Mobile technology and the value chain: Participants, activities and value creation

Constantinos Coursaris
Department of Telecommunication, Information Studies, and Media
Michigan State University, East Lansing, Michigan, U.S.A., 48824
Tel: +01 517 353 3122
Fax: +01 517 355 1292
E-mail: coursari@msu.edu

Khaled Hassanein
DeGroote School of Business
McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada, L8S 4M4
Tel: +01 905 525 9140
Fax: +01 905 528 0556
E-mail: hassank@mcmaster.ca

Milena Head
DeGroote School of Business
McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada, L8S 4M4
Tel: +01 905 525 9140
Fax: +01 905 526 0852
E-mail: headm@mcmaster.ca

Abstract

Technology has evolved significantly and it is increasingly being used by businesses and consumers alike. Technologies such as those supporting electronic business (e-Business) and mobile business (m-Business) are being used across organizations extensively in an attempt to improve operations and subsequently translate in either financial gains or strategic advantages. Opportunities for realizing either of the two types of benefits can be identified through an examination of a business' value chain.

This conceptual study begins by proposing a business-centric interaction model that helps explain the interactions among all participants involved in an organization's possible activities. The paper then explores the potential fit of wireless and mobile technologies across a company's value chain through the citation of potential mobile and wireless business applications currently available. Finally, a discussion on the expected benefits and relevant concerns of mobile technology, as well as considerations for future research are provided.

Keywords: mobile technology, value chain, mobile applications, m-Business, concerns

1 INTRODUCTION

Technology has evolved significantly and it is increasingly being used by businesses and consumers alike. For businesses, the last two decades have been marked by the transition of large and cumbersome mainframe computing systems, to personal computers offering increased capabilities and occupying only a small area of personal and work space. The latest innovation is found in mobile devices that introduce higher levels of flexibility and personalization. Technologies such as those supporting electronic business (e-Business) and mobile business (m-Business) are being used across organizations extensively in an attempt to improve operations and subsequently translate in either financial gains or strategic advantages. Opportunities for realizing either of the two types of benefits can be identified through an examination of a business' value chain.

The paper begins by defining m-Business and presenting a business-centric interaction model that helps explain the interactions among all participants involved in an organization's possible activities. Then, an overview of the value chain and the impact of m-Business on it are provided through the citation of potential mobile and wireless business applications currently available. Finally, a discussion on the expected benefits and relevant concerns of mobile technology, as well as considerations for future research are provided.

2 M-BUSINESS

Mobile business (m-Business) can be defined as electronic business interactions/transactions enabled at least in part by mobile technology that may target businesses and consumers alike (Coursaris and Hassanein, 2002). For the purpose of this paper the term m-Business incorporates m-Commerce activities which represent the transactions enabled by mobile technology.

There are several mobile technologies that support m-Business. These are typically grouped as devices and networks (White, 2005). Mobile devices range from small radio frequency identification (RFID) and global positioning system (GPS) chips to barcode scanners and wirelessly-enabled handheld personal computers. Mobile networks range from Bluetooth and RFID readers to mobile telecommunications networks and GPS. These mobile technologies are being used by organizations to help address their needs while offering opportunities for flexibility and customization.

Unlike e-Business, which leverages wired and consequently immobile access points (e.g. PCs), m-Business offers value by enabling users to be mobile and reachable anytime and anywhere. Therefore, value creation can occur by supporting either mobile users (e.g. employees) or mobile activities (e.g. tracking raw materials and supplies). A growing industry trend is found in Fixed-Mobile Convergence (FMC), in which centralized management and infrastructure support a mobile workforce, providing "full access to business applications from any location or network connection" (Winther, 2007). Thus, the greater the size of the mobile workforce and/or the higher the ratio of mobile activities within an organization, the greater the value proposition of m-Business for a firm. It is therefore important to explore the types of wireless interactions relevant to businesses.

## 3 A BUSINESS-CENTRIC MODEL OF MOBILE INTERACTIONS

In crafting the value proposition of m-Business for a business, three components are of interest: relevant actors, unique attributes of mobile technology, and the types of activities supported. We begin by identifying the relevant actors. These are described below and included in Figure 1, where interactions occurring among them within a wireless environment (i.e. at least one actor is using the wireless channel) are mapped:

Employees (E) – These are individuals that are part of an organization (in Figure 1 the association is identified by the matching subscripts, e.g. Business 1 has two employees E_{1A} and E_{1B}). Employees may need or want to interact with other colleagues or employees of other businesses. In addition, employees may be at the receiving end of an interaction initiated by both internal and external information systems. One example of a business application in this area is wireless notification by a *System* via SMS for a critical update. To this end, the possible wireless interactions are Employee-to-Employee (E2E), Employee-to-Consumer (E2C), and Employee-to-System (E2S). It is important to note that most such interactions could naturally involve activities in the reverse direction, e.g. a wireless System-to-Employee (S2E) interaction mode as well.

Systems (S) – These are machines that are run by businesses and could either be front-end (e.g. web interface) or back-end systems (e.g. corporate database). An example of this type of interaction is an employee engaged in wireless (and possibly remote) access of the business' Enterprise Resource Planning (ERP) system. To this end, the potential wireless interactions are System-to-Consumer (S2C), System-to-Employee (S2E), and System-to-System (S2S). Again, the activity could occur in the reverse direction as well.

Consumers (C) – These are individuals that a business may interact with wirelessly. One example is an interaction between an employee and the consumer by means of SMS or e-mail. To this end, the potential wireless interactions are Consumer-to-System (C2S), Consumer-to-Employee (C2E), and Consumer-to-Consumer (C2C) to the extent it relates to the business activities (e.g. community-based interactions).

Figure 1: A Business-Centric Model of Mobile Interactions
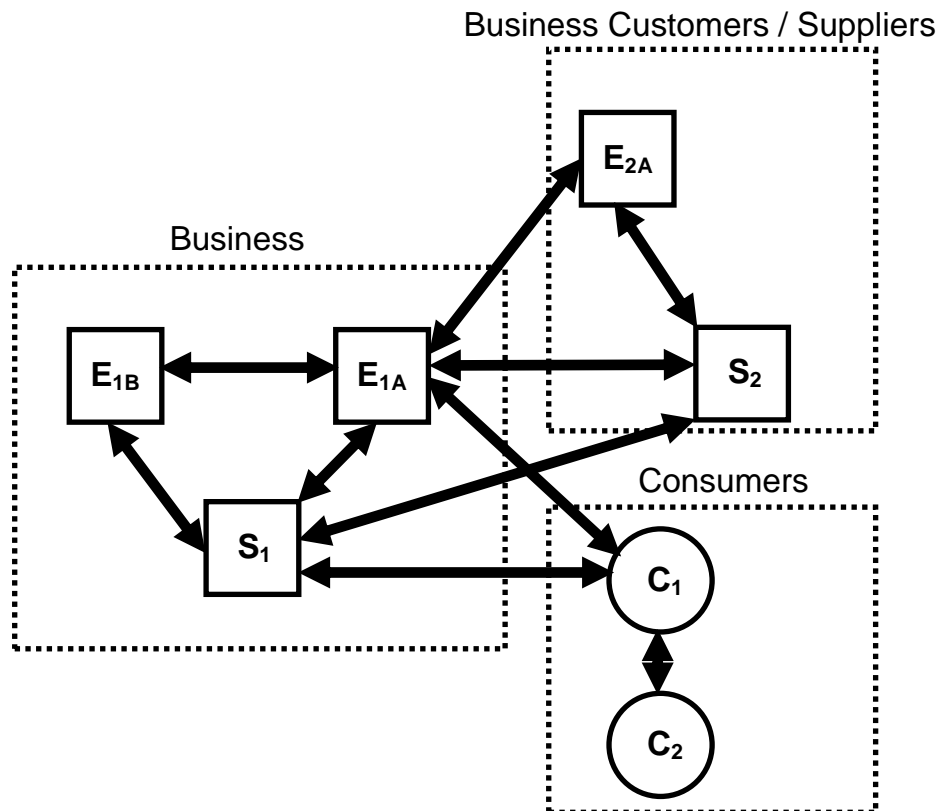
Key:
The Business entity shows two potential employees (E_{1A} and E_{1B}), and a potential internal I.T. system (S_1)
The Business Customers and/or Suppliers entity shows a potential employee (E_{2A}), and an I.T. system (S_s)
The Consumers entity shows two potential consumers (C_1 and C_2)

Having identified the mobile interactions, the next relevant component in formulating a value proposition for mobile technology to organizations is to understand its unique or enhanced attributes, which include connectivity, personalization, and localization (Turban, 2002).

Connectivity - A wireless infrastructure enables mobile workers with 24/7 connectivity supporting "anytime, anywhere" communication and information exchange.

Personalization - Mobile devices are typically assigned to single users, who are then able to personalize interface and application settings that may not only increase their satisfaction with using the device but may also improve the efficiency and effectiveness of the system.

Localization - Localization is particularly important as it adds a new dimension to reachability extending from the Internet's ability to reach a location (i.e. IP address) to reaching a user (i.e. a mobile worker) or an item (e.g. tracking a shipment).

The context of value creation for mobile technology becomes complete by the types of organizational activities supported. These activities are explored next in more detail within the framework of Porter's (1985) value chain.

4 THE VALUE CHAIN

Michael Porter (1985) coined the term "value chain" as the set of linked activities performed by an organization that impact its competitiveness. As seen in Figure 2, the value chain consists of five primary and four support activities. Primary activities are directly concerned with the creation or delivery of a product or service. These include inbound logistics (e.g. receiving and storing raw materials), operations (e.g. converting raw materials through manufacturing into finished goods or service creation process), outbound logistics (e.g. delivering of goods or services to customer), marketing and sales (e.g. identifying opportunities and processing customer orders) and service (e.g. providing after-sales support to customers). These primary activities are facilitated by support activities, which include infrastructure (e.g. organization-wide administrative and managerial systems), human resource management (e.g. managing personnel), technology development (e.g. R&D and continuous enhancements of technology-related activities), and procurement (e.g. purchasing materials and equipment). Support activities span the entire organization, as shown in Figure 2. For example, technology development initiatives could attempt to optimize business activities such as fleet management (inbound/outbound logistics), assembly line operation (operations), sales processing (marketing and sales), and help desk (service). In addition, technology optimization may be used in streamlining operations and freeing up resources "for the strategic initiatives that drive growth and competitive advantage, and accelerate time to business outcomes" (HP, 2007). "Margin" refers to the potential profit margin that an organization could realize through the sale of its product or service, provided the customer is willing to pay more than the cost of the good sold (i.e. cost of all value chain activities involved, from start to finish, in selling a good).

Figure 2: Porter's Value Chain (Source: Porter, 1985)
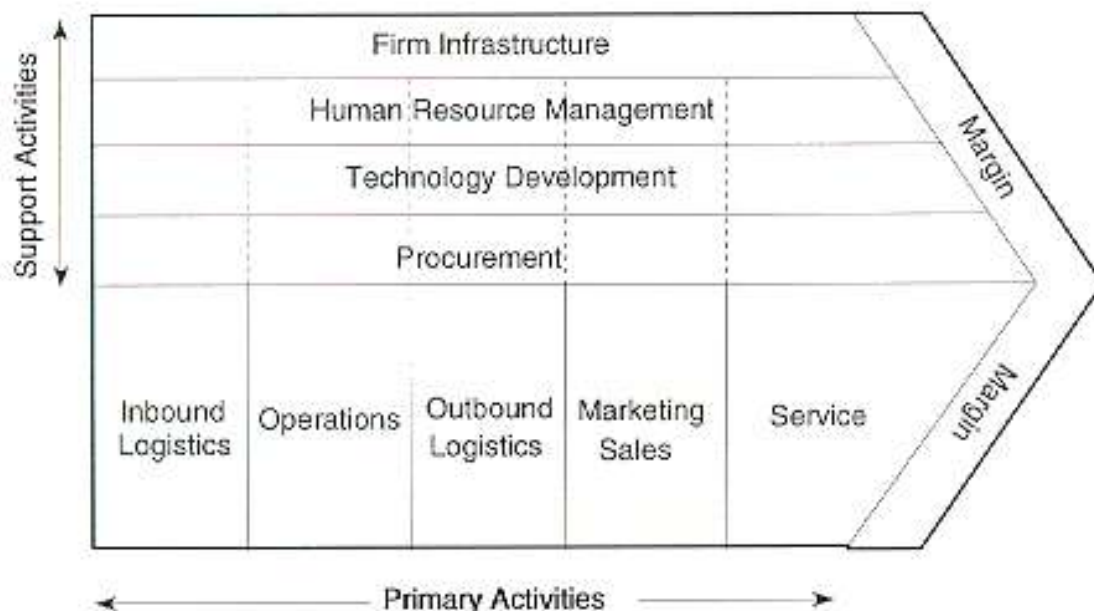
Organizations search constantly for technological opportunities that could yield a lower cost of the goods sold, increased revenue, or improved customer satisfaction, all of which would translate into strengthening a firm's viability. The next section examines how mobile technology can impact an organization's value chain in these areas.

5 MOBILE TECHNOLOGY AND THE VALUE CHAIN

In a landmark paper, Porter examines the impact of the Internet on the competitive positioning of a firm (Porter, 2001). In this work he argues that the basic tool for understanding the impact of information technologies, such as the Internet, on companies is the value chain. According to this approach, the impact of information technologies on a company can be assessed by examining the influence of such technologies on the primary and support activities in the value chain. Here, we employ this approach to gain an understanding into the impact of mobile technologies on companies.

Primary activities

Inbound / Outbound logistics

During these activities a company manages the process of receiving, storing raw materials (i.e. supplies), and distributing finished goods to customers. Supply chain integration and demand chain management are recent extensions in enterprise modeling that require a novel enablement of on-demand information exchanges (Hsu et al., 2007). These information exchanges typically involve a large number of enterprise databases that belong to multiple business partners, and consequently visibility of materials and resources facilitates operational readiness in receiving and delivery timeliness. A current trend highlights the implementation of RFID-augmented systems to integrate enterprise information along the life cycle of a product (Hsu et al., 2007).

RFID tags can be used to track products throughout the entire shipment process (AT&T, 2007c), improving the efficiency of placing new items on the sales floor. For example, after the deployment of their new RFID tagging system, Wal-Mart realized a 19% increase in their use of (RFID tagged) promotional display items. This improvement was attributed to the displays being put up on time and in a correct manner because of the information carried on the RFID tagging system (Hoffman, 2006). In the absence of such visibility, errors can be costly for both inbound logistics, where wrong shipments translate to problems down the supply chain (e.g. meeting outbound deadlines), as well as for outbound logistics where unfeasible order confirmations would otherwise be rejected or rescheduled had real-time inventory data been available at the time the order was being made (Ericson, 2003). Logistics activities can yield strategic business value for a company by lowering distribution costs, reducing inventory, improving customer service, and increasing working capital (Roberts, 2002). Typically neglected, effective inbound logistics can also create value through shorter production and time-to-market cycles of goods produced by the company.

E-Business has been instrumental in generating significant savings during these activities by optimizing processes that previously had been predominantly handled manually. With extensive e-Business applications available in this area, the main driver for using mobile technology is the inherent nature of mobile activities occurring in this segment of a firm's value chain. Receiving raw materials may require the use of a vehicle fleet (e.g. trucks) operated by the company. In this case, wireless fleet management enables real-time visibility of shipment status and performance reporting by providing the location of the shipment's delivery vehicle. For highly valuable products, web-based wireless item-tracking is also possible. Wireless modules are integrated in barcode scanners that allow for automatic registration of shipped products at designated transfer points. This information is then sent wirelessly to a central server for storage. Wireless item-tracking is one of many applications of RFID technology (AT&T, 2007c), making it even more valuable at locations where barcodes cannot be read by fixed devices.

In addition, two-way connectivity between mobile workers (e.g. drivers) and dispatch allows for real-time driving directions, route changes, and delivery schedule updates. General Motors and Siemens are just two of many vendors offering wireless fleet management solutions. These solutions typically make use of the Java2ME platform combined with GPS and GSM/GPRS and other digital networks to enable real-time connectivity between the vehicle, the mobile worker, and dispatch. Solutions are web-based and do not require additional software beyond a web browser (Siemens, 2004).

In addition to the above benefits, fleet management is optimized with integrated wireless solutions. By monitoring a vehicle's status wirelessly, companies are able to improve their "situational awareness, security and decision making in tracking and managing shipments… as they move through global supply chains" (Biesecker, 2006). This area presents significant opportunity for mobile solution providers, since one-third of U.S. transportation companies have been using mobile technology since 2003 (Collett, 2003). Enabling their entire fleet with wireless tracking and messaging can result in these companies eliminating loading errors, improving productivity, and customer service. In a related example, FedEx adopted handhelds that allowed for data exchange directly with the company's back-end system and its Web-based item-tracking application (Collett, 2006). In another case, Lockheed

Martin teamed up with Savi technology to track all of its shipments using RFID-integrated packaging. Not only can customers track the location of their orders, "the tags can also be equipped with sensors that measure humidity, temperature, light, and vibration, which let the shippers know the condition of their goods and whether security may have been breached" (Biesecker, 2006).

20th Century Fox Home Entertainment International was successful in implementing a mobile strategy that involved the use of wireless devices by sales advisors in the UK market. These mobile professionals switched from the traditional pen-and-paper system to wireless PDAs and Bluetooth-enabled mobile phones for collecting necessary information (e.g. retail store DVD stock levels). An integrated SCM solution that exploited the capability for data synchronization via the wireless Web resulted in improved logistics: the stock replenishment cycle shrunk from three days to one day, while product returns diminished from six-seven weeks to one day. A number of additional benefits apply throughout the value chain, including a five percent increase for on-shelf product availability, a ten percent increase in sales, and a 150-labour-hours-per-month reduction in capturing data (Extended Systems, 2004).

Operations

Operations reflect value-creating activities that transform inputs into final products or services. With emphasis on manufacturing and warehouse activities, mobile technology presents organizations with an opportunity to introduce new or enhanced business processes that would result in greater productivity, efficiency, and effectiveness. It could also result in increased employee satisfaction and lower voluntary turnover (AT&T, 2007c).

The use of mobile technology in manufacturing is particularly evident in the automotive and aerospace industries, where approximately two-thirds of all U.S. based companies are actively using it. For example, General Motors installs wireless computers on forklifts so that drivers can send and receive data, such as work instructions and updates, directly from the factory or warehouse floor. This ability is expected to yield savings in excess of one million dollars at a single GM facility by decreasing use of the forklifts by 400 miles per day, and also in productivity increases as the number of deliveries doubled since implementing the wireless solution (Collett, 2003).

Another opportunity for wireless operations is found in quality control (AT&T, 2007c). MicroElectroMechanical Sensors (MEMS) are being developed that will allow for wireless detection of defects. These sensors will identify out-of-range vibrations in industrial equipment and send, and receive data wirelessly with a range of one thousand feet (Collett, 2003). Their small size, approximately the size of a grain of sand, makes them particularly suited for installation on cumbersome machinery, for which quality inspections would otherwise be lengthy and consequently costly. Predictions of wireless operations in the future show a trend toward machine-to-machine (M2M) communications – or S2S according to Figure 1 - for tracking maintenance, service, and status issues (Morley, 2007). By utilizing databases and wireless networking technologies, machines within an operations facility can be monitored automatically, reducing the amount of human labour hours needed to maintain manufacturing equipment.

Real-time wireless asset tracking and inventory visibility is also employed in Operations. Through the use of location-based technologies, e.g. radio frequency identification (RFID) tags and wireless access points (Bryant, 2007), items moved around in a particular facility can be tracked continuously. This allows for faster retrieval of needed items, thus lowering labour costs, increasing productivity and expediting delivery to customers, and subsequently improving customer satisfaction (Collett, 2003). Until recently, the adoption of such technology has been scattered and limited. However decreases in costs and improvement in sensitivity, range and durability have enabled more widespread use of RFID in logistics and operations (Williams, 2004). Powerful players, such as Wal-Mart, have encouraged adoption by requiring their top 100 supplies to place RFID tags on shipping crates and pallets as of January 2005. By the end of 2007, Wal-Mart had over 600 suppliers on board. After two years of RFID implementation, Wal-Mart is starting to reap the benefits, including a 26% reduction in stock-outs along with a plethora of available logistics and sales data (Hoffman, 2006).

BMW is another company that has benefited from RFID implementation by utilizing this technology in its Assembly Finish System to locate any vehicle coming off the assembly line and being parked in any one of 3000 spaces available on site. Similar benefits to those described above are realized through a web-based solution that graphically displays the location of each car on site (WhereNet, 2004).

Inventory visibility is also critical in parts replenishment. Several automakers have implemented wireless solutions that support "just-in-time" manufacturing processes. Typically, the solution continuously monitors and updates inventory levels as stock is being used, and automatically sends a wireless request specifying the type, volume, and delivery location of a material when needed in real-

time. This is an innovative alternative to the traditional "paper-based Kanban parts replenishment systems or hardwired electronic call systems, and it offers the twin advantages of low installation costs and unparalleled flexibility in industrial manufacturing environments" (WhereNet, 2004). Benefits include lower inventory levels, decreased operating costs, and improved productivity, all of which contributed in a significant "Return On Investment" (ROI) of less than one year in the case of the Hummer vehicles. Similar benefits were gained by Monroe Truck Equipment by replacing a broad supplier base with a single provider of raw materials (steel), all enabled through the implementation of a novel wirelessly-enabled just-in-time ordering system (Anonymous, 2007).

Moving away from plant operations and manufacturing, mobile technology can offer significant benefits in the service industry as well. YouthPlaces, a non-profit organization offering youth-related after-school programs, was able to leverage scannable I.D. cards and wireless devices in tracking youth participation in real-time as opposed to experiencing a 30-day lag. This information was then used for activities such as staff scheduling and training (Extended Systems, 2004).

Marketing and Sales

M-Business has been argued by many to be a new channel for commerce. While the objective here is not to support or reject this view, mobile technology certainly enables uniquely two elements of the marketing mix, namely promotion and place (or distribution). Promotion takes the form of wireless advertising and, although it is still at its infancy, it presents significant potential as wireless devices increasingly penetrate the consumer market. Coupled with location-based technology and future built-in sensors and personalization capabilities, wireless promotions can be targeted and more effective. Extending from the promotional opportunities presented, distribution of goods and services to a wireless device is a novel capability, allowing for immediate access/delivery of pertinent data, such as business-related information. By improving the availability of information, mobile workers are more knowledgeable and consequently more productive and effective in satisfying customer needs. Through mobile technology, customer concerns can be addressed immediately by accessing needed resources (e.g. questions on product specifications), without mobile workers having to prepare and carry excessive amount of paper documentation. Finally, in terms of sales, wireless point-of-sale devices enable immediate order fulfillment, reduce the incidence of incomplete transactions (e.g. abandoned shopping carts on the wired Internet), reduce paperwork and waste, improve accuracy of orders, and enhance customer service.

To illustrate these three wirelessly-enabled areas, namely promotion, distribution, and sales, the following examples are cited. Wireless Point-of-Sale (POS) devices are being utilized in retail settings to help employees assist customers on the sales floor without requiring them to wait in long lines for price queries and item availability. On-demand service helps reduce customer turnover, especially during the holidays when large crowds and long lines deter customers (AT&T, 2007a). As an example of promotional activities enabled by mobile technology, SkyGo has been delivering advertisements on wireless devices. Initial consumer feedback has been positive, in particular for time-sensitive coupons from restaurants and media related-promotions such as audio clips for upcoming concerts and movie trailers that further allow users to buy tickets from their wireless Web-enabled phones (News.Com, 2001). While potential benefits of wireless promotions are extensive (e.g. high recall and response rates, reaching clients in a high-growth market sector) (Bergells, 2004), businesses need to place the consumer at the centre of such campaigns and effectively address their concerns. The consumer's ability to personalize the type, volume, and delivery time of advertisements are key success factors in obtaining customer acceptance of this service. In addition to wireless advertising, other forms of wireless promotions include mobile research surveys, e-news sponsorships, and banner ads displayed on wireless Websites.

In terms of distribution, mobile technology provides a new channel for the delivery of simple information such as static web pages, dynamic real-time updates such as location-based traffic information, and rich media such as video streaming of news and movies. Users of web services over mobile phones benefit from "anytime connections," enabling activities that required time-sensitive data. Services such as driving directions and weather updates are frequently needed in a mobile setting where a wired connection is not feasible (e.g. while traveling). Mobile e-mail access also helps users increase productivity and respond to important information in a timely manner. These services are being utilized by employers desiring a centrally managed mobile workforce.

For example, MyPrimeTime utilizes wireless distribution of its articles in real-time to members' mobile devices. These life management related articles can be viewed directly on Web-enabled mobile phones or downloaded for future access on a PC via synchronization. To achieve this, MyPrimeTime has partnered with AvantGo to make use of the latter's mobile Internet service (Petersen, 2000).

Drawing from sales applications, Nappi sales force uses wireless devices to send in orders directly to the corporate back-end system, allowing for timely load and schedule updates, which are then automatically forwarded to the plant. Mobile workers are able to save time from placing phone calls to complete an order and the company realizes savings in terms of communication costs. A barcode scanning feature of some mobile devices further reduces the time to complete a sales transaction and eliminates errors as sales people are not required to key in the order (Collett, 2003).

A similar solution implemented by M.R. Williams, a wholesale distributor of various products, involves the use of PDAs for the collection and wireless transmission of critical data (e.g. inventory levels) from retail stores to corporate back-end systems. This integrated approach resulted in sales increases of 34 percent in the first year of the system's use, as well as in freeing up 60 percent of field sales consultants' time by automating product returns and credits. Additional benefits include improved customer satisfaction and inventory control, as well as increased efficiencies and profits (Extended Systems, 2004).

Service

Corporate responsibility does not end with the sale of a product or service. It continues with ongoing support through after-sales activities that aim to maintain or enhance product value. Most often access to information in a timely manner is a critical component in this endeavor. The flexibility of mobile technology is ideal for supporting mobile workers in unplanned situations that call for information with high variability. Equipping mobile workers with knowledge enhances their ability to solve even the most challenging business problems in less time while improving productivity and customer service (IBM, 2004).

The ability to provide time-sensitive information to mobile workers is a growing competitive necessity. Mobile technology can support collaboration through anytime anywhere access to important information including discussions, documents, workflows, notifications, and e-mail, and provides mobile workers with abilities of synchronization, working offline, and flexibility in the device type used. SiteScape addresses this need for information availability through its wireless collaboration solution. Mobile workers have access to corporate information and key business applications such as Customer Relationship Management (CRM), Sales Force Automation (SFA), Supply Chain Management (SCM), and others that improve productivity, reduce cost of communication, and convert captured data into knowledge thus providing a competitive advantage. Similar benefits can be found through push applications such as emails and system updates (e.g. security updates) sent to wireless devices without requiring mobile workers to log in (Ewalt, 2003). As illustrated through the previous examples, most of these benefits can be realized during other activities as well and not only for Service.

Mobile technology can benefit not only businesses and mobile workers, but also customers. Service technicians are equipped with wireless laptops that contain a library of product repair information (e.g. schematics). When a part is required service technicians can immediately place the order wirelessly directly with the supplier (Collett, 2003). This results in a faster repair and consequently improved customer satisfaction. A similar situation is encountered in the health care industry: integrated mobile devices assist health care professionals with checking-up on patients, keeping track of patient status and medications. Mobile integration offers further benefits by helping workers locate necessary equipment and other workers in emergencies, when time is critical (AT&T, 2007a).

In the service industry, caregivers for in-home patient care employed by STBNO were equipped with wireless PDAs that provide them with current information and real-time updates in terms of patient schedules and care data. With just one fourth of the work force enabled with the new system, the company has achieved a five percent increase in field service productivity. Additional benefits include fewer errors, shorter billing cycles, lower administrative costs, and an improved level of patient care and satisfaction (Extended Systems, 2004).

Support Activities

Firm Infrastructure

A competitive business environment calls for a firm's ongoing effort to develop competitive advantage. This may be found in any of the following gains: operational efficiency (e.g. reducing costs, improving communication); innovation (e.g. implementing new business processes); revenue generation (e.g. increased productivity, introduction of new revenue streams); and customer satisfaction (e.g. improved service). Mobility support is a factor that can positively influence any of the above areas. While employee reachability via mobile phones may be a good start, a truly mobile-enabled enterprise emerges only when employees, applications, and infrastructure are fully integrated. A firm's

infrastructure supports the entire organization and its value chain through systems and mechanisms for planning and control, such as accounting, legal, and financial services (IDA, 2000). Thus, value creation is optimal when a mobile worker is not only able to receive phone calls, but rather able to communicate with business partners, retrieve data, and analyze it by means of applications made available through a mobile device of any type.

Monitoring and supporting a mobile workforce presents a business challenge that goes beyond traditional management requirements. In a pilot study, AT&T devised a new management strategy for over 5,000 employees, whose mobile communications were carried on a variety of networks with an array of calling plans and pricing schemes. By analyzing the multi-carrier system, it was determined that 23% of mobile employees had calling plans that did not fit their usage. By measuring employee usage against hundreds of calling plans in their Multi-Carrier Solutions platform, AT&T was able to streamline their mobile strategy and reduce average monthly cost for mobile systems by 21% (AT&T, 2007b).

While e-Business technologies were responsible for integrating an organization across its value chain, mobile technology will extend this integration across time and place as well. Two areas that benefit from such wireless platforms are communication and information. Wireless devices enable two-way communication through voice, text messaging (and its variants), e-mail, and video-conferencing. Information availability is supported through the integration of mobile technology on existing Enterprise Resource Planning (ERP) systems and all associated modules, such as accounting (e.g. filing expense claims), manufacturing (e.g. monitoring production levels), and quality (e.g. remote management of information technology) among others. Integration across time and place enables synchronization. Synchronous communication, for example, can be realized more often as the time an employee is not reachable is minimized. Synchronous communication will also translate into faster processing of orders, requests, etc. Finally, integrated systems can increase productivity and subsequent profit. Research in Motion's (RIM) Blackberry provides one such solution for mobile workers requiring access to information and communications. This platform integrates voice, email, SMS, wireless Web, organizer and other productivity applications. The proprietary Enterprise Server seamlessly connects multiple enterprise systems (RIM, 2005).

Another platform offering integrated communications and extensive functionality is IT Solution's "m-Power". By utilizing Bluetooth-enabled mobile phones, wireless PDAs and laptops distributed to the company's field service engineers, information technology initiatives including notifications to mobile workers, confirmations of orders, and time sheet management were implemented. This resulted in the following benefits: 50 percent reduction in HelpDesk personnel, 60 percent and 15 percent savings in communication costs to and from field service engineers respectively. Additional benefits include shorter billing cycles and more accurate and reliable expense claim submissions (Extended Systems, 2004).

Human Resource Management

An organization is responsible for employee recruitment, selection, training, development, motivation, and rewards. As employees are an expensive and vital resource to an organization, effective and efficient human resource management (HRM) can add significant value to a firm. Striving for this goal, Motorola decided to redesign its HRM system in an attempt to address present inefficiencies; it was estimated that some employees spent up to 75 percent of their time on administration rather than activities that could be of more value. The solution came in the form of Enet, an HRM system based on Internet technology. This Web-based system, also accessible through wireless devices, allows employees to access critical HR-related information and services anytime anywhere, such as "initiating, approving and tracking administrative change requests such as merit increases, leaves of absence and department job changes" (Accenture, 2005). Thus, clerical work for HR employees is reduced, subsequently reducing paperwork, and allowing them to concentrate on higher value-adding activities, such as relationship management. Benefits of Enet for employees span the entire organization. For example, mobile workers have a direct line of communication with human resources. As a result, there is improved employee satisfaction and greater credibility for the HRM system given a higher level of consistency than previously achieved through paper-based processes. Savings will be realized in the form of "more consistent and efficient processes, cost avoidance, improvements in data integrity and reduced process cycle time, which has dropped from two weeks to two days or less. As a result, the system is expected to pay for itself in just one year. The company also expects Enet to increase employee satisfaction and retention by improving communication and making human resources services more accessible and useful for employees" (Accenture, 2005).

Furthermore, in recent years there is a trend towards satisfying the need for a balanced lifestyle or that of increased work-related mobility through telecommuting and flexible work practices. These

policies can be achieved by adopting mobile technology. While mobile technology is popular among mobile workers in sales, support and field service, only a few companies have implemented wireless services in HR. However, an organization's workforce is becoming increasingly mobile. For example, the U.S. led the world in 2006 with 68% of its workforce being mobile and it is estimated to reach 75% by 2011 (IDC, 2008). At a global level, the mobile workforce is expected to grow by more than 20 percent, with 878 million people working remotely by 2009 (Gosling, 2007) and 1 billion doing so by 2011 (IDC, 2008).

Consequently, wireless HR solutions will become a critical component in successful HRM strategies (Roberts 2001). For example, Wireless-i offers complete solutions for expense and time sheet management that allow employees to enter work-related claims and up-to-date time sheet information easily anytime anywhere (Wireless-I, 2005). By monitoring time utilization and expenses, these solutions allow organizations to reduce HR-related costs, empower employees, improve employee satisfaction, and improve productivity (AT&T, 2007d).

Similar control over field service representatives (FSRs) was desired by Valspar, a leader in the paint and coatings industry. By using their wireless PDAs to scan retail store inventory and update back-end systems, FSRs were tracked in terms of their location and time spent for each job. This feature resulted in better time management by FSRs and in a decrease from three weeks to two days for generating results on ad-hoc requests (Extended Systems, 2004).

Technology Development

Activities focusing on technology development add value to an organization by introducing innovative technology that improves services, products, and business processes. Hence, technology development is an important catalyst for competitive advantage. The latest trend in technology development involves m-Business, where the utilization of mobile technology can potentially reap the above benefits thereby strengthening a firm's value chain. Whether in-house or outsourced, development of wireless solutions can target any of the primary activities and/or their linkages. At the same time, mobile technology can enhance the research process with real-time access to pertinent information regardless of time and/or geographic location, such as real-time consumer feedback transmitted from the user's device (e.g. wireless survey) and wireless access to the organization's knowledge base and knowledge directory. Communication may be initiated by the user or it may be set up to occur automatically between a mobile device and the network at specified times. In addition, mobile technology can foster product development by providing a flexible yet powerful platform for collaboration across locations. Furthermore, the use of the Internet has been shown to have a significant positive impact on Research and Development (R&D) (Linder and Banerjee, 2005). Since m-Business delivers the Internet wirelessly, the benefits gained from e-Business are transferable, thus creating additional value for the organization (caution is needed given the novel usability issues associated with mobile technology). Expected benefits of mobile technology, both current and emerging as in the case of WiMax (AT&T, 2006). in Technology Development include improved productivity through greater accuracy (as calibration can be constantly corrected), improved production times due to reduced downtime, greater flexibility in production times and volumes (DTI, 2005).

One company that has utilized mobile technology in this context is 3Com. The company was able to leverage these wireless networks to strengthen the relationships among team members by improving the communication amongst them and the availability of information to them (3Com, 2005).

Improved communication may also be realized through "On Demand Mobile Conferencing" (ODMC), a solution offered by Zeosoft, a provider for mobile infrastructure software and application development technologies. ODMC enables real-time exchange of information through text messages, file sharing, and live group discussions with white boarding capabilities on a virtual work space accessed by wireless devices. The solution improves "existing business processes, increases employee productivity, and reduces the cost of conducting meetings" (ZeoSoft, 2005).

The ability to gain access to Personal Information Management (PIM) (e.g. e-mail, contact lists) and groupware data was also enabled by First Command's wireless solution. First Command, an international financial management company, implemented a system that allowed for real-time synchronization of sales associates' mobile devices, which not only enabled anytime, anywhere collaboration via the corporate Microsoft Exchange system, but also resulted in savings for each associate of up to three hours per day (Extended Systems, 2004).

Procurement

This support activity encompasses all purchasing transactions for goods and services. Optimal conditions include the lowest price and highest quality for what is being purchased. Mobile technology can add value by enhancing current electronic procurement practices, such as web-based order

fulfillment. Transactional cost savings, increased flexibility, and customer satisfaction are a few of the expected benefits realized when enabling an organization with wireless procurement. Corrigo, a service management solutions provider, offers an application to property managers that enables field technicians to order repair parts through a WAP-enabled mobile device. Eliminating the burden of searching through catalogs for part numbers, followed by phone calls to place an order, apartment maintenance and repair workers can directly access supplier data and order needed parts. In addition, this IT solution brings property managers closer to customers (i.e. residents) by allowing them to enter a service call either by phone or online instead of having them visit the property management's office, and relaying that information immediately to the mobile repair worker. The application also allows residents to track the work order status, while property managers are given visibility to maintenance personnel activities (Moozakis, 2000).

Elcom International, on the other hand, has extended their Internet Procurement Manager to wireless devices. Initially capable only for routing and approvals, eMobileLink enables e-mail notifications of requests for quotes (RFQs), downloading and viewing RFQs, and approving/rejecting them from a wireless device, while integrating settlement capabilities (Ferguson 2001).

A new trend in mobile workforce management is Fixed-Mobile Convergence (FMC), which utilizes a centralized management structure which oversees mobile employees. By using equipment that operates over a variety of networks including cellular, Wi-Fi, and possibly WiMAX in the near future, employees can access and transmit data. When associated with an office private branch exchange (PBX), FMC-enabled devices offer all the functionality of an office phone and laptop computer while allowing the freedom of wireless networks and cellular coverage (Winther, 2007).

In terms of order entry, Zync Solutions, a provider of web-hosted software solutions, equipped field representatives with mobile devices for scanning bar codes instead of placing orders manually, as well as recording any additional information that may be obtained during the store visit. With time savings of 30 percent (i.e. 150 labour hours per month), the information is sent up the value chain wirelessly via the corporate back-end system. Additional benefits include improved information flow, efficiency, productivity, reporting accuracy, response time to retailers' needs, which subsequently improve sales and a faster return on investment (ROI) (Extended Systems, 2004).

Figure 3: Prominent m-Business applications in the Value Chain
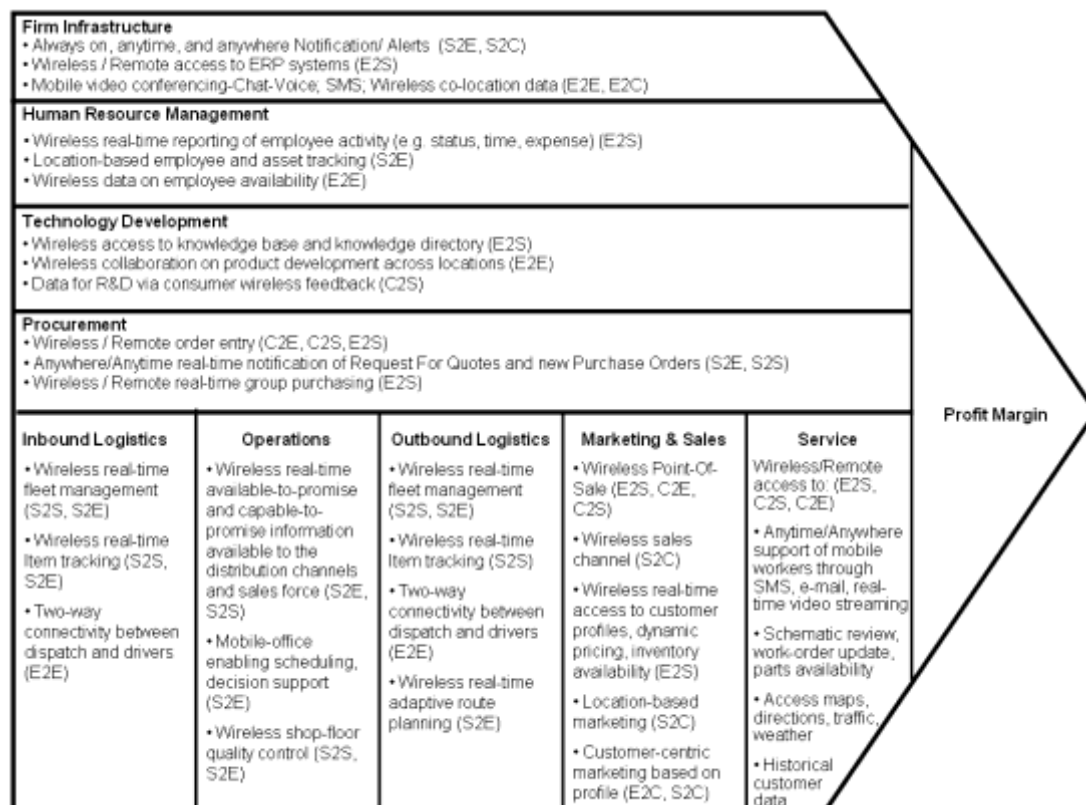
6 DISCUSSION

The foregoing discussion found in the previous section was summarized in Figure 3. Figure 3 describes an organization's primary and support activities in terms of both representative applications currently found in industry, as well as the interaction types (included between brackets) that convey which interactions, from those depicted in Figure 1, are being enhanced by the listed application. Cognizant of these value-adding mobile technologies, managers can then better leverage m-Business to support and enhance both the primary and support activities of an organization's value chain contributing to a firm's overall competitiveness.

By exploring the impact of mobile technologies on the various components of the value chain and through citing extensive industry examples, this paper has demonstrated the potential of such technologies. The applications outlined in the previous section can be generalized and grouped according to the following classification:

> *Asset tracking* – Referring to either physical objects (e.g. merchandise) or human resources (e.g. employees), these applications allow organizations to access tracking information. The organization then leverages the assets' visibility for optimizing processes (e.g. timeliness of deliveries). The function of tracking employees could also be combined with the capability for continuous communication thereby increasing the value of these applications (e.g. a mobile worker equipped with a GPS enabled mobile phone).

> *Data access* – Access to time-sensitive information could enhance an organization's efficiency and effectiveness resulting in competitive advantages. Information could either be pushed to the employees, business partners, and/or consumers (e.g. through SMS), or pulled by employees from remote locations (e.g. field technicians requiring specifications for various jobs). Data access may also optimize an organization's data management, with collaboration applications that support knowledge sharing and increase knowledge flow.

> *Automation* – Mobile technology can be used to automate some tasks previously performed by employees. Benefits for an organization may include lower workforce requirements, improved employee time allocation, and improved quality by automating processes and reducing employee errors. One company that implemented such mobile workforce automation processes is Intermountain Gas Company (IGC). IGC serves more than 275,000 "natural gas customers across Southern Idaho and employs 350 people in seven district offices" (IGC, 2008; Itron, 2005). Unlike many utilities, IGC did not have an integrated dispatch system for work orders rather routed orders either by paper or radio. By enabling dispatch and field service workers to communicate and share data in real time through a wireless, web-based mobile communications and automated solution, IGC "improved emergency response by quickly identifying the nearest field representative with appropriate skills; decreased fleet mileage through tighter, more efficient routing and streamlined order processing by eliminating reams of paper orders and reducing data entry errors. Employee productivity and customer satisfaction increased while the costly paperwork and time associated with traditional manual work order processing was eliminated" (Itron, 2005).

Despite the above applications and associated benefits of mobile technology, it is still in its infancy and companies are faced with the dilemma of why, and if so, when they should invest in it. The decision will depend on many factors, one of which is whether the organization's workforce needs to be or is already mobile. In this case, opportunities arise according to the environment in which it operates. Within a B2B and B2E environment, the value propositions are similar in that mobile technology and the corresponding applications aim to improve the productivity of the parties involved, while the focus varies between the two settings. In B2B it is the efficiency and effectiveness of the interactions between organizations that is of interest. In B2E the efficiency and effectiveness of a single worker and/or a team can be enhanced by wireless solutions that help increase productivity, streamline administrative processes, and build competitive advantage by simplifying and improving the effectiveness of collaboration.

In addition to the above considerations, there are several concerns that arise with using mobile technology in a business setting. Such concerns exist at the level of employees, organizations, and even society at large, and include the following:

> *Employees* - Poor ease of use and low perceived usefulness may be deterrents in workers' adoption of a newly implemented technology (Davis et al., 1989). This usability concern is related to the concern for compatibility between current mobile technology capabilities and employee

expectations, values and experiences. Also, privacy concerns may arise, as the content of an employee's communication, but also his/her whereabouts may be perceived as intrusive and as a threat to their individual privacy.

Organization – Given the unique nature of mobile technology and its vulnerability (Coursaris et al., 2003), concern regarding the safety of information exchanged over a wireless network increases with the degree of interaction and the sensitivity of the information exchanged (Rogers, 1995). In addition to security, there is concern over the reliability of the technology. Connection quality should be maintained for the specified network coverage. The inherent concern here is that loss of the connection can result in loss of data (Nielsen, 2000). Lastly, organizations are faced with the concern over the cost of implementing mobile technology and the expected return on that investment. As some benefits may be intangible and difficult to quantify (e.g. improved communication, timely decision making, improved customer satisfaction through increased responsiveness, etc.), it may be challenging for a business to have sufficient evidence in support of adopting mobile technology.

Society – Social skepticism around the growing use of mobile technology is in part due to the confusion over its effects on people's health. Studies have been inconclusive on whether this technology can be potentially harmful in the long-term, but in the absence of a clear answer there is apprehension towards use of such systems. Concerns over an individual's privacy and security may also deter them from using mobile solutions put forth by businesses. For example, location tracking may be perceived as threatening, both in the context of unsolicited messages/advertising and physical safety, as this information could be dangerous if intercepted. Furthermore, anytime and anywhere access offered through mobile technology provides employees with valued flexibility, but further blurs the line between work and home. Since mobility may provide 24/7 access to employees, expectations of 24/7 availability and responsiveness may also surface. This may have detrimental effects on the quality (and quantity) of leisure time and home life.

7 CONCLUSION

This paper examines the potential for mobile technologies to provide value to various business activities. Resulting benefits of mobile technology implementations may include improved productivity through enhanced process efficiency and effectiveness, as well as improved customer service. Organizations, however, need to be cognizant of potential concerns among employees and society at large in their assessment and implementation of such technologies. This paper can serve managers as a go-to resource during their initial consideration of mobile technology. Rather than making multiple choices and adopting various technological standards, a comprehensive consideration of the organization's value chain can provide a holistic representation of the company's needs. Having identified such an aggregate set of needs, information technology (I.T.) managers can proceed with the adoption of integrated systems that either include or entirely consist of mobile technologies and span multiple areas of the organization supporting a subset of services presented in this paper and delivering maximum value. In addition, I.T. managers were provided in this paper with a different lens that could be used during their assessment of I.T. resource needs. Moving beyond the individual user's needs and considering each individual's potential interactions with other employees and systems, an enhanced set of user requirements is produced from which, again, I.T. choices pertaining to mobile technology adoption are likely to become less risky and may have a higher return on investment.

While the value-chain framework provided in this paper can help managers employ new mobile technologies or assess the value and appropriateness of existing mobile applications, there are several fruitful areas for further investigation. Future research could delve more deeply into each primary or support activity to explore specific advantages and obstacles across various industries. Detailed case studies can be examined to provide managers with concrete best practices in their industry or comparable industries. Additionally, the value chain framework could be used as a lens to understand the current mobile technology platforms and how they support specific needs and expectations of employees, trading partners and customers. Lastly, empirical data could be gathered to provide further evidence of mobile technology usefulness for various value chain activities. Such data could focus on the perceived value of such technologies from various stakeholder perspectives.

REFERENCES

3Com (2005). 3Com Goes Wireless To Improve Employee Productivity. Retrieved February 5, 2008, from http://www.3com.com/solutions/en_US/casestudy.jsp?caseid=137286

Accenture (2005). Internet-Based Human Resource Solution Empowers Motorola Employees. Retrieved on January 28, 2005, from http://www.accenture.com/xd/xd.asp?it=enweb&xd=industries%5Ccommunications%5Chigh-tech%5Ccase%5Chigh_motorola.xml

Anonymous (2007). Just-in-time model eliminates Posat Monroe Truck Equipment. *Purchasing*, 136, 11, 32-37.

AT&T. (2007a). Vertical Applications for Wireless LANs. *AT&T Knowledge Ventures*. Retrieved October 25, 2007, fromhttp://www.business.att.com/resource.jsp?repoid=ProductCategory&repoitem=eb_mobility&rtype=Whitepaper&rvalue=vertical_applications_for_wireless_lans&download=yes&segment=whole

AT&T. (2007b). Making the Case for Enterprise Mobility. *AT&T Knowledge Ventures*. Retrieved October 25, 2007, from http://www.business.att.com/content/whitepaper/POV-TCO-mob_11495_V03_11-07.pdf

AT&T (2007c). Radio Frequency Identification. *AT&T Knowledge Ventures*. Retrieved October 25, 2007, from http://www.business.att.com/content/whitepaper/radioidentification.pdf

AT&T (2007d). Market brief: The Age of the Wireless LAN. *AT&T Knowledge Ventures*. Retrieved October 25, 2007, from http://www.att.com/Common/merger/files/pdf/wireless_LAN.pdf

AT&T (2006). Laying the Groundwork for WiMAX. AT&T Knowledge Ventures. Retrieved October 25, 2007, from http://www.business.att.com/content/article/wimax_gndwk_pov.pdf

Bergells, L. (2004). Wireless Advertising Plan in Six Steps. *Maniactive*. Retrieved October 25, 2007, from http://www.maniactive.com/wireless.htm.

Biesecker, C. (2006). Lockheed Martin Forms Savi Group to Zero In On Supply Chain Solutions. *C41 News*. November 23, 2006. 1. Retrieved November 15, 2007.

Bryant, J. (2007). WiFi on the plant floor. *Control Engineering*. 54, 8, 8.

Collett, S. (2003). Wireless Gets Down to Business. *Computer World*, May 23, 2003. Retrieved on January 28, 2005, from http://www.computerworld.com/mobiletopics/mobile/story/0,10801,80864,00.html

Coursaris, C., and Hassanein H. (2002). Understanding m-Commerce: A Consumer-Centric Model. *Quarterly Journal of Electronic Commerce*, 3, 3, 247-272.

Coursaris, C., Hassanein, K., & Head, M. (2003). M-Commerce in Canada: An Interaction Framework for Wireless Privacy. *Canadian Journal of Administrative Sciences*, 20, 1, 54-73.

Davis, F. D., R. P. Bagozzi, and P. R. Warshaw (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35, 8, 982-1003.

DTI (2005). Wireless & Mobile. *Department of Trade and Industry*. Retrieved on October 25 from http://www.dti.gov.uk/bestpractice/technology/wireless-mobile.htm

Ericson, J. (2003). Considering Inbound Logistics. *Line 56*, August 23, 2003. Retrieved on July 30, 2004, at http://www.line56.com/articles/default.asp?ArticleID=4936&ml=2.

Ewalt, D. (2003). OneBridge Mobile Groupware lets companies support remote workers across multiple networks, hardware, and platforms. *InformationWeek*, August 4, 2003. Retrieved on January 28, 2005, from

http://www.informationweek.com/story/showArticle.jhtml?articleID=12808297

Extended Systems (2004). Success Stories. Retrieved on January 28, 2005, from http://resolution.extendedsystems.com/esi/products/mobile+data+management+products/shared/success+stories/_success+stories.htm.

Ferguson, B. (2001). E-Procurement Goes Wireless. *eWeek*, February 7, 2001. Retrieved on January 28, 2005, from http://www.zdnet.com.au/news/communications/0,2000061791,20156914,00.htm.

Gosling, A. (2007). Lumension Integration For Enterprise Security. *Mobilise*, December 14, 2007. Retrieved on March 4, 2008, from http://www.mobilised.com.au/content/view/1205/96/.

Hoffman, W. (2006). Wal-Mart Tags Up. *Traffic World*. August 16, 2006, 1.

Hsu, C., Levermore, D., Carothers, C., Babin, G. (2007). Enterprise Collaboration: on-demand information exchange using enterprise databases, wireless sensor networks, and RFID systems. *IEEE Transactions on Systems, Man, and Cybernetics—Part A: Systems and Humans*, 37, 4, 519-532.

HP (2007). HP BTO software: Accelerate time to business outcomes – White Paper. Revised June 1, 2007. Retrieved on March 3, 2008, from https://h10078.www1.hp.com/cda/hpms/display/main/hpms_content.jsp?zn=bto&cp=1-11%5E4864_4000_100__

IBM (2004). RFID solution for supply chain management and in-store operations. Retrieved from http://www-1.ibm.com/industries/wireless/doc/content/solution/1025230104.html

Introducing a truly Mobile Server (2005). Retrieved on January 28, 2005, from http://www.zeosoft.com/htmlsite/downloads/Product_Overview.pdf.

IDA (2000). Infocomm21: Leadership Dialogue. *IDA Singapore 2000*, August 2000. Retrieved on January 28, 2005, from http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN011538.pdf.

IDC (2008). IDC Predicts the Number of Worldwide Mobile Workers to Reach 1 Billion by 2011. Press Release, January 15, 2008. Retrieved on March 3, 2008, from http://www.idc.com/getdoc.jsp?pid=23571113&containerId=prUS21037208.

IGC (2005). About IGC. Retrieved on March 3, 2008, from http://www.intgas.com/aboutigc/aboutigc.html.

Itron (2008). Itron to Provide Service-Link® Mobile Workforce Automation Technology to Intermountain Gas Company. Press Release, June 27, 2005. Retrieved on March 3, 2008, from http://www.itron.com/pages/news_press_individual.asp?id=itr_000131.xml.

Linder, J. and Banerjee, P. (2005). Research and Development in the 21st Century: Web-Enabled Innovation Comes of Age. *Accenture*. Retrieved on October 25, 2007, from http://www.accenture.com/xd/xd.asp?it=enweb&xd=ideas%5Coutlook%5Cpov%5Cpov_randd.xml.

Moozakis, C. (2000). Procurement App Will Go Wireless. *InternetWeek*, December 11, 2000. Retrieved on January 28, 2005, from http://www.internetweek.com/ebizapps/ebiz121100-2.htm.

Morley, D. (2007). M2M—The New Robotics. *Manufacturing Engineering*, 138, 4, 144.

News.com (2001). Cell phones: The next great ad conduits? Retrieved from http://news.com.com/Cell+phones+The+next+great+ad+conduits/2009-1033_3-254140.html

Nielsen, J. (2000). Designing Web Usability: The Practice of Simplicity. Indianapolis, Indiana, New Riders Publishing.

Petersen, L. (2000). MyPrimeTime, Inc. Gains Wireless Distribution Through AvantGo. *MyPrimeTime*, November 2000. Retrieved on January 28, 2005, from http://www.myprimetime.com/misc/press/Avant_Go.shtml.

Porter, M. (1985). The value chain and competitive advantage, Chapter 2 in Competitive Advantage: Creating and Sustaining Superior Performance. *Free Press*, New York, 33-61.

Porter, M. (2001). Strategy and the Internet. *Harvard Business Review*, 79, 3, March 2001, 21pgs.

RIM (2005). Products. Retrieved on October 25, 2007, from http://www.rim.com/products/index.shtml

Roberts, B. (2001). HR Unplugged: Wireless technology could help practitioners better serve an increasingly mobile work force - HR Technology: Systems & Solutions - Human Resources - Statistical Data Included. *HR Magazine*, December 2001. Retrieved on January 28, 2005, from http://www.findarticles.com/p/articles/mi_m3495/is_12_46/ai_81393642/pg_2.

Roberts, M. (2002). Inbound Logistics Recognizes Schneider Logistics as Top Logistics IT Provider. *Schneider Logistics*, May 20, 2002. Retrieved on January 28, 2005, at http://www.schneiderlogistics.com/company_info/news_releases/ibltop100_0502.html.

Rogers, Everett M. (1995). Diffusion of Innovations. New York: The Free Press.

Siemens (2004). GSM/GPRS Modules keep a Constant Watch on Goods and Products. Retrieved on October 25, 2007, from http://communications.siemens.com/cds/frontdoor/0,2241,hq_en_0_2245_rArNrNrNrN,00.html.

Turban, E., Lee, J., Warketin, M., and Chung, M. (2002). Electronic Commerce: A Managerial Perspective, Prentice Hall, page 867.

WhereNet (2004). Hummer Factory Implements WhereNet's Wireless Solutions to Enhance Assembly Line Operations and Expedite Production. *WhereNet*, March 9, 2004. Retrieved on January 28, 2005, from http://www.wherenet.com/pressreleases/pr_03_09_2004.html.

White, A. and, Breu, K. (2005). Mobile Technologies in the Supply Chain: Emerging Empirical Evidence of Applications and Benefits. *Proceedings of the 26th World Congress on the Management of E-Business*, Hamilton, Ontario, Canada, January 19-21, 2005.

Williams, D. (2004). The Strategic Implictions of Wal-Mart's RFID Mandate. Retrieved from http://www.directionsmag.com/article.php?article_id=629&trv=1&PHPSESSID=8beb74b1215e23 26d82ac11e775091c5

Winther, M. (2007). Fixed-Mobile Convergence: Lowering Costs and Complexity of Business Communications.

Wireless-i (2005). Products. Retrieved from http://www.wireless-i.com/ourProducts.asp.

ZeoSoft (2005). A New Approach To Enterprise Wireless Strategies. Retrieved on October 25, 2007, from http://www.zeosoft.com/htmlsite/downloads/Product_Overview.pdf.