Mobile communications: evolution and impact on business operations

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Abstract

In recent times, a number of handheld mobile communications devices have taken prominence with a significant impact on global business operations. It is fascinating to learn the history of mobile communications, including the types of devices available and the growth of these technologies. The deliverables for determining if the customers are satisfied are provided in examples of successful implementation of mobile communications in businesses. In addition, it is observed in certain industries, handheld mobile communications have led to closer partnerships between a company and its customers and suppliers all over the world.
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1. Introduction

We are presently in the midst of a global telecommunication revolution. A powerful confluence of technological, economic and social forces is leading to rapid change in the capabilities, price and performance of telecommunications services. Technological forces are driving intense innovation and the convergence of voice, video and data communications. As the telecommunications industry becomes more competitive, deregulation further intensifies the economic forces. Prices are falling as countries open their borders to market competition, and global standards are enabling more uniform and consistent services.

Mobile and wireless technologies are becoming increasingly pervasive. Mobile phones were once considered a luxury, but are now taking the place of conventional telephones in residential use. Wireless networks free users from the tethers that have bound them to their desk, enabling them to live and work more flexible and convenient ways.

Historical perspective is presented on the two most widely used mobile communications devices—cell phones and personal digital assistants. Current state,

including growth and new developments, of mobile communications is reviewed and a number of industry applications are briefly described. Analysis and ramifications of mobile communications in so far as global business operations are affected providing the concluding thoughts.

2. History of cell phones

In 1946, AT&T started the first mobile telephone service through the public telephone system. It required a manual search of an open radio channel prior to placing a phone call. The user would link to a mobile operator, who would then dial the call over the public telephone system. In this arrangement, controlled by a talk button, only one party was able to speak at a given time. This was called a "simplex" radio connection (Dalglish, 1999).

In 1964, Ma Bell improved mobile telephone service. It featured automatic dialing and channel searching with a "duplex" connection. This system had a few channels available as each radio frequency was used only once in the whole geographic region. Usually, in a large city this system could serve about 300 plus customers with another 2000 or more customers waiting for service. In order to provide coverage throughout the entire service area, the antenna for this service had to be placed on a very high structure.

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Motorola and AT&T developed and introduced advanced mobile phone system (AMPS) in 1983 with over 2 million subscribers of this system by 1988, which was not adequate to cover the demand. In 1991, Motorola came up with an analog system called Narrowband AMPS in which each existing 30 kHz channel was divided into three 10 kHz channels. During same period, late 1980s and early 1990s, Inter Digital Communications Corporation developed and introduced another system, which used digital technology and Time Division Multiple Access (TDMA) method. This approach enabled three new voice channels in place of one AMPS channel. Each subscriber of service could use the entire radio frequency channel to transmit data for shorter time frames. TDMA was designed to operate with the efficiency of digital technology and to create a global standard in which all systems would be compatible.

Qualcomm, a San Diego, California company introduced in 1994, another cell phone technology known as Narrowband Code Division Multiple Access (CDMA), which was adopted as standard by the Telecommunications Industry Association. It offered 10–20 times the capacity of existing analog AMPS systems.

The rate of growth of worldwide mobile phone sales has been dramatic but has recently tapered off (Standard and Poor's Industry Surveys, 2002). Fig. 1 presents the growth of worldwide mobile phone sales on a yearly basis.

Within the United States the wireless industry has grown dramatically. Fig. 2 reports yearly growth in the number of subscribers.

Along with the growth in subscribers has come a growth in service revenues. Fig. 3 presents yearly growth in total service revenues.

Why have cell phones been so popular over the last decade? The answer is simple—mobility. The overall dynamics of the industry have changed, with carriers concentrating on profitability rather than raw subscriber growth. In addition, customers had been delaying their orders until new Internet-ready phones were available. On the profitability front, various mobile standards and
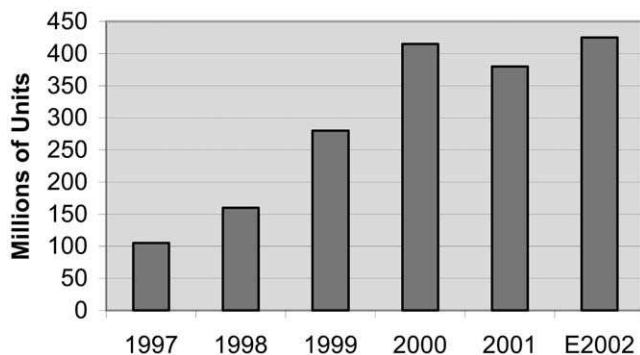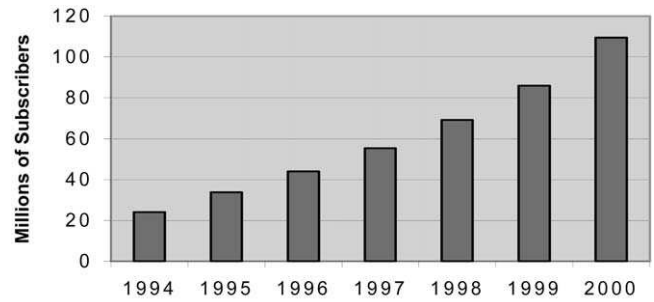

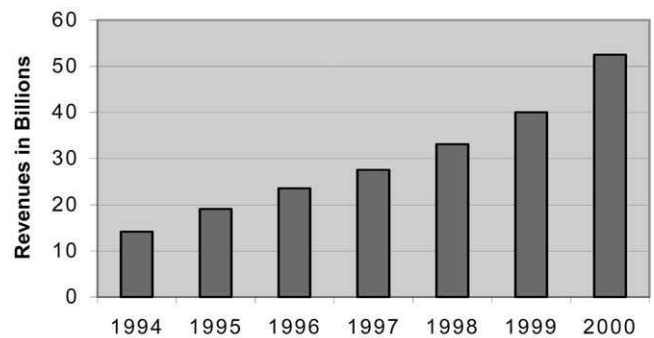Fig. 2. US wireless industry total subscribers by year

Fig. 3. US wireless industry total service revenues

new technologies have created a more complex production cycle that is increasing manufacturing and research costs. With growth rates for the wireless sector declining, product pricing will become an even more important differentiating factor. Wireless handset vendors that cannot produce in large volumes and gain economies of scale will have difficulty turning profits.

3. History of personal digital assistants

The personal digital assistant (PDA) developed from the desire to carry a handheld version of items found on one's computer, such as addresses and phone numbers, date book, calculator, etc. This topic revolves around Palm, Inc., a pioneer in mobile and wireless Internet solutions and the world leader in handheld computing. It was founded in 1992 (Palm, 2002). US Robotics Corporation acquired the company in 1995. In 1996, Palm introduced the Pilot 1000 and Pilot 5000 products that led the resurgence of handheld computing. In June 1997, Palm became a subsidiary of 3Com Corporation when 3Com acquired US Robotics. With its acquisition of Smartcode Technologie in February 1999, Palm added advanced wireless communications capabilities to the Palm OS platform to address the market for mobile information appliances, such as cellular telephones, messaging devices, data communicators and smart phones. In June 2000, Palm announced the acquisition of Actual Software Corporation, a leading provider of email sol-

Fig. 1. Worldwide mobile phone sales

utions for the Palm OS platform and the provider of the award-winning MultiMail line of products.

According to 2001 figures, Palm is the leading global provider of handheld computers with a 41.5% share of the worldwide personal companion handheld device market, and a 60.3% share of the worldwide handheld OS market. Palm products are sold in more than 54 countries and through Internet retail websites.

The Palm Economy—a community of Palm OS licensees, nearly 200,000 registered developers and others committed to advancing the platform and its offerings—has created more than 13,000 software applications and more than 100 add-on devices. Palm handhelds are growing increasingly pervasive as information management becomes ever more mobile. Palm believes that handheld computing is the next wave in individual productivity tools for the global workforce.

Developing applications for mobile units to generate revenues is a major undertaking. Fig. 4 presents the increase in Palm applications developers since March of 1997 when there were 2000 such developers.

The growth of the handheld computing market is, in part, being driven by the transformation of the corporate environment into an extended, virtual enterprise supported by a highly mobile, geographically dispersed workforce requiring fast, easy remote access to networked resources and electronic communications. Palm continues to provide solutions to address this growing demand with products that are simple, wearable, and connected. As of January 2002, in an update on the state of the handheld marketplace, Palm reported that the total number of Palm powered devices sold had surpassed 20 million worldwide. November 2001 sales figures from market research firm NPD Intellect showed Palm powered handhelds made up about 82% of all handhelds sold at retail in the United States.

4. Mobile communications today

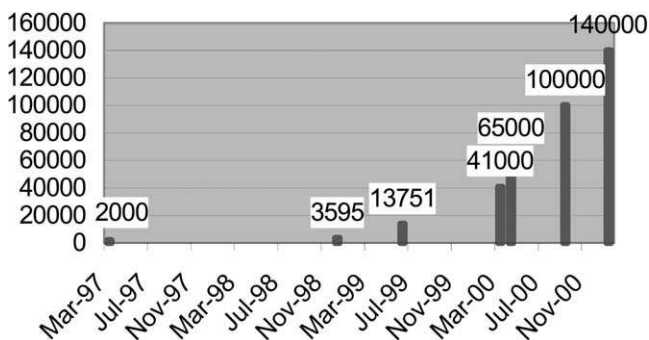Mobile Communications is defined as content delivery, both notification and reporting, and transactions, both purchasing and entry, on mobile devices (Leung and Antypas, 2001). The devices fall into the following five categories:Category 1 consists of two-way pagers/SMS (Short Message Systems) devices.Category 2 consists of Wireless Application Protocol (WAP) equipped cellular phones, which make them Internet enabled.Category 3 consists of Personal Digital Assistants (PDA) with wireless modems.Category 4 consists of Wireless Internet Access on laptop computers.Category 5 consists of In-premise IEEE 802.11(a/b) wireless network devices.

In this section the state of mobile communications is reported in terms of global growth, new developments in this field and a number of industry applications.

4.1. Worldwide growth of mobile communications

The United States has more PCs per 100 inhabitants than any other country. However, the US is far behind Europe and Asia with respect to cell phone users (Anonymous, 2002). The US has the lowest percentage of households using alternative devices for Internet access than other industrialized nations. Only 7.6 million US households have alternate Internet access devices—Web-enabled cell phone (5.1 million), Net-enabled PDAs (1.9 million) and interactive televisions (600,000). By comparison, more than half of Japan's 70 million cellular phone subscribers have Net access via handset.

A new breed of pan-African companies is creating the mobile miracle in Africa (Rose, 2002). A distinctive feature of Africa's mobile revolution is that the major players are not multinationals with core businesses outside the continent, but that the firms are forged on the continent. Of these, perhaps Econet and MTN are the real heavyweights, with both companies recently forking out a hefty $285M each to secure two of the biggest prizes Africa has to offer the private sector, a GSM mobile operator license for Nigeria. The wealth of this prize can be seen in perspective by the fact that within six months of operation, both firms are estimated to have signed up at least 200,000 subscribers each. Analysts say that the Nigerian market could even reach 10 million subscribers at its peak.

4.2. New developments in mobile communications

Palm Inc. introduced the Wireless Database Access Server (WDBAS) for systems integrators who need to create wireless applications that access corporate databases in real time. WDBAS lets software developers use familiar Integrated Development Environments (IDE) to develop mobile applications and extend them so that remote users can access corporate data wirelessly and in real time. This is unique and contrasts with other approaches that are only sync- or browser-oriented. For a mobile user a sync application maintains data on the device and updates it only when the user synchronizes

Fig. 4. Number of palm developers

with the cradle, so the user does not have the most up-to-date information. A browser application lets the user have up-to-date information only in the coverage area. If out of wireless coverage the application cannot function. Palm's approach sits between these methods, letting developers build an application that can access previously stored data while offline, and also taking advantage of real-time data access so users have up-to-date information. WDBAS can also work with leading synchronization products to deliver hybrid applications combining the best of real-time data access and synchronization.

The big m-communication success story that everyone in Europe and the US hopes to emulate is I-Mode, a device that a typical teenager in Japan has to have (Anonymous, 2001). I-Mode is big in Japan, largely because it is cheap, fast and offers access to about 600 official sites and thousands of unofficial sites. Users can send e-mails, transfer funds between bank accounts, book plane tickets, see what is playing at the cinema, find the nearest hotel or restaurant, play interactive games, check their horoscope and download melodies which they can play on their phone. Fig. 5 presents the increase in I-Mode sites in Japan (Naruse, 2002).

Teenagers may be going forward with this technology, but it will be businesses that feel the benefit of power and speed. Mobile phone makers will have bigger, better and more secure phones. The screens on phones are getting larger and one can plug in external keyboards. We just need fast, always on, affordable bandwidth to be available.

4.3. Mobile communications industry applications

A prominent industry application of mobile communications relates to Britannica. The company decided not to go the wireless route just by itself (Tam, 2000) and realized partnerships are vital. The company quickly began to look around for alliances to license Britannica's content to other wireless Web sites. The team formed by the company was charted to get familiar with wireless

technology, using resources and tools from other wireless players including handheld device maker Palm Inc., and wireless modem company OmniSky Corporation. Britannica was approved as a new application for the Palm and formally introduced in April 2000. At the same time OmniSky contracted to feature Britannica as a major content provider. After weeks of technical testing of the application, Britannica was accessible in May 2000 through Palm organizers that came with attached OmniSky modems.

Soon afterward, Britannica began to look at the mobile phone market. While the Palm market has several million users, hundreds of millions of cell phone users loomed as the big prize. Some obstacles were faced in the application's creation. Britannica was hampered by the small size of the screen on a cell phone and wondered how to make the application compelling without having the consumer punch too many of the phone's buttons. This was handled by breaking down Britannica's content into paragraphs that could easily fit onto a phone's screen. By September 2000, Britannica had introduced its first wireless-phone application on the Sprint cell phone network.

The belief that mobile commerce is years away from shaking up business activities or creating new trading opportunities is being dispelled by the popularity of several innovative ways to pay for purchases over a cell phone (Stones, 2001). Canadian motorists no longer reach for their wallets when buying petrol, but wave a radio frequency identification tag at petrol pumps to debit a bank account. Japanese consumers who buy goods over a cell phone are billed as part of their monthly phone bill. Cell phone company DoCoMo hands that fee on to the merchant, but retains a 9% commission. Traders on the eBay auction site can use the Paypal system, where a buyer deposits cash in an account via a credit card. When a purchase is made, Paypal transfers the cash to the seller's account. In Finland, cell phone users can pay for mobile purchases by sending a text message to a telephone company called Sonera, requesting a code number. The buyer gives that code to a merchant, who contacts Sonera for payment from the customer's account. Mobile payments are the key enabler to so many new services because if companies are going to generate revenue they need a way of charging.

Let us look at a healthcare example. According to a study by the Institute of Medicine, as many as 98,000 deaths occur each year as a result of medical error (Jetly, 2001). Based on this estimate, medical errors represent the eighth leading cause of death in the United States. The report further states that the majority of errors do not result from individual recklessness, but from basic flaws in the organization of the healthcare system. Errors in healthcare have been estimated to cost more than $5 million per year in a large teaching hospital, and prevent-
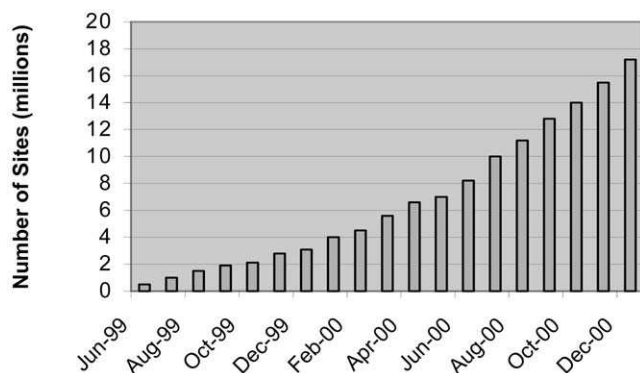

Fig. 5.   Increase in I-Mode sites

able healthcare related errors cost the economy between $17 to $29 billion each year.

A patient visit generates 10–13 pieces of paper in a typical practice. Drawing blood or providing a specimen generates a lab request, order, confirmation, and more. A typical primary care physician may see 30–35 patients a day. Thus, at the end of the day, a physician will end up having between 300 and 715 pieces of paper all created using a typical behavior of the physician and nurse. This behavior is based on the relationship between the nurse and physician, where about 85–90% of diagnosis is made before the physician has even touched the patient. A nurse collects data regarding the symptoms, vitals (blood pressure, temperature, and others), on paper forms, which become an integral part of the patient's case history. A physician typically spends 25–30 minutes with the patient, listening to them, diagnosing, prescribing, and reading the most recent paper document in the file. The physician must either rely on the patient or go through the patient file to cross-reference a patient's allergy history. The medication is prescribed through a handwritten note. The pharmacies usually have to call back for clarity and verification. For an in-patient, the nurse administers the medication. The billing process transcends this whole visit for recognition and collection of revenue. In some cases the blood bank and lab also need to be included for different services. Throughout the whole process, information is transferred using paper forms, each having different handwriting, different data, and different users. All this leads to errors.

These errors can be reduced to near zero with Electronic Medical Records (EMR) and Mobile Medicine. EMR is a means by which clinical documentation is stored electronically for quick retrieval. Mobile Medicine is a means by which prescription information is automatically processed using handheld technology. A physician can use a handheld device in place of a paper clipboard to treat a patient, look at their case history, lab results, and allergies, and then prescribe medication by a click of a button on their handheld. The application can also include initiation of billing and insurance claims from the handheld. The results are fewer errors and thus fewer deaths from those errors, more patients seen in a given day, more accurate billing and fewer hassles with insurance claims, and major cost savings.

Another case study is of a company called KG Knutsson (Ericsson, 2001), which was looking for a solution that would allow the owner of a car to have limited remote control over the vehicle from a long distance. A controller was created for a mobile phone that allows the end user to control the following systems of a car: Car Alarm (Check its status and receive a message if it has been activated); Car Heater (Switch on/off); Car Central Door-lock (Open); Panic button of a Controller (Its use in case of emergency to send a message to a security company to ask for help); Car Engine (Switch

of, if the car has been stolen); Car Battery (Controller to send a warning to owner, if it becomes bad); and Mobile Positioning System (Position the car). The controller only accepts commands from the owner of the car as it identifies the sender of the commands by checking the number that has been used to send the message and also verifies that the PIN code is correct.

The last industry example is of the Scandinavian Garment Service (SGS) (Nokia, 2001). Since December 1999, the SGS, one of the leading logistics companies in the Nordic and Baltic region, has been using a Nokia mobile application to keep its drivers and customers informed about the status of shipments. Prior to implementing the mobile solution, less than 50% of shipments appeared on the SGS order-tracking web site on shipment day. Today 97% of all regularly scheduled shipments are listed on the site. This has meant lower customer service costs and higher customer satisfaction for SGS.

5. Conclusion and ramifications

Mobile communications users often compare the speed and functionality of accessing the Internet via a personal computer against the relatively slower and more cumbersome "on-air" experience (Pastore, 2000). They cite high costs, slow speeds, cumbersome navigation, difficult to type the text using a phone keypad, and unreliable service as their top five dissatisfactions. Despite the initial frustrations of early users, consumers still envision that once the glitches are worked out, mobile applications will become an integral part of their daily lives.

Consider the cell phone market, for example. Vendors are looking for ways to differentiate their products from those of the competition. One way is to offer added functions to the cell phone's capabilities. Currently we can receive voice and data messages with our cell phones, and can also get stock quotes and check e-mail and such. In the near future we will start to see functions such as bar-code scanning, optical character recognition, digital cameras, and even the ability to monitor our physical health as part of the standard cell phone repertoire. Highly integrated optoelectronic sensors are enabling all of this (Strippoli, 2002).

Why should businesses pay attention to mobile commerce now? For the same reasons they should look at wireline e-commerce: operational efficiency and customer interaction. Even in its current nascent stage, mobile commerce can enhance business efficiency by distributing information to the workforce remotely, and offering new channels on which to interact with customers. Sales and marketing personnel use cell phones heavily for customer contacts and relaying customer inputs back to the design and manufacturing teams in a

timely fashion. In fact, cell phones are an immediate method of keeping the lines of communication open between design, manufacturing, marketing, and the customers and suppliers. The result is improved time-to-market with the company's product, and more customer satisfaction.

With respect to PDAs, the Palm with WDBAS capability has many benefits. Enterprises can build or integrate wireless data-driven applications more quickly. There is also a lower cost of ownership. Modeled after typical wireline database applications for desktop and client-server applications, the WDBAS architecture uses tools and languages that are familiar to developers. This can minimize or eliminate training costs as well as speed development time. Other benefits are reduced risk and high quality. Extending corporate applications to multiple wireless devices can now be planned just like any other desktop project. And, using standard tools, prototypes can be developed quickly, with less risk, and executed on a tight schedule. Another benefit is that it works with industry standards. The software comes with support for nearly every enterprise database, including Oracle, IBM DB2, Microsoft SQL Server, and Sybase. Enterprise applications, such as sales force automation, supply chain management, and customer relationship management, are all built on these standard databases. WDBAS also offers end-to-end security.

PDAs support a wide variety of enterprise-level applications in fields ranging from industrial manufacturing to the airline industry to healthcare. Business and personal productivity applications range from document readers to street maps and vacation planners.

In business everyone wants to know how he or she will get a slice of the mobile communication action. For those developing the technology affordability means profitability. If the phones are too expensive, if the telecom companies charge too much per minute, if the vendors' price their goods and services too high for impulse and convenience buying, then the cell phone may not turn into a product development success story. As may be seen in the industry application examples described earlier, it is safe to conclude that handheld mobile communications can lead to improved business operations making way for happy employees, customers and suppliers all over the world, especially in the service industry.

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