Challenge of Wireless and Mobile Technologies in Government

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ABSTRACT

E-government enables the delivery of public services in faster, more convenient and value-added ways. The move by the government to implement a comprehensive programme of on-line, real-time service delivery is based on a commitment to utilizing information and communication technologies to leap-frog development, and hence address service delivery inefficiencies as quickly as possible. Mobile technologies provide the opportunity to both reach citizens who are currently under-serviced by government, largely as a result of the lack of land-line connectivity, and to provide greater convenience to all citizens who are already accustomed to using their cell-phone as a primary means of communication. The potential value of mobile technologies to service delivery is currently largely unknown. It is hoped that this Future Watch report will stimulate vigorous debate on the role mobile solutions should play in government's overall service delivery strategy and provide opportunities for identification of applications that create access to improved education, health care and justice. In this paper, a broad approach to M-governance has been considered, focusing the services that are provided by the government along with public institutions.

Keywords- M-Government, e-Government, ICT, Wireless Technology, Mobile Computing**.**

1. Introduction

The inclusion of mobile technologies in the national e-Government strategies is easier for the developing countries as they have just started rolling out the services. In addition to providing government services like grievance redressal, status of pending applications, alerts for filing tax returns, utility payments etc. , innovative use of mobile technologies can be of great use in marketing the e-Government services and collecting feedback from various sections of the society on the government policies. Mobile Government (m-Government) is a relatively new phenomenon whose potential is largely unknown and unexplored. There is a need to facilitate policy level discussions for inclusion of mobile services as a part of national strategies on e-Government. In this study we use "wireless" and "mobile" interchangeably while being fully cognizant that mobility does not always equate to the wireless space, and wireless does not always equate to mobility. However, there is significant overlap in applications of these technologies, so it makes sense to treat them together for the purpose of this study. However we define the basic technology, it is inarguable that the technology is diffusing at one of the fastest paces witnessed among personal technology products all over the world.

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Studies by various market research firms lend credibility to this trend. Wireless phones will be as common as television sets. The current generation of wireless/mobile technology includes cellular phones, pagers, wireless-enabled laptop computers, PDAs, wireless local area networks (WLANs), and GPSs, with the wireless service providers' technology enabling transmittal of voice and text/data working fairly well. With the advent of wireless networks and broadband, wireless devices can be content rich, enabling transmittal of content rich graphics, video, and other information at speeds up to 2 Mbps. Currently, technology such as Bluetooth can provide short-range wireless connectivity that can link several types of devices enabling seamless interactions among various devices. With the rapid penetration and adoption of personal technology worldwide and with the impending expansion of network functionality and capacity to provide rich content in a mobile environment, wireless/mobile technology has significant potential for providing commercial applications, especially in the business-to-consumer (B2C) domain, which we call "m-commerce".

At the moment, wireless and mobile technologies are being adopted significantly in the business-to employee (B2E) realm because their benefits (such as productivity gains) are easily quantifiable and therefore their adoption is justifiable. We call this domain "m-business." Although this trend is significant in private-sector applications, it is also quite visible in the public sector. Time is right to examine the role that wireless and mobile technologies could play in e-government.

2. Research Issues

Our study has four important goals with regard to understanding how to leverage wireless technologies for e-government applications:

- Understanding the unique characteristics of the wireless/mobile environment and the use of wireless/mobile technology
- Mapping the characteristics and usage for enterprise applications based on studies of successful adoption of the technology in private sector settings
- Understanding the role of wireless/mobile technology in e-government based on the findings of the first two goals
- Assessing the technology readiness of the government workforce for wireless/mobile applications and increasing the likelihood of technology acceptance

Understanding the unique characteristics of wireless technology and its usage is a prerequisite to a successful wireless strategy at the enterprise level. In this context, our research focuses on understanding how the characteristics drive the usage of the technology under different situations—both from a customer/citizen viewpoint and from an enterprise usage situation viewpoint.

The second goal of this study is to map the characteristics of the wireless environment and application orientation in the enterprise context. This is accomplished using studies of initiatives and implementations in private-sector organizations. The focus is on identifying the underlying common factors that are related to mapping wireless characteristics with application orientations. Identification of such factors will help in a normative way to understand what types of applications can be successful in leveraging wireless technology and under what specific usage situations. We develop a prescriptive matrix that managers can use to evaluate the application of wireless technology to specific applications. Based on the findings of the first two parts of the research and the prescriptive matrix, the third part of the study examines emerging e-government applications and potential applications in which wireless technology can be successfully leveraged.

The focus is on both intra-governmental applications as well as upstream channel applications such as

procurement and downstream channel applications such as service provision through portals and websites. We also examine the pros and cons of adopting wireless technology within an e-government setting.

The fourth goal of the study is to illustrate the assessment of technology readiness of the workforce with regard to adopting wireless technology and to provide steps for increasing employees' likelihood of accepting new wireless and mobile technologies.

It is imperative that public-sector organizations focus on integrating the wireless channel as part of their multi-channel effort to reach businesses and citizens as well as use mobile technology within their business processes. Adoption of the wireless environment by citizens and private-sector organizations creates an expectation among citizens and businesses toward such integrated channels of communication and commerce. However, public-sector organizations should not rush into premature applications of the technology without understanding the technology, its usage, and their workforces' readiness. Our study focuses on helping government-sector organizations understand the dynamics of wireless adoption.

It is necessary to remember that devices vary in processing capability from cell phones and pagers, to PDAs and laptops. We will focus mostly on cell phones, pagers, and PDAs, and when necessary address issues regarding laptops separately. The characteristics we discuss are relevant to both G2C (B2C) and G2E (B2E) applications.

Technology readiness of users (consumers/citizens and employees) plays an important role in the decision to deploy wireless/mobile technology. We focus on this issue specifically in the upcoming sections of this report, although we have highlighted this factor here for the sake of completeness.

3. A Prescriptive Matrix

Based on our analysis, we provide a prescriptive matrix that considers all the relevant factors in deciding whether a specific wireless application should be deployed.

Table 1: A Prescriptive Matrix for Wireless Adoption

		Degree of Sophistication of Technology *	
		High	Low
Technology Readiness of Target Segment	High	Stars High-impact projects Mission-critical applications of high strategic advantage should be undertaken; high-level commitment needed for success	Low-Hanging Fruit Go for immediate wireless deployment High probability of successful adoption
	Low	Future Potentials Wait and see Applications more complex; go forward with pilots; educate/train employee; wait for mature technology	Near Harvests Educate/train segment Wireless deployment with extensive training; significant chance of success

- Factors influencing degree of sophistication of technology: Information Intensity, reliability of access, interactivity intensity, and security/privacy requirements. Each factor ranges from high to low.

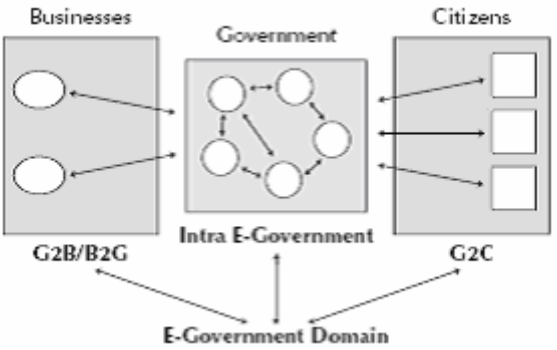

Figure 1: The Scope of e-government

4. Applying Wireless / Mobile Technology to Government

The potential for wireless/mobile applications within government is immense. With the advent of e-government and high-tech device use that allows telecommuting, it could easily be much higher in the coming decade. Thus, the extent of mobility in the target employee segment can be significantly high, setting the stage for widespread wireless/mobile deployment. Given that governments, by their very nature, have a segment of the workforce involved in law enforcement and compliance enforcement, transportation and logistics, and health and social services, there are many instances of low-hanging fruit—this involves the police force, traffic enforcement, firefighters, health-care workers, social workers, inspectors of all kinds, transportation officials, emergency management workers, and maintenance workers. This indicates that the potential for deploying wireless technology for *intra-governmental* applications is significant.

However, the potential does not stop there. As seen in Figure 1, e-government activities encompass not only intra-governmental processes but also the interface between businesses (G2B/B2G interface) and the interface with citizens (G2C interface). Wireless applications in these interfaces, although less common at present, also have a bright future.

5. Government-to-Citizen Applications

At the local government level, Total Web- Government project involves small cities and municipalities to set up information portals that could be accessed by wireless devices. Such services aimed at the general public are especially useful where a wired network infrastructure does not exist because they enable citizens to access the portals to check on community events and send e-mail to legislators. The other applications involve accessing information portals using wireless devices: bus riders checking on bus schedules, citizens checking on the status of bills, and students at universities accessing portals and the Internet through wireless devices. The universities, especially, have gained significant experience in rolling out services for students that can be accessed in the mobile mode. The advantages they possess include promoting a homogeneous population and relatively tech-savvy, enclosed, small environments that allow deployment of reliable wireless technology and easier troubleshooting.

There are many issues that need to be resolved in the G2C domain before the applications catch on. First is the issue of urgency of access: Are government services ever needed in such an urgent access mode? Except for emergency situations, this is generally not the case. Citizens could well use wired access through the Internet or telephone to access the services. However, as we have seen in some applications, if the wired infrastructure is nonexistent or expensive, then the wireless infrastructure becomes a viable alternative. In such cases, government needs to look at this service channel seriously. Second is the issue of security and privacy. For extensive rollout of services using wireless technology, an adequate level of

security and privacy must be ensured. Finally, there is the issue of user acceptance of technology: Is a significant portion of the user group sufficiently tech savvy to appreciate the value of the service? This is a question of cost versus benefit that needs to be critically analyzed before a wireless deployment is contemplated.

6. Mobile Collaboration Applications

The common feature in these applications is that they are all in the intra-governmental domain, all requiring effective security features, and all requiring a good deal of interactivity in applications. Most of these applications are also mission critical. Many potential applications in the e-government realm can become a reality with maturing technology, increased security, and increased bandwidth. These include applications such as e-learning through wireless technology, wireless WAN applications, CRM applications based on service portals accessed by citizens in a secure and private mode using their wireless devices, and so on. Although the potential is seemingly limitless, it is necessary to understand that wireless is but another alternative channel that can be used for services. Therefore, wireless/mobile technology should not be adopted for the sake of the technology itself.

7. Other Issues Relevant to E-Government

In addition to the factors presented, a few more issues are relevant in the case of e-government. These factors moderate the impact of the other factors in determining whether to deploy wireless/mobile technology and, if so, how to deploy it.

Substitute for Wired Networks

These are cases in which the areas of operation are remote and the wired infrastructure is very expensive. In many developing countries, the wired networks are unreliable, expensive, and experience frequent. In some developing countries, technology has skipped a generation and thus, while the wired telecommunication infrastructure is spotty and sporadic, one may find extensive wireless coverage. In such cases, wireless technology is an obvious choice for e-government applications.

Multi-Channel Strategies

E-government is accomplished through providing multiple “touch points” to citizens and businesses. The wireless channel is but one of them. It is important to understand that the application of the prescriptive matrix is done with a multi-channel strategy to provide services to citizens and businesses. The impact and role of wireless technology on e-government ought to be examined within the context of a multi-channel strategy.

Impact on Digital Divide

Given the penetration of wireless technology among citizens, its social acceptability, its user friendliness, and its cost as compared with the PC based Internet, the use of wireless technology may be a significant way to reduce the impact of the digital divide and provide e-government services that more citizens can access other than through the PC-based Internet.

Impact of Competition

It is obvious that government should not be looking at wireless technologies from the point of view of return on investment (ROI) and cost containment alone. This is an era in which governments compete. Local governments, state governments, and even national governments compete in today’s global economy for business investments, a skilled workforce, good jobs, and so on. Governments need to view wireless/mobile technology as a means of gaining competitive and strategic advantage in a crowded field. Thus, some wireless applications may not make much sense from an ROI viewpoint but may make good sense from a strategic viewpoint.

8. Technology Readiness and Wireless Technology Adoption

In the context of adopting wireless technology, measuring employees' technology readiness is necessary for three important reasons:

- First, TRI scores of the employees provide insights into using the prescriptive matrix (Table 1), where the mean TRI values of the employee group can be used to classify employees on the technology readiness scale.
- Second, the individual scores of employees can be used for screening those employees for specific technology assignments, training programs, and education.
- Third, the individual scores on the specific dimensions of optimism, innovativeness, discomfort, and insecurity can be used to group employees into segments based on their scores so that training and education programs can be tailored for the different segments with a view toward easing the process of wireless technology adoption.

Employees' acceptance of new technology and intention to use the new technology for work processes depend on three main factors: (1) the perceived usefulness of the technology, (2) the perceived ease of use, and (3) the perceived availability of resources for technology.

- Perceived usefulness is defined as the extent to which an employee believes that using a particular technology will enhance her or his job performance—the higher the perceived usefulness, the higher the technology acceptance and technology adoption.
- Perceived availability of resources includes resources such as time available for performing or learning to perform a task, level of support available from other staff, and technology attributes such as system availability, cost of access, documentation, and perceived level of control over the technology. The higher the perception of the availability of these resources, the higher the technology acceptance. This factor is particularly relevant if the wireless/mobile application is complex.

9. Planning for Technology Acceptance

Government agencies can take the following steps to increase employees' acceptance of wireless/mobile technology.

- *Train and Educate Employees.* Training programs, which include formal classroom education and hands-on job training, are essential for employees to understand the role wireless technology can play in their jobs. Given the gender differences, these training/education programs must emphasize the productivity benefits for men and the process/usability issues for women. Testimonials from peer groups and superiors can play an important role in the acceptance of specific applications.
- *Create Peer Support. A*n organization can identify employees who are most receptive to wireless/mobile technology and use them as the "lead-user" group in providing support for their peers. Lead-users can be selected for training programs first and then play a critical role in helping/supporting their peers through similar training programs.
- *Implement Pilot Applications.* In many situations, the usefulness of applications may not be evident explicitly before implementing the applications. In such situations, pilot programs are excellent ways to introduce the wireless technology and its benefits to employees. Such programs, in addition to resulting in employee buy-in, may also identify the potential inhibitors to successful applications so that the negatives can be minimized before a full-scale launch.
- *Provide Excellent IS Staff Support.* It is critical that employees perceive and make use of support from IS staff early in the adoption process, especially when technology readiness is low. This helps employees overcome the inhibitors of discomfort and insecurity through liberal help and support from IS staff as they use the technology. An organization cannot provide too much help at the start of the adoption cycle.
- *Create a Learning Culture in the Organization.* Employees should be encouraged to experiment

with new wireless technology and new applications. Incentives should be provided to them for helping in designing applications and for suggesting improvements to the processes and applications. This enhances their involvement in the use of wireless technology, providing a sense of ownership and thereby improving the chances of successful adoption and potential productivity gains.

10. Key Findings

We introduced this report with four important goals with regard to leveraging wireless technologies for e-government: (1) understanding the unique characteristics of the wireless/mobile environment and technology usage, (2) mapping the characteristics and usage for enterprise applications based on studies of successful adoption of the technology in private-sector settings, (3) understanding the role of wireless/mobile technology in e-government, and (4) assessing the technology readiness of the government workforce for wireless/mobile applications and increasing the likelihood of technology acceptance.

The summary of our findings and recommendations based on the four goals is as follows:

- Wireless and mobile devices are user-friendly personal devices with a significant penetration among citizens and consumers. Wireless/ mobile technology provides an alternative channel to reach consumers and citizens. Because of its widespread use and personal nature, its potential for B2E/G2E and B2C/G2C applications is significant. However, due to limited security/privacy features and a plethora of incompatible standards, it is more suitable, currently, for B2E/G2E applications rather than B2C/G2C applications. G2B (vendors/system integrators/contractors) applications also have significant potential.
- Strategies for successful wireless adoption depend on four important factors: extent of mobility in the target segment, information access needs, security/privacy requirements of the application, and technology readiness of the target segment.
- Most of the current applications of wireless/ mobile technology in government fall within the low-hanging fruit quadrant. A few citizen centric applications are motivated by the need to reach out to geographically remote communities or by the lack of wired access. With maturing technology and developments, governments should be able to roll out citizen focused services through the wireless channel.
- Measuring employees' technology readiness is a key component of the wireless technology implementation process. Employees' TRI scores are good predictors of their attitudes toward wireless technology adoption in their work processes and their ultimate acceptance of wireless/mobile applications.
- Employees' acceptance of wireless technology can be influenced through technology training and other programs. These can have a positive impact on employees' perceptions of the usefulness of wireless applications, the ease of use of wireless applications, and the availability of necessary resources.

11. Recommendations

Although this report has outlined many of the technology's characteristics and potential, it also holds out a warning. As with any technology, adoption of wireless/mobile technology should not be pursued for the sake of having a new technology; rather, the adoption should be motivated by the needs of the organization or the government agency. We have described many of these needs and how they affect an organization's wireless strategy through the prescriptive matrix. The following are the specific recommendations for government agencies:

- *Measure Technology Readiness, and Educate and Train Employees.* The organization must determine where its employees stand with respect to technology readiness and technology acceptance. An important first step, based on this measurement, is planning for formal education

and training focusing on wireless/mobile technology basics, specifics, and role in government. Case studies of government agencies that have implemented wireless programs could contribute toward this end. IT partners could also provide help in training and education.

- *Harvest the "Low-Hanging-Fruit."* Once the low-hanging fruits are identified based on the prescriptive matrix, government organizations should go for quick and full deployment to take advantage of the productivity improvements. Agency budgeting should reflect funding for these deployments, and these projects should be put on the fast track for immediate implementation.
- *Plan for the "Stars."* Stars are high-impact projects that have complex requirements in terms of security/privacy needs and information interactivity and reliability needs. These projects should form part of strategic plans, and budgets should be allocated for experimentation and pilots. As wireless/mobile technology matures, these projects will pay off significantly. However, care should be taken in selecting the technology platform and infrastructure so that the organization does not get locked into proprietary technology, especially in the realm of G2C applications.
- *Launch Pilot Programs.* Government organizations should think creatively in identifying opportunities for wireless and mobile implementations. Wireless may be a good substitute for wired technology in geographically remote areas where citizen access is important. Wireless may play a significant role in bridging the digital divide, given its wide usage. Launching pilot programs focusing on these areas is especially important as employees and citizens learn using the technology for mutual benefit. Creation of a central testing environment, such as the DISA or NIST laboratories, may help significantly in launching pilots.
- *Encourage Employees' Wireless/Mobile Use.* Increasing employees' comfort with the technology and increasing their perceptions of ease of use are the best ways to prepare them for technology acceptance. Government agencies should encourage, through incentives, employees' use of PDAs, wireless devices, and handheld devices both for work and personal use. Wireless LANs could replace wired LANs in some locations as a means of experimenting with technology and moving up the learning curve.

We also saw that, in addition to the factors in the prescriptive matrix, other issues may have an impact on the decision to adopt wireless technologies in the government context. For example, governments work in competitive environments, just like private business organizations. So sometimes wireless adoption can be motivated purely from a strategic viewpoint rather than from ROI considerations. Governments should be proactive in designing systems and applications with this goal in mind. It is clear that much needs to be done if wireless applications are to deliver on their potential. Some of these efforts rest with the federal government. The supply of spectrum available to wireless carriers for rolling out broadband initiatives is fast dwindling. This calls for broadband-friendly policies and stimuli to encourage building a wireless infrastructure. The second issue is the confusion over prevailing standards. Market forces will determine and solve much of this eventually, but until then, widespread deployment and adoption of wireless technology can be risky. The third issue is that of security. Widespread G2C applications are possible only when a secure and private environment is ensured. This will also happen eventually, and until then, governments should roll out successive pilot programs to gain experience and expertise for large-scale applications.

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