribution of Articles by Journal and Year of Publication

Based on the results, 173 m-commerce articles from 17 different journals were gathered online. Table 6 shows the list of journals that published three or more articles. The International Journal of Mobile Communications had the most number of articles (85 articles or 49.13%), followed by Electronic Commerce Research and Applications and Decision Support Systems (11 articles or 6.36% each) and Business Process Management

Journal (9 articles or 5.20%). The International Journal of Mobile Communications, a fully refereed journal, publishes articles that present current practice and theory of mobile communications, mobile technology and mobile commerce applications. The journal Electronic Commerce Research and Applications aims to create and disseminate enduring knowledge in the fast changing e-commerce environment. It solicits papers on current technologies from areas of Management Information Systems, Business and Artificial Intelligence, Marketing, Business Strategy and Re-engineering, Knowledge Management, Computer Science and Telecommunications. Decision Support Systems welcomes contributions on the concepts and operational basis for DSSs, techniques for implementing and evaluating DSSs, DSS experiences, and related studies. The Business Process Management Journal provides insights into best practice management of key processes and examines how a variety of business processes intrinsic to organizational efficiency and effectiveness are integrated and managed for competitive success.

Table 6 also shows the distribution of articles by year from 2006-2009. A great number of articles were published on 2007 and decreased the following years of 2008 and 2009.

<Table 6> Summary of Distribution of Articles Published by Journal per Year

Journal	2006	2007	2008	2009	Number of Articles	Percentage
1. International Journal of Mobile Communications	19	19	22	25	85	49.13%
2. Electronic Commerce Research and Applications	4	0	6	1	11	6.36%
3. Decision Support Systems	1	7	3	0	11	6.36%
4. Business Process Management Journal	3	6	0	0	9	5.20%
5. Journal of Theoretical and Applied Electronic Commerce Research	0	8	0	0	8	4.62%
6. Information and Management	2	1	3	1	7	4.05%
7. Communications of the ACM	0	4	2	0	6	3.47%
8. Telematics and Informatics	0	2	1	3	6	3.47%
9. Journal of Systems and Internet Research	0	1	2	2	5	2.89%
10. Journal of Internet Commerce	0	0	4	0	4	2.31%
11. Computers in Human Behavior	0	1	0	2	3	1.73%
12. Journal of Consumer Marketing	1	0	1	1	3	1.73%
13. Journal of Interactive Marketing	0	0	1	2	3	1.73%
14. Electronic Markets	0	0	0	3	3	1.73%
15. Mobile Networks and Applications	1	1	1	0	3	1.73%
16. Internet Research	0	0	1	2	3	1.73%
17. International Journal of Web Information Systems	3	0	0	0	3	1.73%
Total	34	50	47	42	173	100.00%

5.2. Distribution of Articles by Topic

The distribution of articles by topic is exhibited

in Table 7. Most of the articles were related to Mobile Commerce Theory and Research (90 articles or 52.02% within all reviewed articles).

<Table 7> Distribution of articles by topic

Classification Criteria	Number of Articles	Percentage of Topic	Percentage of all Topics
1. Mobile Commerce Theory and Research			
1.1 Development of m-commerce applications and guidelines	7	7.77%	4.05%
1.2 M-commerce behavioral issues (consumer behavior, acceptance or diffusion of technology)	60	66.67%	34.68%
1.3 M-commerce economics, strategy, and business models	6	6.67%	3.47%
1.4 M-commerce legal and ethical issues	7	7.77%	4.05%
1.5 M-commerce overview, context and usage	10	11.11%	5.78%
Total	90	100%	52.02%

2. Mobile Commerce Applications and Cases			
2.1 Location-based Services	9	16.67%	5.20%
2.2 Mobile Advertising/Marketing	11	20.37%	6.36%
2.3 Mobile Financial Applications	7	12.96%	4.05%
2.4 Mobile Auctions	1	1.85%	0.58%
2.5 M-commerce in Groups or Countries	4	7.41%	2.31%
2.6 Mobile Entertainment Services and Games	2	3.70%	1.16%
2.7 Mobile Ticketing	2	3.70%	1.16%
2.8 Mobile Medical Information System/Healthcare System	9	16.67%	5.20%
2.9 Mobile Customer Relationship Management	5	9.26%	2.89%
2.10 Mobile TV	1	1.85%	0.58%
2.11 M-Library	1	1.85%	0.58%
2.12 M-Supply Chain Management	1	1.85%	0.58%
2.13 M-Learning	1	1.85%	0.58%
Total	54	100%	31.21%
3. Mobile Middleware			
3.1 Agent Technologies	2	16.67%	1.16%
3.2 Security Issues	6	50%	3.47%
3.3 Wireless and Mobile Protocols	4	33.33%	2.31%
3.4 Database Management	0	0	0
3.5 Wireless and Mobile Communications Systems	0	0	0
Total	12	100%	6.94%
4. Wireless Network Infrastructure			
4.1 Wireless and Mobile Network	11	100%	6.36%
4.2 Networking Requirements	0	0	0
Total	11	100%	6.36%
5. Wireless User Infrastructure			
5.1 Mobile Handheld Devices	5	83.33%	2.89%
5.2 Mobile Interfaces	1	16.67%	0.58%
Total	6	100%	3.47%

The classification of Mobile Commerce Theory and Research is divided into five broad sub-topics. The heading “M-commerce behavioral issues” (60 articles) made up a large portion of this category. Mobile Commerce is an emerging market. And one of the four success factors believed to make m-commerce happen across the globe is consumer adoption. Thus, Mobile commerce adoption has been the most popular topic in the m-commerce research literature. Other topics under Mobile Commerce Theory and

Research discussed in m-commerce articles were “M-commerce Overview, Context and Usage” (10 articles), “Development of M-commerce Applications and Guidelines” (7 articles), “and “M-commerce Legal and Ethical Issues” (7 articles) and “M-commerce Economics, Strategy and Business Models” (6 articles).

The second largest number of articles published is related to Mobile Commerce Applications and Cases (54 articles or 31.21%), which articles describing “Mobile Advertising/

Marketing” (11 articles) made up the bulk within this category. This is followed by “Location-based Services” (9 articles) and “Mobile Medical Information System/Healthcare System” (9 articles), “Mobile Financial Applications” (7 articles), “Mobile CRM” (5 articles), “M-commerce in Groups or Countries” (4 articles), “Mobile Ticketing” (2 articles), and “Mobile Entertainment Services” (2 articles). Also, we found articles regarding mobile auctions, mobile TV, m-library, M-SCM and m-learning.

The topics with the least numbers of articles were on Mobile Middleware (12 articles or

6.94%), Wireless Network Infrastructure (11 articles or 6.36%) and Wireless User Infrastructure (6 articles or 3.47%). Based on the reviewed articles, we did not find articles on Database Management and Wireless and Mobile Communications Systems under Mobile Middleware and that relates to Networking Requirements under Wireless Network Infrastructure. This can be explained by the sources of the articles which are mostly on management and commerce journals.

After categorizing the articles into topics, the corresponding references were also assigned to each classification and is shown in Table 8.

<Table 8> Classification of the reviewed articles and references

Classification Criteria	References
1. Mobile Commerce Theory and Research	
1.1 Development of m-commerce applications and guidelines	Rangone and Renga (2006); Maamar, Z. (2006); Ondrus and Pigneur, (2006); Weber, (2007); Van de Kar and den Hengst, (2009); Caus et al., (2009); Gregoire et al., (2009)
1.2 M-commerce behavioral issues (consumer behavior, acceptance or diffusion of technology)	Constantiou et al., (2006); Koivumaki et al., (2006); Mahatanankoon et al., (2006); Hong et al., (2006); Cyr et al., (2006); Lin and Wang, (2006); Lim et al., (2006); Wu et al., (2006); Kim et al., (2007); Wang and Liao, (2007); Ha et al., (2007); Bouwman et al., (2007); Heinonen and Strandvik, (2007); Hung et al., (2007); Passerini et al., (2007); Lee et al., (2007); Laukkanen, (2007); Sulaiman et al., (2007); Haghirian and Inoue, (2007); Constantiou, (2007); Kim et al., (2007); Laukkanen, T. (2007); Rao and Troshani (2007); Bigne et al., (2007); Lee and Jun, (2007); Lu et al., (2007); Au and Kauffman, (2008); Junglas et al., (2008); Chen, (2008); Li and McQueen, (2008); Karaiskos et al., (2008); Lim and Kumar, (2008); Wei, (2008); Dickinger and Kleijnen, (2008); Yang and Folly, (2008); Lu et al., (2008); Kim, (2008); Lopez-Nicolas et al., (2008); Choi et al., (2008); Li et al., (2008); Mahatanankoon and Vila-Ruiz (2008); Song et al., (2008); Liu, (2008); Gebauer and Tang (2008); Chin and Aritejo, (2008); Lin and Shih, (2008); Kim et al., (2008);Shin, (2009); Kuo and Yen, (2009); Sultan and Rohm, (2009); Constantiou, (2009); Economides and Grousopoulou, (2009); Crabbe et al., (2009); Troshani and Hill, (2009); Xu and Yuan, (2009); Jung, (2009); Lu et al., (2009); Lu and Su, (2009); Kim et al., (2009); Lin and Lin, (2009); Sun et al., (2009)

1.3 M-commerce economics, strategy and business models	Gressgard and Stensaker, (2006); Haaker et al., (2006); Scomavacca and Barnes, (2006); Zeidler et al., (2008); de Reuver et al., (2009); de Reuver and Haaker, (2009)
1.4 M-commerce legal and ethical issues	Bessler (2007); Gurau and Ranchhod, (2009); Giray et al., (2009); Samanta et al., (2009); Huang (2008); Elmufti et al., (2008); Gerpott, (2008)
1.5 M-commerce overview, context and usage	Shim et al., (2006); Turel and Yuan, (2006); Smith, (2006); Ngai and Gunasekaran, (2007A); Ngai and Gunasekaran, (2007B); Tsai and Gururajan (2007); Dahlberg et al., (2008); Hsieh et al., (2008); Parveen et al., (2009); Kivi, (2009)
2. Mobile Commerce Applications and Cases	
2.1 Location-based Services	Weng et al., (2006); Junglas (2007); Choi, (2007); Junglas et al., (2008); Gidofalvi et al., (2008); Xu and Gupta, (2009); Vijayalakshmi and Kannan, (2009); Lee et al., (2009)* Xu et al., (2009)
2.2 Mobile Advertising/ Mobile Marketing	Gopal and Tripathi, (2006); Merisavo et al., (2006); Mahmoud and Yu, (2006); Kautonen et al., (2007); Molina, (2007); Xu et al., (2008); Barnes and Scomavacca, (2008); Idwan et al., (2008); Leppaniemi and Karjaluo, (2008); Cudmore and Patton, (2008); Venkatesh and Balasubramanian, (2009)
2.3 Mobile Financial Applications	Pousttchi, (2008); Lim, (2008); Hassinen et al., (2008); Kousaridas et al., (2008); Laukkanen et al., (2008); Chang, (2009); Zarifopoulos and Economides, (2009)
2. Mobile Auctions	Wang and Barnes, (2009)
2.5 M-commerce in Groups or Countries	Park, (2006); Varshney and Ravikumar, (2007); O'Donnell et al., (2007); Min and Ji, (2008)
2.6 Mobile Entertainment Services and Games	Rajala et al., (2007); Soh and Tan, (2008)
2.7 Mobile Ticketing	Bauer et al., (2007); Mallat et al., (2009)
2.8 Mobile Medical Information System/ Healthcare System	Han et al., (2006); Kung et al., (2006); Fitch and Adams (2006); Andersson et al., (2007); Susilo and Win, (2007); Wickramasinghe and Goldberg, (2007); Gururajan et al., (2008); Jokela et al., (2009); Hafeez-Biag and Gururajan, (2009);
2.9 Mobile Customer Relationship Management	Rossi et al., (2007); Schierholzand et al., (2007); Lee and Jun, (2007); Sinisalo et al., (2007); Valsecchi et al., (2007)
2.10 Mobile TV	Tjondronegoro et al., (2006)
2.1 M-Learning	Trinofova and Ronchetti, (2006)
2.12 M-Supply Chain Management	Jankowska et al., (2007)
2.13 M-Library	Tung et al., (2007)
3. Mobile Middleware	
3.1 Agent Technologies	Guan et al., (2006); Varshney, (2008)
3.2 Security Issues	Chang et al., (2006); Zhong and Yang, (2006); Veijalainen et al., (2006); Wei et al., (2006); Siddigi et al., (2007); Lee et al., (2007)
3.3 Wireless and Mobile Protocols	Ezziane, (2006); Shiriram et al., (2008); Ponnusamy (2009); Hsu and Chang, (2009)
4. Wireless Network Infrastructure	

4.1 Wireless and Mobile Network	Dekleva et al., (2007); Sakiyama et al., (2007); Ngai et al., (2007); Hsu and Chang, (2007); Jolly and Latifi, (2007); Shen et al., (2008); Roman and Lopez (2009); Kabilan et al., (2009); Tsai et al., (2009); Khan et al., (2009); Ryoo et al., (2009)
5. Wireless User Infrastructure	
5.1 Mobile Handheld Devices	Hu et al., (2006); Zhang, (2007); Yang and Wang, (2007); Ruiz Martinez et al., (2007)
5.2 Mobile Interfaces	Prammanee and Moessner, (2008); Uden and Helo, (2008)

VI. Discussion

Based on the results, the large portion of the reviewed articles in this study was related to mobile commerce theory and research, especially on the study of “m-commerce behavioral issues”. Platforms, services and applications have been set, but businesses need customers to adopt them. Thus, concerns on enhancing the adoption of m-commerce are popular. Like the study of Ngai and Gunasekaran (2007), this category made the bulk of the classified literature. It shows that, still, this topic is famous. Especially, the adoption studies, wherein several models of mobile commerce acceptance and use have been developed. But the interest to explore the other dimensions related to the understanding of consumer’s intention toward m-commerce is still popular to researchers. This is also observed in Korean publications such as *The Journal of Information Systems*, wherein published papers mainly investigate the intention to adopt and use mobile commerce (Lim and Lee, 2006; Cha and Moon, 2007; Chung and Lee, 2008; Kwon and Chae, 2009; Kim and Mun, 2009). These

behavioral studies were motivated by the contradiction between the high penetration rate of mobile devices and the low adoption rate of m-commerce. Also, the results help managers prioritize their m-commerce initiatives and to allocate resources accordingly.

The second research area with the greatest number from the papers reviewed is on Mobile Commerce Applications and Cases. Since its inception on 1997, m-commerce is just at its realization now and the real potential has yet to be tapped. There are many mobile commerce applications that are becoming very widely known, such as mobile banking, mobile advertising, mobile entertainment and games, mobile ticketing and location-based services. Among the papers reviewed, topics on Mobile Advertising/Marketing has the greatest number. There is no doubt that it is one of fast growing markets in the mobile ecosystem. As mobile phone users outnumber the PC based Internet users, advertisers have recently rushed to these media. Also, in an increasingly mobile world, location-based services have undergone rapid growth. Demand for faster or real-time information, usability, and an increasing reliance

on the mobile web is just three emerging trends. Another application with a high potential is the mobile healthcare. With its advantages such as faster searching and availability of relevant information, efficient decision-making and quicker documentation, it is expanding rapidly.

Based on the results, this study implies that emerging studies on applications that are researched on include M-Learning, M-Library, M-CRM and M-SCM. Mobile learning is extending virtual education support for mobile users everywhere; for an example, taking a class using streaming audio and video. Mobile library provides a real-time searching tool for library's online systems via mobile devices. Mobile Customer Relationship Management is a solution that extends the reach of CRM applications to any user, whenever and wherever needed. Lastly, Mobile supply chain management is fast gaining recognition as a major source of cost reduction and supply chain performance. These applications are some of the mobile commerce strategies that are integrated in mobile business being deployed today.

VII. Conclusion

This paper gathered and utilized 173 online articles published between 2006 and 2009. After a decade of m-commerce existence, it is still on its way of fulfillment and growth. The results presented in this study have the following

implications:

1. Mobile commerce is likely to continue growing steadily as more advanced wireless devices and more applications are unfolding. The successful future of m-commerce depends on the power of the underlying technology drivers and the attractiveness of m-commerce applications. There are many applications that have been named but there are those few which are really popular among customers. Thus, m-commerce initiatives and strategies can solve these drawbacks. A concrete case can be on privacy and security concerns which are still at the forefront of customer's minds. Future studies can be conducted regarding this issue.
2. There are other major limitations of m-commerce which hinders its success. As viewed today, these include small screens on wireless devices, limited processing power, modest memory, restricted power consumption, low speed data transmission, unproven security and scarce bandwidth. Future researches could focus on these issues, taking into account the findings of our study regarding mobile middleware, wireless user and network infrastructure researches have been scarcely explored. In light of this fact, a new technology has already arrived, the 4G which provides faster display of multimedia, more security, higher speeds, higher capacity, lower costs,

and more intelligent infrastructures and devices that will help realize m-commerce applications. It is anticipated that with the wide deployment of 4G systems, m-commerce will become the most dominant method of conducting business transactions.

3. Based on the results, there have been numerous studies concerning mobile commerce behavioral issues especially on m-commerce adoption. As time goes by, this issue becomes more specific, targeting a certain application. As an example: mobile ticketing or mobile banking adoption. This could lead to studies involving demographic variables such as age, gender, race or location and income level, knowing these variables affects m-commerce adoption.
4. Studies concerning the differences between e-commerce and m-commerce are not explored well. This could be an interesting area for investigation.
5. Researches regarding mobile inventory management and mobile ERP (enterprise resource planning) will likewise gain attention succeeding the M-CRM and M-SCM. Further studies are required in these areas.
6. Subheadings or sub-categories in the classification framework were identified based on the results of reviewing the articles. The subheadings provided by Ngai

and Gunasekaran (2007) especially on the Mobile Commerce Applications and Cases were updated. For future researches, it is believed then that more sub-categories should be added as more applications and cases can be found considering the time frame. This can also be true with the other type of categories.

As a limitation of this study, due to restricting the search descriptor to m-commerce and mobile commerce, some articles on topics such as wireless user and network infrastructure may have not been searched, affecting our results which may not represent the actual status. Moreover, we may have missed some m-commerce articles from other online journals. To gain a more comprehensive research, future researches can go beyond the m-commerce or mobile commerce keywords. For example, using m-business or mobile learning and the like can provide an exhaustive study.

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<초록>

모바일 상거래 연구의 최근 동향

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최근 수년간 모바일 상거래는 점점 더 많은 관심을 끌고 있다. 그것은 도달성과 이동성이라는 점에서 전자상거래에 비해 강점을 지니고 있어 모바일 상거래는 주목받는 이슈가 되었다. 모바일 상거래의 현황을 검토하고 미래를 조망한 문헌을 연구해 보는 것은 흥미로운 시도이다. 이 연구는 Varshney and Vetter(2002)와 Ngai and Gunasekaran(2007)가 제시한 분류기준을 참조하되 세부내용을 일부 수정하여 모바일 상거래의 이론과 연구, 모바일 상거래의 애플리케이션과 사례, 무선 사용자 인프라스트럭처, 모바일 미들웨어, 무선 네트워크 인프라스트럭처 등 5가지 대분류기준에 따라 선행연구들을 검토하였다. 여기에는 최근 부각되는 모바일러닝, 모바일라이브러리, M-CRM과 M-SCM 같은 주제도 포함하였다. 연구결과 많은 논문들이 모바일 상거래의 이론과 연구 그리고 모바일 상거래의 애플리케이션과 사례를 다루고 있었다. 그리고 모바일 상거래의 성공은 서로 다른 애플리케이션의 강점과 필요한 기술을 잘 수용한 결과라는 점을 보여주었다. 마지막으로 모바일 상거래의 현황과 미래 방향에 관한 함의를 기술하였다.

Keywords: mobile commerce, m-commerce theory and research, m-commerce framework

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