

METHODOLOGY FOR FUTURE TECHNOLOGY: MOBILE COMPUTING APPLICATIONS

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ABSTRACT

There is a tremendous amount of interest in developing mobile enterprise computing applications, driven by recent advancements in mobile technologies and standards, as well as an increasing mobile workforce population. However, many enterprises are uncertain of the various options they may have due to the emerging nature of mobile computing technologies. Additionally, they are concerned about the integration of mobile technologies with existing IT infrastructure and applications. In this paper, we propose a methodology to help enterprises develop business strategies and architectures for mobile computing. A generic mobile technical infrastructure is presented to assist enterprises in evaluating and implementing mobile applications. Software standards that may have major impacts on mobile technical architectures and application development are discussed. Finally, the implications of the proposed methodology for mobile computing for practitioners and researchers are discussed in the conclusion.

INTRODUCTION

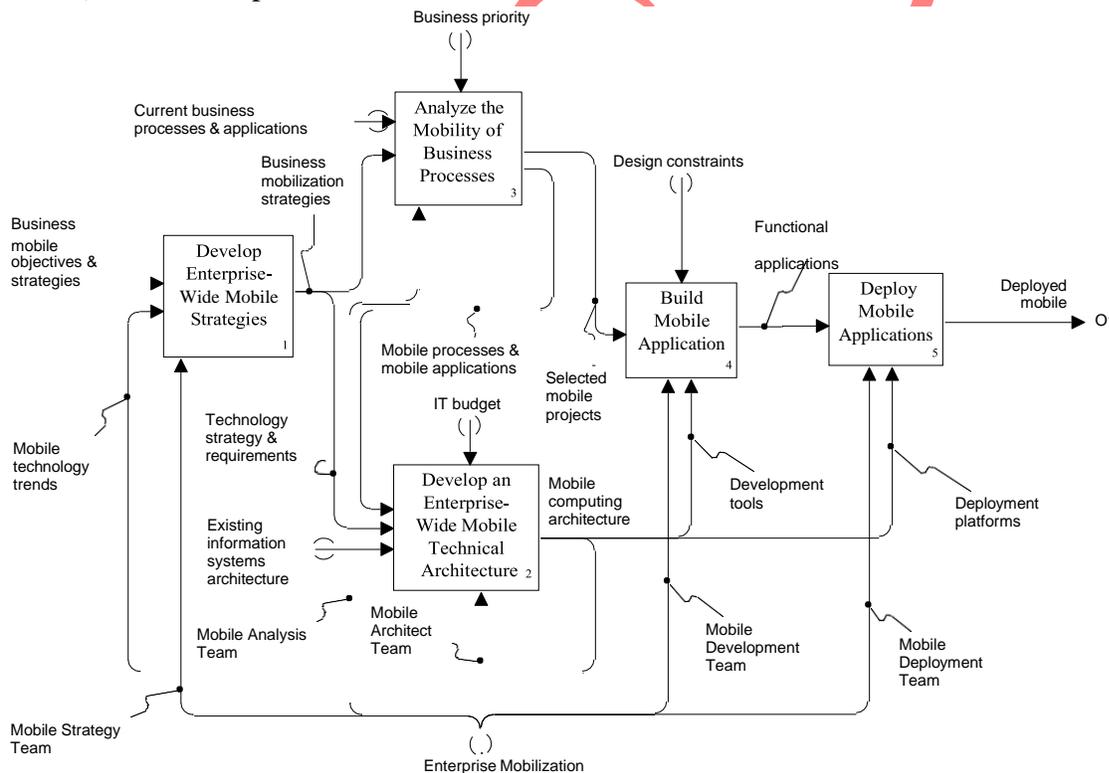
The twenty-first century workforce is becoming increasingly mobile. A recent IDC study predicted the number of mobile workers in the U.S. will rise from 92 million in 2001 to 105 million in 2006 while the non-mobile workforce will decline by 2 million to 53.8 million by 2006. Therefore, two-thirds of U.S. employees will be mobile workers by 2006. Mobile workers are defined in this study as workers who spend more than 20% of their time away from their desks attending meetings, traveling, or telecommuting from home.

Some players in the mobile computing market focus on consumer oriented contents and service, such as ring-tones, MP3 music, and MMS. However, according to studies from IT research firms, 40% of companies will use wireless technology for business applications by 2003, up from just 5% in 1999. According to this trend, more than 50% of companies have or will have wireless connectivity to corporate systems by 2005. The aggressive deployment of mobile computing is in part driven by recent advancements in mobile computing technologies and high payback for effective application of mobile technologies. Some studies show that the productivity of mobile workers may be improved by 30% when proper mobile technologies are deployed.

The abundance of emerging mobile technologies and standards as well as expanding opportunities to capitalize on them has created a lot of confusion among business managers and IT architects. We have developed a methodology to help organizations plan and build enterprise-wide mobile computing applications. The methodology proposed in this paper is an attempt to provide a comprehensive strategic framework to identify business opportunities for mobile business and commerce, as well as a roadmap and action plans to develop and deploy mobile applications.

METHODOLOGY

The enterprise-wide mobile computing is the use of mobile devices, wireless networks and Internet connections to access enterprise data and applications. The lack of methodologies to help organizations in their mobile computing initiatives may have hindered the deployment of enterprise-wide mobile applications. Based on the literature regarding systems development, business process reengineering methodologies information systems planning methods and mobile computing a methodology for building enterprise-wide mobile computing applications was developed. The proposed methodology shown in Figure 1 is depicted in IDEF diagramming notation. In IDEF, a process is represented as a rectangular box and its relationships to inputs, controls, outputs, and mechanism (ICOMs) can be interpreted as:



A Methodology for Building Enterprise-Wide Mobile Applications

"Inputs are transformed by the process into outputs according to controls, using mechanisms." The boxes in Figure 1 represent five phases of the life cycle for building enterprise-wide mobile computing applications. The arrows coming in contact with the box from the left are the inputs to a life cycle phase; arrows coming out from the right side of a box are outputs (i.e., deliverables); controls are shown as arrows coming in contact with the top side of a box representing constraints and guidelines governing the conduct of a phase. Mechanisms are arrows coming in contact with the bottom of a box representing systems, organizations, or individuals that perform activities in a life-cycle phase.

The methodology should be treated as a suggestion and a general guideline. Companies can plan and develop mobile applications by conducting activities in various phases in the life cycle iteratively and concurrently to allow quick prototyping and feedbacks.

VARIOUS PHASES OF MOBILE COMPUTING APPLICATION

1. **Develop enterprise-wide mobile strategies:** Companies engage in mobile computing initiatives because they want to take advantage of emerging mobile computing technologies as well as supporting an increasingly mobilized workforce to gain competitive advantages in the marketplace and to better serve their customers. A mobile strategy team should consist of top level management (e.g., chief executive officer, chief information officer, chief technology officer, and business-line managers). The process of creating enterprise-wide mobile strategies should be based on existing business strategies and objectives, as well as high-level understanding of mobile technology's trends and impacts. Details of this phase are further discussed in Section 3.
2. **Analyze the mobility of business processes.** Until recently, enterprise communication and computing support was limited to desktop computing tools that glue employees to their desks. Mobile technologies enable organizations to redesign their business processes such that their sales forces and field services representatives can perform critical activities at customer sites. In this phase, the mobile analysis team will develop business process maps and identify promising mobile projects that may bring in more revenues and result in better customer service. Section 4 elaborates the activities involved and approaches in analyzing process mobility.
3. **Develop an enterprise-wide mobile technical architecture.** A comprehensive mobile technical architecture will be developed in this phase based on mobile business strategies, mobility analysis of business process map, as well as mobile application portfolios developed in the previous two phases. The technical architecture will allow companies to invest wisely in mobile technologies based on current IT infrastructure and mobile standards so that the development and deployment costs for mobile applications may be reduced.
4. **Build mobile applications.** The most obvious constraints in building applications for mobile devices are smaller screen sizes, less efficient data entry methods, and limited local CPU power. Keyboards and mice are normally not available for small mobile devices. Developers may need to learn new development tools and observe these constraints in building mobile applications. The first step in mobile application design to reduce user input requirements by providing point and click interfaces as

well as delivering only the most critical contents to mobile users. A step further is to take advantage of special features in mobile devices such as Soft-Key, telephone dialing, and voice capabilities of cell phones. An example of a design method for the building of mobile applications has been proposed by Beaulieu.

STANDARDS FOR MOBILE COMPUTING: MARKUP LANGUAGES AND WEB SERVICES

Many standards have been developed to provide interoperability among various mobile devices and software components. A mobile computing architecture should be defined and developed according to standards to ensure the flexibility and expandability of the mobile architecture. In this section, we focus our discussion on software standards for mobile computing.

XML AND MARKUP LANGUAGES

XML definition language is a meta-language to define new markup languages. Currently, there are two "standards" used as XML definition languages: XML 1.0 W3C Recommendation and XML Schema. The structure of a document is defined by XML DTD or XSD files. The content is captured in actual XML documents. There are two approaches to handle the display aspect of XML documents: XSL and XML parsers. XSL (eXtensible Stylesheet Language) 1.0 is a W3C Recommendation that specifies how one can convert an XML document to another document format. XML parsers are program libraries that can be used by a programming language to process XML data.

There are several web page specification markup languages such as WML and cHTML. Wireless Markup Language (WML) 1.0 used in WAP-enabled phones is an XML-compliant document format. cHTML used in DoCoMo's iMode is a subset of HTML for small information appliances. WAP 2.0 has adopted XHTML which is a reformulation of HTML 4 as an XML 1.0 application. iMode may migrate to XHTML in the near future. When a mobile device requests a web page implemented by a server-side scripting program such as ASP and JSP, the program can detect the requesting browser type by examining the HTTP_USER_AGENT CGI variable. The program can then dynamically apply an appropriate XSL template file to transform an XML document to a format (e.g., WML, cHTML, XHTML, and HTML) that is appropriate for the requesting mobile device.

SynchML

As mobile computing devices continue to proliferate, users will demand ubiquitous and consistent access to up-to-date information and applications. IT organizations will need standards to ensure consistency and a common data protection protocol for mobile device access to the corporate server. SyncML is the leading open-industry standard for universal synchronization of PIM data leveraging XML standards.

SyncML is sponsored by leading mobile and wireless organizations and vendors such as Ericsson, IBM, Motorola, Nokia, and OpenWave, etc. It is a standard for implementing two-way synchronizing mechanism for all devices and applications over any network. Some vendors have remained non-committal. For example, Microsoft has developed its own ActiveSync synchronization software for its Pocket PCs for applications such as Microsoft Outlook.

Web services

Web services provide a standard-based approach to implementing distributed components. Web services offer data and business logic services over standard protocols such as HTTP, XML, and SOAP over the Internet. Gartner, an IT research firm, defines Web services as "loosely coupled software components delivered over Internet-standard technologies". "Loosely coupled" implies that the Web services are independent of any programming languages, platforms, and object models. Using the ubiquitous and low-cost Internet, Web services can easily provide software functions over the internal networks and the public Internet for mobile computing applications.

Mobile computing devices that are capable of consuming Web services can use distributed components implemented as Web services to get access to legacy data and applications [**Error! Reference source not found.**]. This approach will enrich the functionality of mobile applications as well as increase the reusability of distributed software components. As a result, maintenance of business logic that is shared by both mobile and non-mobile applications will be easier.

CONCLUSIONS

With mobile computing and wireless networking, people can conduct businesses at any time without been constrained by the availability of physical networking connections or specific computing platforms. With information delivered to employees at their fingertips while away from their offices, employees can increase their responsiveness and productivity. The proposed methodology in this paper is an attempt to identify some guidelines and formulate a life-cycle approach to assisting enterprises in planning and developing enterprise-wide mobile strategies and applications.

The methodology may also help researchers identify areas where further research may be called for. For example, in our literature research, we found that there is a lack of research on mobile workforces. More rigorous and large scale studies on mobile applications usage patterns are very much in need. Field studies of how companies plan and deploy their mobile strategies in conjunction with measurements of the resulting business performance improvement can help the further development of the proposed methodology.

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