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The future of mobile phone-based Intranet applications: A view from Japan

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Abstract

This paper looks at the future of mobile phone-based Intranet applications using data from the Japanese market and models of industry evolution. Owing to the faster and greater agreement on protocols for defining the way in which content and information is presented on phones and the faster introduction and promotion of push-based Internet mail and methods of accessing content via the input of a URL, Japanese firms have moved faster to introduce mobile phone-based mobile applications than the rest of the world. Based on analysis of published material in Japanese newspapers and magazines and interviews with more than 30 firms (users, suppliers, and service providers), this paper discusses the status and future of these applications; the latter focuses on both technological change and models of industry evolution.

Keywords: Mobile; Phone; Intranet; Applications; Japan

1. Introduction

Industry participants estimate that about 20% of large Japanese firms had introduced mobile phone-based Intranet systems by the end of 2004.[1] This paper defines these systems as ones that enable their employees to access corporate data from their phones. Many of the Japanese systems use a combination of inexpensive push-based Internet mobile mail and embedded URLs to enable employees such as maintenance and other mobile workers to access data (See Table 1 and Fig. 1). Unlike browser-based systems that require users to open their mail clients, Japanese service providers' servers automatically push Internet mail to the phone after it arrives on their servers and the mail's arrival causes the phone to beep and display an icon on the screen. Employees merely click on the icon to access the mail and it is not necessary to open their browsers. By clicking on a URL, the employees are able to access additional data and forms that can be completed via inputs from the keypad.

This paper first discusses the factors that support the diffusion of these mobile phone-based Intranet applications in Japan. Although a more rigorous comparison is needed between Japan and other countries like the US and European ones, based on analyses of home pages and interviews with five of the largest US and European service providers,[2] reports on the US mobile data market (Signorini, 2004), and searches of the Wall Street Journal, it appears that mobile phone-based Intranet applications have diffused much more widely in Japan than in the US or Europe. For example, a keyword search of Japan's Nikkei Shinbun using "keitai denwa" (portable phone in Japanese) produces several articles a week on the implementation of mobile phone-based Intranet applications up from about one a week 2 years ago; a similar search of the Wall Street Journal using "cellphone" and "cellular phone" produces almost no articles about such applications.[3] Of course, PDA (Personal Digital Assistant)- and laptop-

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[1]Based on interviews with Japanese service providers and several firms that had installed systems.

[2]Multiple interviews were conducted with Vodafone, T-Mobile, Sprint, Cingular, and Orange in 2003 and 2004.

[3]An exception is an article on Roto-Rooter's use of mobile phones that contain GPS (global positioning system) functions. "Roto-Rooter is Flush with New Technology: Company Tracks Plumbers Using GPS-Based Cellphones," by Carl Bialik, The Wall Street Journal, July 17, 2003.

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Table 1
Examples of firms that have introduced mobile phone-based Intranet applications

Application/industry	Examples of firm(s)	Summary of activities
Purchasing	CoroChan	Order raw materials with phones since shops are too small for PCs
Inventory management	Kosugi Industries Kobayashi Pharmaceutical	Use phones and bar code readers to record material movements and send data to servers
Construction	Sumitomo Forestry	Workers input job status, which is used to update project schedules
Home health care	Many firms	Workers use GPS-assisted phones to locate patients and input reports on phones
Part-time and temporary workers	Various firms that employ part-time workers and offer temporary workers	Workers access schedules, input work content, and request holidays
Agriculture	Japan Agricultural Association	Farmers receive notifications and can access information about deliveries, price changes, weather
Airlines	ANA	Flight personnel receive notifications about schedule changes and can access and input information about holidays
Marketing and sales	Avon	Sales personnel analyze customer's skin with camera phones, Internet mail, and photo analysis software in servers
	Shiseido	Sales personnel access Internet mail and product and other information and input ideas while working in department stores
	Sony	Sales personnel access PC mail and sales, inventory, and pricing data
	Fish markets	Buyers receive advance information about fish including pictures of them
Delivery	Sagawa Kyubin	Drivers confirm deliveries and receive instructions including requested delivery times from customers
	Endeavor Inc. Yasuda transportation	Firms manage trucks using GPS-assisted phones and exchange information via the phones including bar-code data via a connection between the bar-code readers and the phones
Maintenance	JBCC, NEC, Otsuka Shokai	Workers receive notifications about next job and input job status

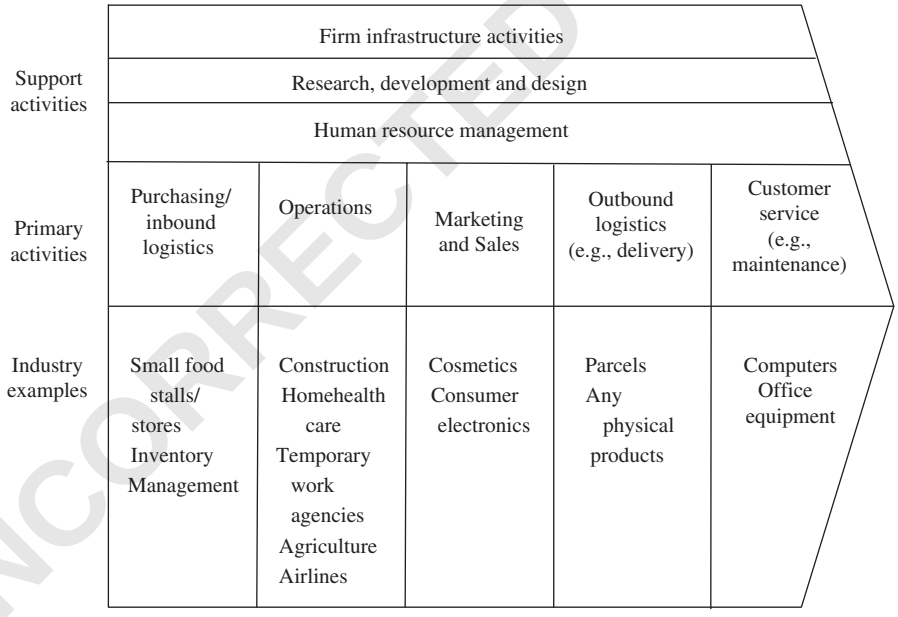

Fig. 1. Examples of mobile Intranet applications.

based applications have diffused widely in the US (Signorini, 2004) and interestingly this was one reason why early Western analyses of the mobile Internet emphasized business applications for the mobile (phone-based) Internet (Bergeron, 2001; Burkhardt et al., 2002; Easton, 2002; Kalakota and Robinson, 2002; Morgan, 2000; Sharma, 2001).

Second, this paper discusses the diffusion of these mobile phone-based Intranet applications in terms of models of industry evolution with focus on the concept of a dominant design (Anderson and Tushman, 1990). Third, the paper discusses four mobile phone-based applications in terms of their status and future where the latter considers both technological change and models of industry evolution.

The selection of these four applications and the discussion of them are based on analyses of published material in Japanese newspapers and magazines[4] and interviews with more than 30 Japanese firms including users, software suppliers, and mobile phone service providers. Although a more rigorous comparison is needed, the interviews and published material suggests that these four are currently the largest mobile Intranet-based applications in Japan.

2. Factors supporting mobile phone-based Intranet applications

The faster diffusion of Japan's mobile phone-based Intranet and other applications like entertainment[5] are supported by the faster and greater agreement on protocols for defining the way in which content and information is presented on the phone and the faster introduction and promotion of push-based Internet mail and the access of content via the input of a URL. The fact that Japanese service providers had dictated phone specifications and standards to their manufacturers throughout the 1990s (Funk, 2003) made it easier for them to do so with content display and other mobile Internet standards. NTT DoCoMo was the first Japanese service provider to define these specifications for the mobile Internet and started a mobile Internet service called i-mode in February 1999. Four of Japanese leading phone manufacturers had released phones for this service by mid-1999 (Natsuno, 2003). The other two major service services followed with their own specifications and services and phone manufacturers released phones for these services also in 1999. Some manufacturers worked with a single Japanese service provider while others worked with multiple service providers (Funk, 2003).

All three major Japanese service providers have provided compatible push-based Internet mail services as a standard item on all phones since 1999. Although these mail services restrict the size of the mail messages and do not allow the attachment of files, anyone can send mail from a PC to a phone including mail with an embedded URL. The service providers charge users less than $US 0.01 to receive such a mail message and if the mail is sent form a PC, there is no fee for sending the mail.[6] Accessing sites via the input of a URL has been facilitated by adoption of x-HTML by all three service providers after initially choosing different markup languages.

Because NTT DoCoMo's i-mode service achieved growth before the mobile Internet services from the other two service providers did, the early implementers of mobile phone-based Intranet systems were exclusive users of NTT DoCoMo's data service. However, as the other two service providers (KDDI and J-Phone) introduced similar services and experienced growth in the number of users, corporate customers of these service providers also began to introduce mobile phone-based Intranet systems.

Furthermore, the compatibility of the push-based Internet mail services between service providers in Japan and the move towards common standards (e.g., x-HTML) for displaying content on a phone has enabled Japanese firms to introduce these systems without the need to purchase special phones for employees. More than 70% of Japanese phones were Internet compatible by mid-2002 and thus Japanese firms merely had to modify their existing Intranet systems for the mobile phones. The biggest challenge was to reformat the mail and menus for the smaller mail clients and screens, respectively, on mobile phones than in PCs. The emergence of mail and menu development packages that are compatible with widely used PC mail clients and content development packages facilitated this reformatting of mail.

Table 2 estimates the number of firms who had implemented various types of systems at the end of 2000, 2001, and 2002 (fiscal year ends on March 31 of the following year in Japan) and who had a data contract with a Japanese service provider. Japanese service providers (NTT DoCoMo, KDDI, Vodfaone Japan) defined these systems and provided me with estimates on the number of corporate users in each stage. It should be noted that it is not necessary for firms to pass through stages one and two before they can implement stage three systems. Because the data is only for firms that are "corporate users," where firms as opposed to individual users have signed service contracts with one of the Japanese service providers, these numbers greatly underestimate the number of firms that have implemented mobile Intranet applications. Since only about 10% of mobile phone subscribers in Japan are corporate users (as compared to 30% in Europe and the US[7]), there may have been 3–5 times the number of firms as shown in Table 2.

Western firms have been much slower to introduce mobile phone-based Intranet systems due to less consistency in the display of content across different phones and a lack and/or promotion of push-based Internet mail services and access of content via the input of a URL by Western service providers. Western manufacturers determined the mobile phone specifications and standards for GSM and CDMA phones and have also done so with mobile Internet protocols and standards. And unlike their common desire to promote market growth with common standards during the creation of GSM in the late 1980s and early 1990s (Funk, 2001, 2002), the large phone manufac-

[4] I primarily relied on the Nikkei series of newspapers and Mobile Magazine, which is published by C-Media.

[5] Entertainment and consumer mail/messaging are still the largest drivers of mobile Internet traffic in Japan and the rest of the world (Credit Suisse, 2004; Natsuno, 2003).

[6] For example, NTT DoCoMo charges users 1 Yen (0.008 Euros) to receive a short Internet (http://www.nttdocomo.co.jp/english/p_s/charges/mova/f/imode.html) mail message versus 0.136 Euros to receive an SMS in Europe (Credit Suisse, 2004). Other service providers do not charge users to receive Internet mail in some plans (e.g., Vodafone Japan). http://www.vodafone.jp/english/live/mail/skymail.html

[7] Based on interviews with T-Mobile and Nokia.

Table 2
Growth in the number of mobile Intranet users (number of firms)

Application	Description	Number of firms		
		2000	2001	2002
1. Mail				
1.1 Forward	Forward PC mail to phone	6	25	33
1.2 Instructions	Send instructions to phones	5	31	52
1.3 Secure mail server	Forward mail or instructions via secure mail server	6	17	51
2. Groupware	Enable groupware access on mobile phone	22	43	87
3. Access company databases	Access and input sales, product, price, customer, and order data	14	37	101

turers did not perceive benefits from the adoption of common standards for displaying content on the phone and instead promoted their own proprietary standards within the WAP Forum.[8] The inability to adopt common standards is one reason for the failure of WAP and the failure of WAP and the desire to differentiate their own services has caused the service providers to define the specifications for their own "branded services." These service providers have asked the manufacturers to develop phones that match these specifications which is something that manufacturers do not want to do and will only do so for the largest service providers.[9]

Western service providers have also not introduced and promoted inexpensive push-based Internet mail services and/or the access of content via the input of a URL. Although most Western service providers have introduced services that enable users to access their PC mail on their phone, they had only done this for a limited number of phones as of early 2005. Instead, SMS is the dominant form of text-based communication outside of Japan and the average price of an SMS was between 7 (US) and 15 (Europe) times more expensive than the price of mobile mail in Japan in mid-2004 (Autorite de Regulation des Telecommunications (ART), 2004; Credit Suisse, 2004).

Furthermore, Western service providers have been slow to introduce services that enable SMS messages to be sent from a PC to a phone. Some US service providers introduced such services in late 2002 (e.g., Sprint PCS) and some European service providers did so in late 2004 (e.g., Vodafone). Instead, most service providers have only allowed an SMS to be sent from another phone or a special Internet site that is managed by the service provider; this enables the service provider to charge for sending an SMS from a PC.[10]

One final reason for the slow introduction of mobile phone-based Intranet applications may be the greater use of PDA-based Intranet applications in the US than in Japan. Although hard data on these PDA-based Intranet applications do not exist, most analyses of these applications argue that the US is the leader in them (Burkhardt et al., 2002; Kalakota and Robinson, 2002; Sharma, 2001). On the other hand, the early use of mainframes in the US did not prevent US firms from being the first user of minicomputers, PCs, laptops, or PDAs; this data suggests that success in the previous generation of computing technology supports rather than slows the introduction of the new generation of computing technology.

3. Dominant designs and mobile phone-based Intranet applications

Technological discontinuities like the mobile Internet cause a period of ferment in which alternative product forms compete for dominance due to the large amount of market and technological uncertainty that exist following a technological discontinuity. Eventually, however, the process of experimentation between the firm and the users of the product leads to the appearance of a standard architecture or dominant design, which defines the interfaces for complementary products and many of the incremental improvements that are subsequently implemented. The emergence of these dominant designs is driven by both technological and social factors where there are decreasing returns from technological change and increasing returns from network effects (Abernathy and Clark, 1985; Abernathy and Utterback, 1978; Anderson and Tushman, 1990; Tushman and Anderson, 1986; Utterback, 1994).

Mobile phone-based Intranet applications are currently in a period of ferment in Japan and elsewhere. Although most industry observers describe a phone architecture that

[8] Many people have made this argument about the initial standard setting in the WAP Forum (Sigurdson, 2001) and press announcements by the leading Western service providers suggest that these problems continue to exist. For example, the largest service provider outside of China, Vodafone, complained at the 2005 GSM conference that the inability of manufacturers to agree on specifications for content was slowing the take-up in services (See Nordstrom, B., "Handset vendors still out of step," 3GSM Daily News feed, February 15, 2005.

[9] Based on analyses of home pages and interviews with Vodafone, T-Mobile, Sprint, Cingular, and Orange in 2003 and 2004, these arguments are made in more detail by the author in a separate paper, which is not referenced in order to protect the author's anonymity.

[10] Ibid.

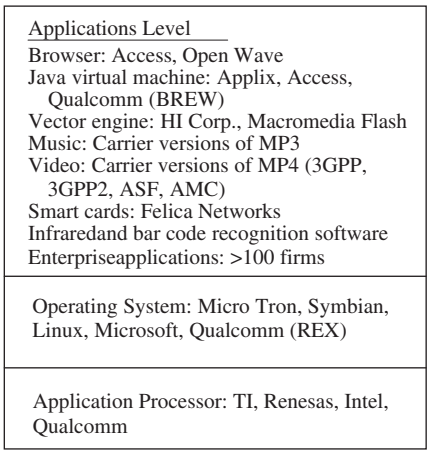

Fig. 2. Basic block diagram of software and hardware in phones and examples of key suppliers/products in Japan.

resembles the one shown in Fig. 2, there is still a great deal of uncertainty about the needed application software, the relevant interfaces between the application software and between the various layers, and the dominant suppliers. This is partly due to rapid increases in phone processing speeds and memory capacities, which are driving continuous changes in the browser, Java virtual machine and programs, three-dimensional rendering techniques, enterprise application software, and methods of connecting phones with other devices (e.g., smart cards, infrared, Bluetooth, 2D bar codes). These technical changes and the uncertainty in the needed application software are slowing the emergence of a dominant design.

Because a dominant design has not yet emerged, most Japanese firms have been introducing fairly custom mobile Intranet installations. Although more than 100 suppliers offer several hundred mobile business solutions as of late 2004, few of these solutions were from the leading suppliers of Enterprise Resource Planning (ERP) and Customer Relations Management (CRM) like SAP, PeopleSoft, Oracle, J.D. Edwards & Co., or Siebel. The early lack of participation by incumbent suppliers in a new and disruptive technology (Christensen, 1997; Christensen and Raynor, 2003) is consistent with the concepts of technological discontinuities and dominant designs (Anderson and Tushman, 1990; Tushman and Anderson, 1986).

Defining the types of dominant designs that will emerge in a new industry is highly problematic, an issue that few papers address. Although the standards literature focuses on network externalities (e.g., see Shapiro and Varian, 1999), it largely assumes user needs and design choices to be straightforward. On the other hand, Christensen's concept of disruptive technologies (Christensen, 1997; Christensen and Raynor, 2003) suggests that many firms often focus on existing users and user needs even when the new technology is more appropriate for a different set of users.

The concept of smart phones illustrates some of these difficulties.[11] Microsoft's smart phone software is called "Windows Mobile software" which is a software platform that combines popular desktop and PDA functions (e.g., e-mail, calendar, contacts, Internet browsing) with popular entertainment contents from the mobile Internet.[12] However, the history of PDAs and Microsoft's joint venture with NTT DoCoMo suggest that the critical functions in smart phones may be very different from those in PDAs and desktop computers. While the first PDAs released in the mid-1990s (for example those that were based on Microsoft CE) attempted to mimic desktop computers and in fact used the term "hand-held computers," it was Palm that identified functions such as calendars and address books that could be done on a small device with limited computing power (Butter and Pogue, 2002; Day, 2000).

Furthermore, most industry observers in Japan have claimed that the joint venture between Microsoft and NTT DoCoMo called Mobimagic (created in 2000) did not produce any results because Mircosoft emphasized the functions in desktop computers as opposed to the functions needed to solve real-world problems in mobile Intranet applications. The dissolution of this joint venture provides further evidence of this.[13] The following sections discuss four cases of mobile phone-based Intranet applications in Japan and this will be followed by a discussion of the implications of these cases, in particular the latter three cases, for a dominant design in mobile phones and mobile Intranet applications.

4. Case 1: access to PC mail

There are a variety of ways for Japanese employees to access their PC mail on their phone. The most-simple approach is for individuals to have their PC mail forwarded to their phone. Potential problems with this approach include viruses, crowded in-boxes on the phone, and full mailboxes in the servers of the mobile phone service providers. These full mailboxes can generate an endless number of error messages to the phone, which makes this approach largely unusable.

A second approach is to apply the concept of Web mail services to phones, which is more time consuming for users but more secure and reliable than the first approach. Several firms offer commercial services and most large Japanese firms have introduced such services for their employees. The most popular Web mail service for phones in Japan has been offered by Net Village since 2000. For

[11] For example, see Dow Jones, Newswire listed on Wall Street Journal On-Line, "Nokia: New Website For Series 60 Platform Information," Friday, February 20, 2004 and Wall Street Journal On-Line, "Microsoft Introduces Two Smart Phones That Are a Little Slow," December 11, 2003.

[12] http://www.microsoft.com/windowsmobile/products/smartphone/faq/default.mspx

[13] "DoCoMo abandons Microsoft venturehttp," PMN Publications, January 29, 2004, www.pmn.co.uk/20040129mobimagic.shtml

several dollars a month, individuals can have their PC mail converted to c-HTML format so that it can be read on their mobile phone. Users first register their PC mail server and user names along with the password. When they wish to access their PC mail from their mobile phone, they access Net Village's mobile site, input the password via the mobile phone keyboard, and the mail is viewed on a home page.

Client programs like Java can provide additional capabilities. By eliminating the need for downloading the tags and other formatting information, a Java program can reduces the packet charges by more than 50% while at the same time providing faster mail response. For example, Net Village's servers (since 2001) will check the PC mail in-box as often as every 30 s for mail including the reporting of mail from specific mail addresses. Net Village's Java program also enables users to access Microsoft Word and Excel files. Increases in the phone's processing speeds and memory capability had made this and other capabilities standard functions on phones by late 2004. Not only could users access Microsoft Word and Excel files, they could run multiple applications simultaneously (i.e., multi-tasking). Thus, users could talk on the phone while they were looking at a home page, mail message, Java program, and/or Word file.

A key issue in Net Village's service and in the services that firms offer their employees is security. The most-simple method, which is used by Net Village, relies on consumers or employees inputting their user names and passwords. Of course, user name and passwords can be stolen, and one option is to constantly change these user names and passwords. Another option, which is offered by International Digital Solutions (IDS) and used by many Japanese firms including some of the ones discussed below, is to use a second firewall in addition to the one that relies on user names and passwords. The additional firewall is the sending of mail, which includes a URL, to the authorized mail address following the authorization of the user's name and password. The use of this approach obviously depends on the push-based Internet mail services that are available in Japan. With this approach, even if a user name and password are stolen, mail containing the appropriate URL is only sent to the authorized mail address. Furthermore, since a random number generator changes the URLs each time they are sent to an authorized user, the URLs by themselves are useless. Therefore, unless the user name, address, and phone are all stolen, unauthorized people cannot enter the firm's mobile Intranet.

Technological advances in biometrics and faster processors will increase the number of security alternatives. They make it possible to compare the user's fingerprint, facial, or voice characteristics with a template to confirm the user's identity. Fujitsu has included the capability for comparing fingerprints with a template in its phones since 2003 where users "roll" their finger over a small reader. While these phones include the template in the phone, placing the template in the server would add additional security while perhaps increasing the confirmation time.

5. Case 2: maintenance

Modern economies require the continuous maintenance of equipment such as elevators, copy machines, computers, and power and transportation systems. Managing these maintenance engineers can be a complex and expensive business; ideally you would like to choose the engineer with the right skills and the right location and provide that person with the right information about the customer.

For example, consider Japan Business Computer Corporation (JBCC), which provides maintenance for IBM computers. As of mid-2002, it had 16 branches, 74 offices, and maintenance contracts with 2000 companies. Its maintenance engineers make about 18,000 visits each month to its clients' offices in 2002.

Before implementing its mobile Intranet system, an operator in the call center chose an engineer based on his or her best judgment and sent a message to that engineer's pager. The engineer then made a phone call from a pay or mobile phone to discuss the customer's problem with the operator. The operator explained the problem to the engineer and if it was determined that the engineer should be assigned to the customer, the operator verbally provided the engineer with additional information. The operator then called the customer and confirmed the visit. The engineer also called the operator when he arrived at the customer's site and when he completed the work and the operator updated the databases accordingly.

JBCC began implementing its mobile Intranet system in 2001. It purchased i-mode phones for each of its maintenance workers in order to ensure the consistent display of information across phones. Push-based Internet mail and embedded URLs play a key role in the new process (see Table 3). When an operator receives a call from a customer, the operator chooses a maintenance worker based on information about the available workers in the computer database. The operator sends the engineer mail that contains information about the customer both in the main body of the mail and in a URL, which is included in the mail message. The main body of the mail includes the firm's name, phone number, and address, and a place for confirming their ability to visit the customer in a return mail message. The URLs provide links to maps, maintenance contracts, spare parts, and project status. The contract information includes the product manufacturing number and whether the product is still under guarantee. The links to the spare parts enable engineers to order parts, which are delivered via special courier.

Engineers update the project status as they complete the project by choosing from a list of choices in the URL. These choices include waiting for the next project, waiting for more information, in transit to next project, started task, finished task, and returning to the office. All of this is done with the push of one button, and engineers are not

Table 3
JBCC's maintenance process

Process step	Old method	New method	Comments
1. Customer contacts call center	Telephone	Telephone	
2. Call center chooses engineer	Best judgment	Computer database	
3. Call center contacts engineer	Telephone	Mail	Mail and URL contains customer-related information and place to confirm visit
4. Call center confirms visit to customer	Telephone	Telephone	
5. Engineer updates call center on project status	Telephone	Mail	Update status in URL, which automatically updates database

required to search through long menus. The operators can access the project and engineer status information from PCs in the call center. Each engineer's schedule includes their own inputs and inputs by their boss (e.g., meeting times). Engineers can also access their schedules on their mobile phones, and operators use these schedules to choose engineers for assignments.

The new system has reduced telecommunication costs, increased labor productivity, and increased customer responsiveness. Telecommunication costs were 37% lower than those of the previous year, which involved savings of more than 1 million yen ($US 8333) per month. Call center operators can handle more calls, engineers can solve more problems, and the engineers arrive at the customer's location faster than before JBCC introduced the new system.

JBCC is now incorporating camera phones, GPS-enabled phones, and mobile groupware in its mobile Intranet system. Camera phones can be used to record events and the photographs can be attached to Internet mail messages; this enables the maintenance engineers to better communicate with experts in the home office. Some problems require interactions between the maintenance workers and specialists and the camera phone facilitates these interactions.

GPS phones would enable the company to more efficiently choose maintenance workers based on their location. Although NTT DoCoMo also offers phones that contain GPS functions, Japan's second largest service provider KDDI offers a superior and much more successful GPS phones and services. KDDI's service is based on network GPS, a technology that is offered by Qualcomm's subsidiary Snap Track. The use of these GPS phones and other data-intensive applications are also driven by flat rate plans that were first introduced in late 2003 and are now quickly diffusing. As of March 2004, about 500 firms were using KDDI's corporate GPS services and these firms were managing about 50,000 employees with the services.

6. Case 3: construction

Construction industries around the world are using the Internet to improve productivity and mobile phones provide additional and needed capabilities particularly when one considers the "mobile" nature of construction workers. Sumitomo Forestry first started applying the Internet to its home construction business in the year 2000. It is one of Japan's largest home construction companies and it builds over 10,000 custom homes per year. Unlike JBCC it did not purchase the phones for its employees and required them to own i-mode compatible phones. Since most construction workers in Japan had been required to own mobile phones for more than 5 years, the only change was the requirement to own a phone from NTT DoCoMo.

In Sumitomo Forestry's Internet-based system, sales personal prepare a home's specifications on the PC while consulting with the customer in a sales office. They choose dimensions, colors, and other features, and Sumitomo Forestry shares this information with suppliers from an early stage. While previously the specifications and schedule were sent 3 weeks in advance of the start of construction, this information is now shared with suppliers as early as three months in advance. The sales offices choose the starting and completion dates and the project managers create the detailed home construction schedule.

Sumitomo's project managers uses inputs from its construction workers to update these home construction schedules; more than 4000 of its construction workers have been providing these updates on their phones since mid-2002. To facilitate these updates, Sumitomo carefully divided its home construction schedules into about 200 steps of which inputs from construction workers are used to update the schedule for about 70% of these steps. Construction workers complete, on the average, 1.5 process steps per day. Project managers send mail to the workers each day at about 2 P.M, the workers click on the URL, and they input on a form whether they have completed a specific step or steps. This causes the status of the home construction project and the next day's mail for each worker to be automatically updated.

Following the status update of a home construction project each afternoon, the project manager updates the schedule, which includes when specialists like plumbers and electricians will be asked to be at the construction site and when materials must be delivered. Because plumbers and electricians work multiple sites and only spend a few consecutive days at one site, it is important to only contract for their time when they are needed. The plumbers and

electricians access project schedules on their own PCs and bring their own tools and materials to the site. They provide inputs on the status of the 30% of process steps that are not provided by construction workers.

The use of the new system has enabled Sumitomo Forestry to reduce the average construction time from 112 to 90 days (or about) 20% and the average construction cost by 5% through the better scheduling that the PC and mobile Intranet provide. It also reported record profits in fiscal 2004 (ending in March 2005) as a result of these improvements. Previously, the project managers spent a lot of time checking the status of various tasks and then contacting the plumbers and electricians. There were often multiple days lost due to poor scheduling, and site managers spent a lot of time re-checking the status of multiple steps before deciding to proceed, particularly in the cases where multiple steps need to be completed before the next process step can be started. The data input on the mobile phone enables the site manager to have better data on process steps and to spend more time managing as opposed to collecting data.

In the future, Sumitomo Forestry plans to use phones as radio frequency identification tag (RFID) readers, as cameras to record tasks, and as GPS devices to record the location of workers and incoming materials. Recording the arrival of materials at a work site is an important task and as RFID readers become a standard function in phones over the next few years, Sumitomo Forestry plans to have construction workers use their phones to record the arrivals of materials. Combined with Internet mail and other functions available in mobile phones, this information can be used to automatically update the databases in the project management office much faster than is currently done.

Camera phones are also expected to play a big role in the future. Construction projects require photographic records of many tasks and mega-pixel cameras provide sufficient resolution. Mega-pixel cameras became standard items on Japanese phones in 2004 and it expected that most mobile phone subscribers including the ones working for Sumitomo Forestry will have them by the end of 2006. This will reduce the cost of recording and cataloguing the completion of tasks for Sumitomo Forestry and other construction companies.

The GPS function can be used in combination with the cameras to record the photographs longitude and latitude and to monitor both worker and material location. The former provides additional quality control for both legal and managerial purposes. The use of GPS phones by workers enables Sumitomo Forestry to manage their location and more importantly the location of materials as they are transported to construction sites.

7. Case 4: sales force automation

Sales is one of the oldest and still one of the largest professions in the world even in countries where B2Bs have seen significant growth such as in the US While replacement orders may largely be carried out using B2B systems, this analysis assumes that sales people will continue to explain new products and services in person. Therefore, many firms will be implementing systems that enable their salespeople to access sales related information from their mobile phones to support their work with customers. Consumer electronic, toiletry, and cosmetic manufacturers are the largest implementers of these systems in Japan. Sales personnel in these companies use their phones to access corporate data particularly in their work with explaining new products to retail outlets.

For example, consider Sony's implementation of a Sales Force Automation (SFA) system called e-mouse beginning in late 2001. Sony provided its sales personnel with PCs for use in their homes and enabled them to access their PC mail and the sales database from their phones. By early 2002 about 1740 salespeople were using their mobile phones to check mail and schedules, and access corporate data like sales, price, and inventory numbers and this number had risen to 2700 by mid-2003. These sales personnel were doing this from about 40 different phones and using services from three different service providers. They were accessing the system on average 15 times a day in 2003 with the largest applications being checking sales figures for individual stores or companies followed by checking their PC mail and schedules, and product inventory. Sales figures are the most popular item to access since the sales personnel are evaluated in terms of their sales.

The major benefit to Sony is greater time by their sales personnel visiting customers. While previously salespeople spent most of their mornings in the office doing administrative work and only spent their afternoons visiting companies, they now spend most of their work days visiting companies. They do their administrative work in their homes or on their mobile phones between visits. Sony had previously introduced laptop computers on an experimental basis but found that few sales personnel, even those who traveled by car, used them due to their heavy weights, poor battery lives, and long start-up times. Eliminating the need to purchase laptop computers is also a major benefit to Sony. Third, Sony believes it will increase sales through faster inventory checks. The ability to confirm the availability of inventory enables sales people to more quickly provide the information to customers and thus close the sale.

Sony and other firms are in the process of introducing GPS phones to their workers. The purpose is to monitor their location and to help them more quickly and effectively reach their customers. The latter is particularly important in crowded cities where sales personnel can waste large amounts of time looking for a customer's location. Sony is also considering making it possible for users to access product videos on their phones, particularly as flat-rate plans began widely used. While the sales personnel currently access new product information via

videos sent to their PCs, accessing these videos on their phones would enable the sales personnel to do this work during breaks between customer visits during the day.

8. Discussion

This paper discusses the future of mobile phone-based Intranet applications using data from the Japanese market and models of industry evolution. These models suggest there will be dramatic changes in these systems as dominant designs emerge for them over the next few years. A dominant design defines the interfaces between complementary products and many of the incremental improvements that are subsequently implemented in these systems. The emergence of a dominant design or designs for mobile Intranet applications will accelerate the diffusion of these mobile Intranet applications and to some extent determine the winners in the competition between firms shown in Fig. 2.

Defining the types of dominant design that will emerge is highly problematic. While many Western firms focus their attention on existing smart phones that combine popular PDA and desktop computer functions, the successful mobile Intranet applications in Japan suggest a different set of functions will be important in mobile Intranet applications and smart phones. Furthermore, technological changes like Java, 3D image representation, greater memory, and faster applications processors will also impact on the dominant design(s) for mobile Intranet applications including smart phones.

Client side programs like Java will likely cause significant changes in the way mobile Intranet applications are implemented and the definition of smart phones once certain problems are solved. One firm (name not released at the firm's request) found that Java-based graphs reduced packet charges by 95% while other firms estimate that Java can also reduce packet charges by as much as 80% for text. However, the firm that initially used a Java program to display graphs found that different phones displayed the graph differently thus making the graph unreadable on some phones due to different implementations of Java. While many entertainment content providers have developed different programs for each handset, this particular firm decided not to make such an investment. This is one of the problems that need to be solved before Java programs will diffuse in spite of the superior user interface and lower packet charges that these programs offer. Similar arguments can be made for the three-dimensional representation of data.

Eventually dominant designs for mobile Intranet applications like maintenance, construction, and SFA will also emerge and drive the further diffusion of these applications and determine the winners in the competition between the suppliers of these software packages. The former will have a greater impact than the latter on the overall productivity growth of Japanese firms while the latter will impact on firms like SAP, PeopleSoft, Oracle, J.D. Edwards & Co., or Siebel. Will the necessary integration between the new mobile Intranet functions and existing ERP, CRM, and SAP systems give existing providers of this software the opportunity to become leading suppliers of mobile solutions? Or will the firms that first introduced these mobile-based sales, construction, and maintenance systems become major suppliers of the software?

Independent of who provides the technologies that form these winning dominant designs, the diffusion of mobile phone-based Intranet systems will have a large impact on the productivity of firms. The diffusion of these systems is already having a large impact on the productivity of Japanese firms and technological improvements and the emergence of a dominant design will accelerate these changes. It is possible that these systems will have the same type of impact on firm productivity that the introduction of corporate Intranets have had, the only difference being that it is now Japan and not the US that is leading the way.

This paper argues that Japanese firms have introduced these systems faster than Western firms due to the faster and greater agreement on protocols for defining the way in content and information is presented on phones and the faster introduction and promotion of push-based Internet mail and methods of accessing content via the input of a URL. Policies that promote agreement on protocols and encourage the promotion of push-based Internet mail and methods of accessing content via the input of a URL are needed.

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