
A framework for mobile business applications

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Abstract: Many predict that mobile business (m-business) will revolutionise modern corporations as e-commerce did in the last decade. However, many unresolved technical, application, and global issues relevant to m-business are preventing companies from adopting m-business as a prudent business model. Furthermore, little academic research in this area has been attempted to provide practitioners with guidance to more effective utilisation of wireless technologies. To partially fill this void, this paper presents a framework for m-business applications that is designed to give managers a systematic approach to discovering m-business opportunities in their organisations.

Keywords: mobile business application; impact/value framework.

Reference to this paper should be made as follows: Chen, L. and Nath, R. (2004) 'A framework for mobile business applications', *Int. J. Mobile Communications*, Vol. 2, No. 4, pp.368–381.

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1 Introduction

Agility is the key to success in a competitive business environment and an agile organisation needs the capability to deliver vital business information from anywhere and at anytime to its constituents. It is this imperative that is prompting many organisations to implement mobile systems in support of mission critical activities and processes. Additional drivers for the acceptance of wireless technology-based systems by firms include the proliferation of handheld wireless devices, advances in wireless communication technologies, and the integration of web-based systems with back-end legacy systems. In the popular press, wireless systems that support business functions are referred to as mobile business (m-business) or m-commerce. Leung and Antypas [1] define m-business as “content delivery (notification and reporting) and transactions (purchasing and data entry) on mobile devices”.

Organisations that have successfully implemented m-business applications for their workforce have demonstrated that these applications contribute to the organisations’ operational efficiency and productivity. According to Glass [2], the wireless business “removes costly and time-intensive delays from traditional business processes”. For example, by using a new kitchen control system operating on Palm devices in its 500 company-owned restaurants, Burger King restaurants reduced the time it took a manager to program product-holding cabinets from 30 minutes to 4–5 seconds. Such a dramatic reduction in a delay in the business process allowed Burger King restaurants to efficiently adjust kitchen operations and equipment for new advertising campaigns [3]. In another example, John Hopkins Hospital is achieving a saving of \$1,000 a day per pharmacist by delivering timely information to the pharmacists’ handheld devices [4].

European and Asian countries have lead many developments in m-business. Notable among these countries are Finland, UK, Japan, and South Korea [5]. However, the USA is not too far behind in exploiting the potential of wireless technologies to enhance the efficiency of information distribution and increase channels of interaction with customers, employees, and business partners. It is predicted that m-business will grow to \$200 billion worldwide by 2004 and the number of US m-business users will grow to 29 million [6]. As elucidated above, the factors driving the m-business include the following:

- Mobile devices such as internet-enabled mobile phones and personal digital assistants (PDAs) are gaining popularity among business users and consumers.
- The growing number of travelling employees who demand access to critical business information from anywhere at any time. The old ways of communication are no longer suitable for today’s fast-paced business environment. M-business offers businesses new ways to improve operational efficiency.
- Both corporate and individual customers are demanding more channels for interaction and services. M-business can offer convenient, immediate, and personalised services to these customers.
- The wireless infrastructure and support are constantly being upgraded by vendors in order to provide seamless and affordable access.

The marketplace offers a wide range of mobile devices, and these allow users access to a myriad of wireless services and applications. Leung and Antypas [1] identify five categories of wireless device: two-way pagers and short message systems (SMS), wireless application protocol (WAP)-equipped cellular phones, PDA with wireless modems, wireless internet access on laptop computers, and in-premise IEEE 802.11(a/b) wireless network devices. However, a number of industry-specific wireless devices do not fall into any of these five categories. For example, transportation companies such as FedEx have relied on handheld computers ranging from handheld scanners to global positioning systems (GPS) systems for data collection and communication for years [7].

Business and individuals deploy a number of wireless network solutions, including wireless personal area networks (WPANs), wireless local area networks (WLANs), and wireless wide area networks (WWANs). With a wide range of mobile devices and multiple technical platforms coexisting, it is important to put all these in perspectives. Table 1 summarises these different types of wireless networks and their attendant technologies. Within personal areas (e.g., an office), one of the most promising wireless technologies is Bluetooth. Bluetooth is a global standard for wireless connectivity that is being fast adopted by many device manufacturers. The technology has the potential to replace cables that connect digital devices and offer users a higher level of freedom within users' personal areas. Its relatively high data transfer speed and extremely low power consumption have made it an ideal technology to be deployed in many environments.

Table 1 Wireless networks and their attendant technologies

<i>Wireless networks</i>	<i>Attendant technologies</i>
WPANs	Line-of-sight infrared, radio frequency (RF), and Bluetooth
WLANs	Spread spectrum technology (802.11b), Orthogonal Frequency Division Multiplexing (802.11a), infrared, and narrowband technology
WWANs	Analogue cellular networks, digital cellular systems and PCS, Cellular Digital Packet Data (CDPD), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), CDMA2001x, W-CDMA, and satellites

Analogous to a traditional wired local area network (LAN), many organisations have adopted the IEEE802.11b technology to provide wireless access to users within a local geographical area (e.g., a building, campus, airport, coffee shop, or hotel). According to a recent study, the market penetration of WLANs in the USA has reached 10%, and users have credited WLANs with attainment of convenience, flexibility, mobility, time saving, and productivity gains [8]. While IEEE802.11b technology is the most popular WLAN solution among US businesses today, new technologies (e.g. IEEE802.11a) are promising higher data speeds and more security in the near future.

WWANs allow users to communicate and access resources within a wide geographical area such as a city, a region, or the entire country. Due to its wide coverage and the unprecedented freedom for its users, a WWAN allows maximum flexibility. However, in the absence of new generation cellular networks (2.5G or 3G), low data transfer rates are an impediment for certain business applications. Nevertheless,

innovative wireless business systems utilising existing cellular and satellite networks are capable of providing value in areas such as wireless banking, wireless stock trading, remote monitoring, and location-based wireless services.

In spite of its potential, the growth of m-business has been slower than anticipated [6,9]. Factors that have attributed to this slow growth include the immaturity of the wireless technology, the existence of a chaotic array of competing technologies and standards, and the lack of killer wireless applications [10]. To better illustrate these obstacles, Tarasewich et al. [5] identified three dimensions of m-business issues: technical, application, and global issues.

Mobile e-commerce technical issues include the questions relevant to mobile devices and infrastructure that must be answered. For m-business to grow, problems such as the device limitations, user interfaces with low usability, lack of technical standardisation, and high initial cost of wireless infrastructure must be resolved. The m-business field is governed by a chaotic array of platforms, devices, and standards. Each device class differs from other classes in terms of screen resolution and button functions tremendously [11]. Developing business applications for such a diverse group of client devices proves to be extremely difficult. Furthermore, the small screens of mobile devices and their limited input capabilities have created many design challenges. Mobile devices have been tremendously miniaturised in the last few years. This phenomenon has resulted in many mobile devices with screens that are often too small to display any meaningful data. The limited keypad of mobile phones has also made m-business applications clumsy and hard to use. In addition, the low bandwidth and unreliability of wireless data services have also limited the growth of m-business. Hence, wireless devices are often only useful in bandwidth-limited applications such as text messaging and stock quotes [5].

Mobile e-commerce application issues deal with the challenges faced by business managers and technical developers when developing m-business applications. Among the application-related issues, the most daunting challenges are identifying killer applications, maintaining data integrity, ensuring data security, and attending to legal and privacy issues. While most of the internet security threats and privacy issues pervade m-business applications, m-business applications introduce new risks due to the mobility and communication medium [12]. These risks are severely dampening the speed of business' and consumers' adoption of m-business as a mainstream business practice.

The last category, mobile e-commerce global issues, raises the question of what impact social, legal, and cultural characteristics of different nations will have on the globalisation of m-business. Issues such as the lack of global standards, the disparity in wireless technology adoption, and global access-pricing variations must be addressed. Many of these three categories of issues still remain unresolved today for businesses to seize the potential opportunities in m-business; therefore, currently it is still difficult to predict consumers' and businesses' acceptance of this new means of communication and business transaction.

Given the nascent nature of m-business and the existence of a plethora of competing and emerging wireless technologies, there is little understanding of how, when, where, and why m-business can add value. Therefore, it is critical for business managers to understand the fundamental value that can be derived from m-business. This in turn enables managers to identify areas and applications within their firms that are candidates for m-business. Given the paucity of research in this area, this paper proposes a generic framework for studying and developing m-business applications. The proposed

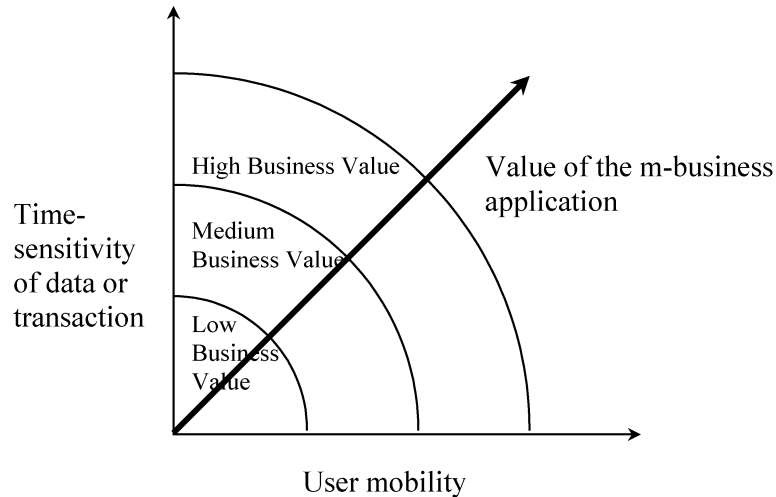
framework can guide a researcher in future research and provide practitioners with a systematic approach to identifying m-business opportunities in their industries.

2 A framework for m-business applications

At this infant stage of m-business, the lack of academic research and industry experience have left many practitioners in the dark when trying to identify m-business opportunities that will contribute to the business value in their organisations. Only a paucity of literature provide useful frameworks to assist businesses understand m-business opportunities (e.g. [13,14]), and no published study has offered any application-oriented framework. To partially fill this void, we present a framework for m-business applications. Besides the theoretical contribution, another purpose of this framework is to provide managers with a systematic approach to identifying m-business opportunities in their organisations. The framework consists of two components. In the first part, the value proposition of m-business applications is examined, and the business processes where m-business applications will bring the most value are identified. The second part of the framework is a technology-independent and application-oriented framework that will help managers device m-business applications that will meet the organisation's goals and objectives. The two components of the framework are discussed in the forthcoming sections.

2.1 Part I: value proposition of m-business applications

As a starting point of their pursuit, business managers must understand how m-business applications will contribute to the success of the company. The business value of m-business lies in its ability to provide users with time-sensitive data and the ability to transact from anywhere at any time. Therefore, it can be argued that the value of m-business is a function of the time-sensitivity of the data or transaction and the mobility of the information user. The value of m-business increases with increases in user mobility and time-sensitivity of the required data or transaction. At one extreme, we have a travelling stock broker whose ability to have access to the most up-to-date stock quotes and market news at all times is essential to his or her effectiveness in the job. Stock quotes and news are highly time-sensitive as they are updated virtually every second. As the stockbroker travels from place to place, being able to use one or more mobile devices to access the latest market information and to execute transactions is highly valuable. At the other extreme, in a situation where the information has little or no time-sensitivity (e.g. historical or periodical reports) or where decisions do not need to be made in real-time or where the user is mostly stationary, the value of wirelessly enabling such applications becomes minimal. Information can be delivered to the user using traditional channels such as paper reports, newsletters, or electronically to the user's PC workstation. The value of m-business applications can be demonstrated using the diagram in Figure 1.

Figure 1 The business value of m-business applications

Using time-sensitivity of the data or transaction and user mobility as the two dimensions, managers can categorise business activities into classes of applications that have the potential to contribute a low, medium, or high level of value to the business by making these applications wireless. This approach allows managers to identify the business processes where wireless applications are likely to bring the most value to the company. Once these business processes have been identified, managers will need to determine which type of value (i.e. efficiency, effectiveness, and innovation) they expect the m-business application to produce. The second part of this framework presents a technology-independent and application-oriented framework for m-business opportunities that will guide managers to arrive at specific wireless applications that will meet a organisation's goals and objectives.

2.2 Part II: a technology-independent and application-oriented framework for m-business applications

A technology-independent and application-oriented framework is a common approach used in research dealing with emerging technologies. Hammer and Mangurian [15] developed the impact/value framework to outline the business values of communication technology in 1987. Based on Hammer and Mangurian's research, Riggins [16] expanded the impact/value framework to identify web-based electronic commerce opportunities. This study will adapt the impact/value framework to study the business opportunities made possible by wireless technologies, and the new framework can also serve as the cornerstone for future research in this area.

Unlike the three impacts of communication technology (time, geography, and relationships) in the original impact/value framework by Hammer and Mangurian [15], the present framework describes the four dimensions of m-business – time, mobility, relationship, and location. First, m-business applications dramatically compress the time required for accessing information and completing business processes. Second, besides allowing organisations to overcome geographic limitations, m-business applications grant users a high level of mobility, making information accessible from anywhere at anytime.

Third, m-business applications help restructure relationships between the provider and the recipient of the information. This occurs both within an organisation and between the organisation and its customers and business partners. Finally, certain m-business applications utilising location identification technologies (e.g., angle of arrival (AOA), time difference of arrival (TDOA), location pattern matching, and GPS) to take advantage of location information in order to proactively seize business opportunities. Due to these unique business impacts that m-business offers, organisations will see increased efficiency in operation, improved effectiveness in decision-making, and innovative business processes that generate competitive advantage. Table 2 provides an impact/value framework for m-business applications. Each cell entry represents a unique business opportunity powered by m-business.

Table 2 A framework of m-business applications

<i>Impact</i>	<i>Value</i>		
	<i>Efficiency</i>	<i>Effectiveness</i>	<i>Innovation</i>
Time	Reduce business process cycle time	Reduce information float	Enhance service quality
Mobility	Capture information electronically anytime-anywhere	Access critical information anytime-anywhere	React to problems and opportunities anytime-anywhere
Relationship	Enhance connectivity and communication	Increase collaboration	Increase information transparency to improve supply chain
Location Leverage	Track and surveillance	Alert and m-marketing campaigns	Localise

2.2.1 *Utilising compressing time*

2.2.1.1 *Reduce business process cycle time*

The operational efficiency of business processes can be greatly improved through m-business applications. These applications allow critical information related to a task to be delivered to the user wirelessly when it is requested, resulting in a significant business process cycle-time reduction. For example, at Embassy Suites hotels, maintenance and housekeeping crews are equipped with mobile text messaging devices. Using a silent page, the front desk can inform the crew the location and nature of the repair without physically locating them [17]. Also, at the Las Vegas Four Seasons, customer food orders are wirelessly transmitted from the poolside to the kitchen [18]. Yet another example where wireless systems have significantly enhanced efficiency involves Johns Hopkins Hospital, where pharmacists use a wireless system for accessing critical information on clinical interventions, medication errors, adverse drug reactions, and prescription cost comparisons [4]. Cost savings of over \$1,000 a day per pharmacist have been reported as the system allows each pharmacist to perform an average of six more interventions a day. These simple yet powerful applications of wireless technologies provide a noticeable advantage to these firms by significantly reducing the cycle time associated with certain processes.

2.2.1.2 Reduce information float

Getting the right information to the right persons at the right time has always been one of the top concerns of businesses. Outdated information is as good as having no information. Therefore, reducing information float has always been a top priority, especially when the associated information can alter the course of action taken by a decision-maker. Wireless systems reduce information float by delivering needed and relevant information to field decision-makers so that time-sensitive business decisions can be made on the spot. For example, at Carlson hotels, managers use Pocket PCs to access all the information they need to manage the properties in real-time. The wireless system compiles information from the hotel's various information systems and delivers it to the manager. This information ranges from how many minutes it takes room services to fill an order to the night's occupancy level. Equipped with such critical information, managers can quickly spot any problems or opportunities at their hotel and react to them [17].

2.2.1.3 Enhance service quality

The wireless technology allows organisations to bring their services to where their customers are, and hence a higher level of customer convenience and service quality can be achieved. For example, the Sheraton hotel in New Jersey is experimenting with a new wireless check-in technology in order to reduce the waiting time for guests during check-in and check-out [17]. Employees carrying wireless devices will be able to check guests in the lobby, parking area, meeting rooms, and any other hotel facilities. The system also allows a key to be issued at the time of check-in from a portable imprint device. This application offers the hotel guests a real and visible convenience.

Major stadiums and retailers are experimenting with wireless point-of-sale (POS) terminals. The new wireless POS terminals can take credit or ATM cards, receive authorisation on the spot, and print out a receipt for the customer. The wireless POS terminals reduce transaction costs, increase the number of contact points with customers, and make the purchasing experience more rapid and convenient for customers. Industry analysts predict a 25% annual growth rate for the sales of wireless POS terminals in the next few years [19].

2.2.2 Taking advantage of the mobility offered by wireless systems

2.2.2.1 Capture information electronically anytime-anywhere

Often business operating efficiency is hindered by paper-based processes and the inability to electronically capture data at its source and in the field. This results in data reentry, repetitive tasks, increase in errors, and waste of human and natural resources. Modern computer systems have partially addressed this problem by replacing a great deal of paper-based systems with computerised systems (e.g., purchasing orders vs. electronic data interchange (EDI)). M-business has taken this process one step further. It allows data capture anywhere in the field and the ability to interact with the company headquarters in resolving problems and answering client questions. For example, consider the operating efficiencies achieved by many utility companies by virtue of employing wireless systems for maintenance inspectors. Traditionally, when a repair work is needed, inspectors create an entry on paper. At the end of the day, the work request is typed and sent to the repair

department, and it will then issue a work order to be sent to the repair technician. With a wireless infrastructure, maintenance inspectors can now send in the repair request by checking a few boxes on the screens of their handheld devices. A work request is automatically generated and dispatched to the repair technician. The new and improved process saves time, reduces errors, and leads to a quicker and more proactive maintenance approach [20]. It is reported that due to these advantages, most utility companies expect to recuperate their costs on the mobile systems within six to 18 months.

2.2.2.2 Access critical information anytime–anywhere

M-business allows users to have access to critical information from anywhere at any time, resulting in greater abilities to seize business opportunities. Target opportunities of this type can be found in situations where a large portion of the workforce is geographically dispersed and highly mobile and where rapid access to information creates competitive advantages and business opportunities.

Producer Lloyds Insurance Company specialises in crop insurance. Since September 2001, it has equipped its field agents with laptops and a host of mobile devices so that they can access the company's Policy Administration & Services System (PASS) and Online Policy Update System (OPUS). The remote access has dramatically mobilised the field agents, which is a critical success factor for the industry. This system allows the agents to get instant quotes, create policies in the field, prepare various insurance forms, and determine claim status. Such services effectively improve the agents' chance of closing a deal that would otherwise slip away. Some insurance companies project a 17–21% increase in annual revenue due to implementation of such systems [21]. Other organisations with a large mobile workforce are also taking advantage of the mobility of wireless systems to help their employees make better business decisions.

Auto-maker Nissan lets the salespeople at the dealership showrooms access customer relationship management (CRM) information using handheld devices. Salespeople can offer customers more attractive deals on the spot based on the customer's history and financial situation as well as provide an array of other services [22].

2.2.2.3 React to problems and opportunities anytime–anywhere

Besides allowing user access to critical information from anywhere at any time, some wireless systems let users react to the information. These innovative systems have changed the way businesses operate and the way employees work. Opportunities abound where problems must be resolved quickly and onsite in order to avoid significant loss and shutdown of operations and where conditions change constantly and a close monitoring and quick reaction are the keys to success. A number of software companies are offering wireless network management tools so that network managers can react to problems from any location [23]. These wireless network management tools are designed to solve remotely some of the most common problems that bring down corporate networks. The cost savings, convenience, and quick resolution to network problems that these tools offer have enticed both large and small companies without an onsite IT crew.

Another innovative use of wireless systems to monitor closely changing conditions and quickly react to problems is found in Formula One auto racing. A high-tech race car speeding at 150 mph has about 120 sensors transmitting real-time data ranging from

engine temperature to the position of each wheel via microwave to the pit crew as well as the team's headquarters in UK. Based on this information, the pit crew can more effectively decide when the car needs to pull in for a pit stop and thus make the necessary adjustments to the car. Engineers at the headquarters also make real-time suggestions to the onsite crew members on how to keep the car running in its optimal condition [24].

2.2.3 Restructuring business relationships

2.2.3.1 Enhance connectivity

It is well known that meaningful improvements in customer–firm communication result in enhanced customer loyalty. Wireless access allows customers to receive value-added services when they need them. Consequently, as the customer's dependence on the service increases, so does the customer's loyalty to the business. Banks and brokerage firms have long been using the internet technology to connect with their high-end and tech-savvy clients. Gartner Group estimates that the percentage of North American banks that offer wireless services will increase from the current 5–29% by 2003. A number of banks, such as Citibank and Juniper Bank, send their customers alerts on balance levels, bill payments, and check clearances. As customers get more and more comfortable with the wireless security, many banks plan to offer wireless bill payments so that customers can act on the alerts that they are receiving [25]. Brokerage firms like Fidelity Investments offer their customers the service of stock quote alerts.

Opportunities for revenue enhancement can also be found in situations where consumer awareness can be translated into sales. Marketers are seeking opportunities to convert cellular phones into an efficient advertising channel. In Europe, businesses are experimenting with sending short messages to consumers' wireless devices to promote their products and services. A survey shows that most consumers in Europe and the USA are willing to receive relevant advertisements via wireless communications [26]. In addition, businesses are using permission-based marketing to target the most receptive group of consumers without alienating them, while some companies, such as BTcellnet, are exploring consumers' reactions to non-opt-in advertisements. Marketers for companies like 20th Century Fox and Pepsi are using mobile games to entice consumers. The mobile games that can be easily played on the small screens of mobile devices promote a higher level of interaction between the business and the consumer [27]. Due to the popularity and the personal nature of the cellular phone, interactive wireless advertising will have a profound impact on how businesses promote their products and services in the near future.

2.2.3.2 Increase collaboration

Wireless systems are restructuring and improving relationships within organisations and between business partners. Information can be synchronised centrally and shared with every employee and business partner. Such systems result in more effective business processes. Historically, the construction industry has been struggling with the problem of a lack of coordination among many subcontractors collaborating on a project. When the right information and building materials are not in the right hands at the right time, it affects the builder's bottom line by creating waste in time and materials. A family of new mobile project management tools allows contractors to track the workflow of the project and share the information with subcontractors. With the vital information about a project

readily available via mobile devices, contractors and subcontractors can collaborate in an effective fashion. As a result, human errors are prevented, and the cost savings are significant [28].

Wireless systems are also producing dramatic results within organisations by empowering front-line employees with information access so that they can take a more active role in decision-making and problem solving. In the transportation industry, truck drivers on the road have not been able to participate in procurement decisions until the recent introduction of wireless solutions. With WAP enabled phones, drivers can access information about loads and book shipments. Instead of depending on the fleet managers, drivers can now work with the fleet managers to find the optimal shipments. This high level of collaboration is only possible when field employees have similar access to critical information as office employees [29].

2.2.3.3 Increase information transparency to improved supply chain

A high level of information transparency in the supply chain can be achieved with wireless systems. In some cases, parties involved in the supply chain are gaining timely information about orders and shipments. In other cases, the supply chain is totally revolutionised by new wireless technologies. For business customers who demand access to supplier information from anywhere, suppliers are providing them with wireless access to business-to-business marketplaces. The new wireless supply chain software allows business customers to access information regarding order status and inventory level and also execute transactions using a wide array of handheld devices [30]. This will soon become a common practice in supply chain management for suppliers to build closer relationships with their customers. In the business-to-consumer arena, as part of FedEx's wireless strategy, FedEx lets its customers track their packages wirelessly and locate the nearest drop-off points. This service is expected to be extremely popular among mobile customers [31]. The service will also help FedEx lock in customers as they become dependent on the service.

Another technology that is currently under development is going to affect the retail supply chain. The Massachusetts Institute of Technology Auto ID Field Center is developing a globally standardised and low-cost radio frequency identification (RFID) technology. The new RFID had the potential to replace the Universal Product Code (UPC) on products as it can provide all parties in the retail supply chain real-time information about the location of the product wirelessly. The RFID will improve the accuracy and speed of inventory management, and most importantly, it will significantly increase the information transparency between the retailer and the manufacturer so that the right amount of the product can be supplied to the right place at the right time to reduce the loss in revenues resulting from out-of-stock products for retailers [32].

2.2.4 Leveraging location information

2.2.4.1 Track and surveillance

By leveraging the location information, organisations that manage mobile assets are achieving unprecedented efficiency. These opportunities abound in situations where the management of mobile assets is crucial to the success of the business. For example, in the trucking industry, truck drivers depend on GPS to determine the best route. These GPS-based systems also provide the driver with information pertaining to the

nearest restaurant, gas station, or rest area. Furthermore, fleet managers at the headquarter are able to dispatch the mobile workforce more efficiently and react to any changes in the shipment as they know exactly where the shipment/truck is at any moment. Consequently, customers can get a highly accurate status report of their shipments and can be informed of any schedule changes due to unexpected heavy traffic or severe weather conditions. Overall, such wireless systems lead to efficient operations, better utilization of the mobile workforce, and higher customer satisfaction [29]. Similar applications can be developed to track any mobile personnel and assets, control inventory, and manage supply chain.

2.2.4.2 Alert and m-marketing campaigns

For the US army, it is important to get real-time weather alerts to the field as weather conditions have a significant impact on the performance of weapon systems and personnel. Newly developed handheld devices give soldiers in the field the ability to access real-time weather alerts and evaluate the effects of the weather on the mission. The vendor is also considering the possibility of combining this technology with GPS systems so that the information can be automatically retrieved for the location of the mission [33]. The same can be done for businesses where location information is a crucial part of the business. The nationwide implementation of the E911 Act will provide businesses and carriers with a new dimension of customer data – real-time location data. This capability will allow marketers to push relevant alerts and advertisements to the consumer when he or she is at a certain location. Businesses are seeking opportunities to leverage the location data to provide their customers with more targeted advertisements and enhanced services. Alert systems and m-marketing campaigns based on the customer's location are promising applications. Imagine getting an alert on your mobile phone that you have a prescription to pick up when you drive within a one-mile radius of the pharmacy. One day, a consumer may get a reminder on a mobile device that his or her car is due for an oil change and that there is an auto service shop 500 feet away that is running a special on the service. Experience gained by retailers suggests that location-based m-marketing campaigns are most effective for promoting last minute offers and attracting impulse buys.

2.2.4.3 Localise

Opportunities for localising information on the fly can be found in situations where consumers in different geographic regions have significantly different needs and where business opportunities may arise as the location changes. Businesses have realised that consumers in different geographic areas respond to different product advertisements. Vert, a technology company, has found a way to integrate electronic billboards on top of taxicabs with the GPS system to create a more powerful promotional tool. Based on the location of the taxicab detected by the GPS system, the central server will transmit electronic advertisements wirelessly to be displayed on the top of the taxicab. The type of advertisements being displayed will depend on the information the company has about the area. This tool allows marketers to better target their customers [34].

3 Conclusions

The goal of this paper is to provide both researchers and practitioners with a holistic view of the m-business phenomenon, its current and potential impacts on business and consumer communities, and a roadmap to investigate or exploit further the opportunities it presents. Towards that goal, a framework for m-business applications that consists of an investigation of the value propositions of m-business applications and a technology-independent and application-oriented framework was presented. The framework provides researchers with a start point to study further the impact and value of m-business applications on modern business organisations. At the same time, the framework will guide business managers to discover m-business opportunities that will lead to an improvement in the efficiency and effectiveness of and innovation in their organisations.

References

- 1 Leung, K. and Antypas, J. (2001) 'Improving returns on m-commerce investments', *Journal of Business Strategy*, Vol. 22, No. 5, September/October, pp.12–16.
- 2 Glass, R.M. (2002) 'What's the value of a wireless business?', *Wireless Business & Technology*, Vol. 2, No. 4, pp.34, 35.
- 3 Reckert, J.R. (2002) 'A whopper of a wireless solution', *Wireless Business & Technology*, Vol. 2, No. 7, pp.52–54.
- 4 Keane, B. (2002) 'Lowering health care costs out-of-the-box', *Wireless Business & Technology*, Vol. 2, No. 2, February/March, pp.36–38.
- 5 Tarasewich, P., Nickerson, R.C. and Warkentin, M. (2002) 'Issues in mobile e-commerce', *Communications of the Association for Information Systems*, Vol. 8, pp.41–64.
- 6 Kelly, S. (2001) 'M-commerce slower than expected', *Communications News*, Vol. 38, No. 7, July, p.10.
- 7 Stephenson, W. (2002) 'Tracking a wireless Trailblazer', *Wireless Business & Technology*, Vol. 2, No. 3, pp.30–34.
- 8 Cisco Systems (2001) 'Wireless LAN benefit study', NOP World-Technology, http://newsroom.cisco.com/dlls/tln/WLAN_study.pdf.
- 9 Schultz, B. (2001) 'The m-commerce fallacy', *Network World*, Vol. 18, No. 9, February, pp.77–82.
- 10 Siau, K. and Shen, Z. (2003) 'Mobile communications and mobile services', *International Journal of Mobile Communications*, Vol. 1, Nos. 1–2, pp.3–14.
- 11 Chan, S.S. and Fang, X. (2001) 'Usability issues in mobile commerce', *Proceedings of the 7th American Conference on Information Systems*, Atlanta, Georgia, pp.439–442.
- 12 Ghosh, A.K. and Swaminatha, T.M. (2001) 'Software security and privacy risks in mobile e-commerce', *Communications of the ACM*, Vol. 44, No. 2, pp.51–57.
- 13 Lau, A.S.M. (2003) 'A study on direction of development of business to customer m-commerce', *International Journal of Mobile Communications*, Vol. 1, Nos. 1–2, pp.167–179.
- 14 Yuan, Y. and Zhang, J.J. (2003) 'Towards an appropriate business model for m-commerce', *International Journal of Mobile Communications*, Vol. 1, Nos. 1–2, pp.35–56.
- 15 Hammer, M. and Mangurian, G.E. (1987) 'The changing value of communications technology', *Sloan Management Review*, Winter, pp.65–71.

- 16 Riggins, F.J. (1999) 'A framework for identifying web-based electronic commerce opportunities', *Journal of Organizational Computing and Electronic Commerce*, Vol. 9, No. 4.
- 17 McGarvey, R. (2002) 'Hospitality checks out wireless', *Mbusiness*, March, pp.18–23.
- 18 Terry, L. (2002) 'Wireless checks into hotels', *Wireless Business & Technology*, Vol. 2, No. 2, pp.30–33.
- 19 Baldwin, H. (2002) 'Sell where you want, when you want', *Mbusiness*, February, pp.29, 30.
- 20 Kuchinskas, S. (2002) 'Wireless helps utilities go with the flow', *Mbusiness*, February, pp.27, 28.
- 21 Rachel, K. (2001) 'Mobilizing the insurance industry', *Wireless Business & Technology*, Vol. 1, No. 9, pp.62–64.
- 22 Nelson, M.G. (2000) 'Nissan readies wireless CRM for salespeople', *Informationweeks.com*, October 2, <http://www.informationweek.com/806/epiphany.htm>.
- 23 Yokomizo, S. (2002) 'Dial 'r' for remote administration', *Mbusiness*, February, pp.31, 32.
- 24 Caulfield, B. (2001) 'Where the code meets the road', *Business 2.0*, October, pp.99–111.
- 25 Fox, L. (2002) 'Wireless banking's next wave', *Mbusiness*, March, pp.33, 34.
- 26 McDonough, B. (2002) 'BT Cellnet tests the waters for mobile ads', *Mbusiness*, February, pp.39, 40.
- 27 Rendon, J. (2002) 'Mobile game ad play', *Mbusiness*, February, pp.43, 44.
- 28 McGarvey, R. (2002) 'Building the wireless way', *Mbusiness*, February, pp.41–43.
- 29 Stevens, M.G. (2001) 'What has 18 wheels and no wires?', *Wireless Business & Technology*, Vol. 1, No. 9, pp.52–55.
- 30 Nelson, M.G. (2000) 'Real-time wireless access to supplier information', *Informationweeks.com*, October 2, p.151.
- 31 Williams, A.M. (2001) 'FexEx delivers information right to customers' hands', *Informationweek.com*, March 19, p.33.
- 32 Rendon, J. (2002) 'The supply chain's RFID gambit', *Mbusiness*, March, pp.43–45.
- 33 Sauter, D. and Torres, M. (2002) 'Mobile weather technology for the army', *Wireless Business & Technology*, Vol. 2, No. 2, pp.58–62.
- 34 Schibsted, E. (2001) 'The sizzle', *Business2.com*, April 17, p.56.