A Case for Business Process Deployment for Location Aware Applications

Saqib Ali, Torab Torabi and Hassan Ali,

Department of Computer Science and Computer Engineering
La Trobe University,
Melbourne, 3086, Australia.
Fax: +61 3 9479 3060

Summary

Every action a business process performs must be explicitly anticipated, designed for and implemented by business professionals. Most of the current techniques specify business processes (BP) without incorporating all four Ws; **W**ho, **W**hen, **W**hat and **W**here. These processes when used especially in logistics or supply chain applications will result in a BP becoming even more complicated and harder to customize. The business process is dependent upon business rules (BR) and required resources to achieve its objectives. To overcome some of these issues we propose a location aware business process deployment framework. Using this framework we can integrate location awareness into the existing business processes. In this paper our focus would be on how the companies can adopt their traditional business processes to be mobile. This case study presents a scenario for a company that uses a location aware technologies and information intensive business processes to enrich its existing enterprise applications.

Key words:
Location aware, Business process, Mobile applications, deployment

Introduction

Business process is defined as a set of linked procedures or activities, which collectively realize a business objective or policy goal. This is normally within the context of an organizational structure defining functional roles and relationships [1]. The software process usually specifies the actors executing the activities, their roles and the artifacts produced [2]. Businesses realize that the cost of automating transactions with trading partners is very high. Standards and technologies for modeling business process that use web services could drive the costs down by achieving automated business process [2], [3]. Traditional applications cannot support the flexibility of location dependency in business process.

As the technology is changing very fast and the companies operate in complex environments that consist of thousand of processes, the business profit depends on efficient delivery of goods and services controlled by business process [4], [5]. So there is a need for the companies to make use of the technologies to make their product more profitable and their services more efficient.

Now many companies are earning profits by using mobile technology in their business applications. By this these companies tend to make their traditional business processes into mobile business processes. "*Mobile Business Process*" is a business process, when the place of execution of an activity can be different in different instances of the business process or the places can change during the execution of an activity [6], [7]. The use of the mobile technology in business application has helped the companies to reduce costs and provide new revenues by improving business processes, creating competitive advantages, improving the efficiency of the mobile workforce, and by guiding stakeholders to maximize their efficiency thus reducing field costs [8], [6].

There is a need to make business process more location aware. Business processes also needs to be customizable and reusable so that the companies can be able to work more efficiently and be able to provide better service to the customers. In this paper we propose a location aware business process framework which would be used to make a mobile business process more location aware. This would result in a more complete, accurate, and flexible use of the Business Process.

2 Proposed location aware business process framework

A location-aware application makes use of a user's location. A Location aware application is a middleware that lets company's business application take advantage of location based services from multiple vendors, while providing application developers with an easy-to-use, yet powerful Application Programming Interface (API) [7]. In this section we propose a location aware business process framework. We divide the proposed framework into different environments. We simply grouped similar

functionalities into an environment, for example mobile and non mobile services in separate environments. Each environment has its own associated behavior and characteristics. Figure 1 shows that mobile and non-mobile environments perform their business processes through server environment, which is also the communication layer between business process environments.

We use software agents [9], [10, 11] to synchronize, integrate and execute all the business processes which are defined in business process environment for both mobile and non mobile devices. We have identified business process environment as a core component of this framework and have separated from the other components. Our framework as shown in figure 1, uses agent oriented rule-based approach [12]. We separate agent environment from main business process environment, the agent's behavior and their actions controlled and customized through this environment. In business process environment business logics and process are defined. Using the framework it is easy for a business to introduce and integrate new process in this environment.

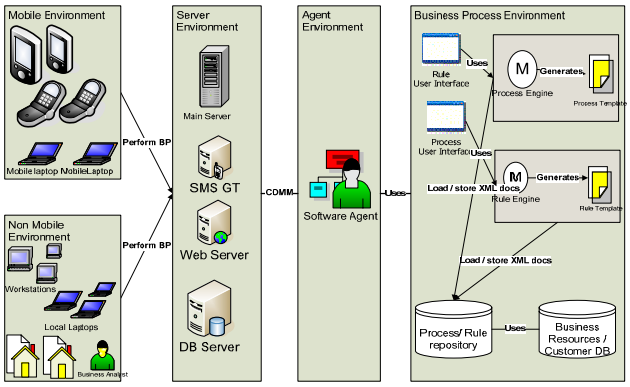

Fig 1: General overview of mobile business process framework

In following sub-sections we present an overview about different environments used in our framework.

2.1 Mobile and non- mobile environment

Mobile and non-mobile devices helps to determine the location of a process. All mobile and non-mobile devices are assessed through server environment. All static entities are come under non-mobile environment and an entity whose location is not static is come under mobile environment. Non-mobile environment is used to provide a flexibility of executing business processes through web pages. For example a customer can put a pickup request through company's web pages. Whereas mobile environment is use to provide a link between business processes and non-mobile devices. Business analysts also use this environment to define its business process or process conditions. Latest technologies like GPRS (General Packet Radio Service) are used to detect the location of mobile devices.

2.2 Server environment:

Figure 2 shows different sub servers that are connected with main server for connectivity with external entities like mobile or non mobile devices. The sub servers may include web servers, SMS gateway translators, database servers etc. The main server is also used for GPRS (General Packet Radio Service) connectivity.

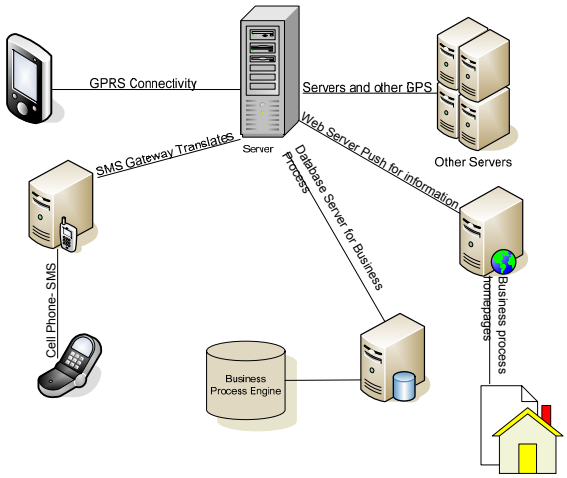

Fig 2: communication layout of business process

The GPRS environment is used to control all the communication connections used in location-aware approach. There are different ways or methods that are used to access any business process depended upon different locations including use of web services. Every server entity is linked with main server, which is responsible for accessing authority.

2.3 Agent environment

Agent environment is a middleware between mobile and non mobile devices. Agent is responsible for synchronizing business processes, their integration with rules and deployment or execution of business processes within its environment shell depending upon business resources. The agent performs all its actions with its own defined ADDED properties [12], [13]. We are using software agents to handle all the business process's synchronization, integration and executions.

The agent is situated in a business environment with set goals and abilities to perform actions and having understanding of environmental characteristics [10]. An agent is capable for automating new processes at different

locations depending upon roles, rules and company's resources. This agent has the objective (set goals) of calculating (performing actions) all the new processes with new process conditions (business rules) within business process environment.

2.4 Business process environment

This is a main environment where business processes are defined. In this environment business process and rule engines are defined where user can define business processes as well as process's rules and conditions. For simplicity, rule and process engines are not discussed in this paper, we adopted the agent oriented rule based business process approach [12, 14], [15].

Business resources and processes repository is used to define or customize business processes. Business analyst can use mobile or non mobile devices to customize existing processes through process engines or alternatively customize conditions for any particular process.

Figure 3 (class Diagram*) shows the different classes and their relationships used in the location aware business process approach. This class diagram presents the overall representation of the application in the context of the location aware approach. Classes are defined in such a way that user can interact with system either from mobile technology or through web based applications.

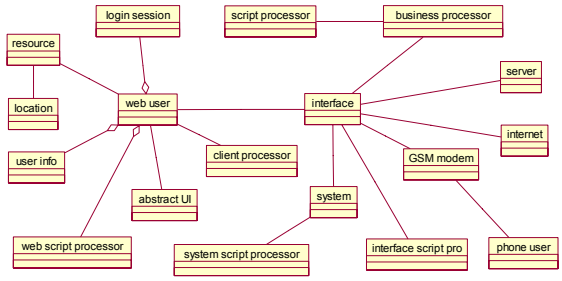

Fig 3: Classes of location aware business process

Following are brief overview of some of the classes used in our approach:

Web user is the class for the user who will use the system through the website. This will be in regard to our system where the user will do its activities through the website.
Loginsession class is defined to record all the session details for the specific webuser. Userinfo class is used to record user information (such as address, phone etc.). Abstract UI class is being used to store the user interface customization layer, so each user will be able to customize his/her view. Every user would have specific profiles within the company.

Script processors
Script processors include WebuserScriptProcessor, SystemScriptProcessor, and InterfaceScriptProcessor classes. These classes are used to store all the functionalities and commands as scripts in the database. These script processor classes process the scripts from the database that are going to be used in the system.

Interface class

Interface class connects the mobile user to the rest of the system. A mobile user may not be able to connect to the system directly, as there are issues in mobile systems such as the device compatibility, and service integration, etc. All these issues are taken into consideration by interface class. Script class is also connected to the interface class that processes the scripts from the database class.

Business processor class

Business processor class stores different process or activities which are stored as scripts in the database. To run these scripts from the database we need the script processor that is also connected to the database.

Resource and location class

The resource class is used to have all the information associated with company's resources. And location class is part of resource class, which is responsible for having all the information about which resources are needed at what location by whom and when.

Resources are very important part of businesses where its processes are depends upon location. Every location might require specified resources to conduct business process.

3. Business process deployment

In this section we will discuss the deployment of business processes on mobile environment. First section will cover the concept of deployment and of different approaches to deployment business processes. The second section consists of deployment of mobile business process.

According to wikipedia the word "deployment" in terms of technology means, "Installing, setting up, testing and running" [16]. Therefore, deployment can be interpreted as a general process that has to be customized according to specific requirements or characteristics [16] [17].

* http://www.agilemodeling.com/artifacts/classDiagram.htm

Deployment of software, application or even a process is a complex task which covers all the activities that have to be carried out from the end of the development itself to the installation and maintenance of the application on the consumer devices. In [17] [18] the authors have compared certain types of deployment techniques in terms of their scale, complexity, expressiveness, and barriers to first use. Some of these characteristics are compared in table 1. The deployment solutions being discussed in the article are: manual, script, language, and model based deployment.

These deployment tools provide varying levels of automation. Automation of application or service deployment is beneficial for improved correctness, speed and documentation but it comes at an increased cost in development time and administrators learning curve as being experienced by different companies.

In terms of comparison between these deployments tools, no universally optimal solution exists, the best approach is the one that closest matches the deployment need. For example when the number of deployed systems is small or system's configuration rarely changes then the manual deployment tool is most ideally used. Consequently, if the configuration comprehensively changes then the script-based deployment strategy is preferred. In larger environments in which changes involve dependencies, language based solutions are preferred. "If the changes also involve significant perturbations to the under lying service's design, the model based approach is probably ideal" [17].

The comparison of each of the deployment tools is summarized in the table 1:

Characteristic	Manual	Script-Based	Language-based	Model-based
Solution based on	Human Knowledge	Configuration, files, scripts	Declarative Language	Models and Policies
Automation	None	Event-based closed loops	Lifecycle Management	Automated design
Self-Healing	None	Minimal	Re-deployment, dependencies	Change design
Barriers to first use	None	Low	High	Very High
Expressiveness	None	Partial: dependencies and constraints	Significant: inheritance, lazy evaluation	Complete: reuse, correctness, and maintenance.

Table 1: Comparison between different approaches in business process deployment.

Certain technologies and models have been presented in recent years for the deployment of services and applications to the mobile devices.

One of the technologies being used recently by the companies for the deployment of services is over-the-air (OTA) deployment. OTA is becoming increasingly important to support. OTA delivery enables easy deployment and upgrades to the applications, thereby reducing the disrupting effect which installation of new applications and upgrades may have on mobile users. Users should not have to surrender their devices to computer specialists, or have to connect to a powerful desktop computer, in order to receive new applications updates. OTA delivery allows users to receive new applications and updates anytime and anywhere, enabling users to easily continue with their work [19] [20].

OTA delivery of applications works as in the following technical steps; a mobile phone user sends a WAP request for a JAD (Java Application Descriptor) file. The request from the mobile phone is sent to the Web server through the WAP gateway. The Web server sends backs JAD file to the mobile phone. Then the phone fetches the JAR (Java Archive) package defined in the JAD file from the web server. The phone Java Application Manager (JAM) installs the package. After the installation the phone sends back the acknowledgement [20] [21].

Other kind of deployment technique is "static deployment". Where the user connects to the site of the application server through its mobile and then subscribes to a download operation. Then the user would receive SMS containing instructions for downloading and installing the application.

The framework known as Smart Deployment Infrastructure (SDI) is designed to ease the installation of large distributed applications for any kind of user terminal. The framework is designed to take into account the execution context like available resources or user's terminal capabilities, in order to bring the application to the user and adapt to the execution context [19].

The framework is implemented with middleware technologies like CORBA [22] and SOAP [23] which ease the development of large scale distributed applications. These technologies allow an application to be described as assembly of components which gives an opportunity to design new kinds of tools to deploy and connect the components of an application. SDI offers automatic deployment of multi-component applications and provides a deployment solution to customize installation and to adapt to device capabilities [19].

3.1 Deployment of Mobile Business Processes

According to recent research business processes are deployed through xml web services. In this section we would discuss and explain how a business process is deployed onto a mobile device and how we use these technologies to deploy business process using our framework.

A Web Service is defined as "a collection of protocols and standards used for exchanging data between application or systems" [24]. Web services can be considered as the emerging distributed middleware technology that uses a simple xml-based protocol to allow applications to exchange data across the web. Services are described in terms of messages accepted and generated. Users of such services do not need to know anything about the details of the implementation, they only need to send and receive messages. At the core of the Web Service is the Simple Object Access Protocol (SOAP) an xml based communication protocol for interacting with Web Services. The SOAP specification includes syntax to define messages, encode or serialize rules for data exchange and conventions for representing RPCs (Remote Procedural Calls) [25] [26].

WSDL (Web Services Description Language) is used for describing the services available. It is a general framework based on XML for describing network services as collections of communication endpoints capable of exchanging messages. It describes where the service is located, what operations are supported and the format of the messages to be exchanged based on how the service is invoked. Whereas UDDI (Universal Description, Discovery and Integration) is used for listing of services are available to users. It provides a mechanism for service providers to advertise their services in a standard form and for service consumers to query services of interest, thereby paving the way for interoperability between services [25] [26].

Business Process Execution Language (BPEL) is the language that is used to implement business processes in Web Services. It defines a notation for specifying business process behavior based on Web Services [27].

BPEL is also used to model the behavior of both executable and abstract processes. The Scope for BPEL includes:

- Sequencing of process activities especially with Web Service interactions
- Correlation of messages and process instances
- Recovery behavior in case of failures and exceptional conditions
- Bilateral Web Service based relationship between process roles [27] [28].

In our location aware business process deployment approach we adopt mobile business process deployment methodologies using java technologies. Whereas we can use different approaches to deploy our business process both on mobile and non-mobile environments.

4. CASE STUDY

This case study presents a scenario for a company that uses a location aware technologies and information intensive business processes to enrich its existing enterprise applications such as service dispatch or fleet management. The company has different services like order pickups, order delivery and invoicing. All these processes are being processed at different locations. Each location may have different set of processes and activities. Each particular process (What) is done by particular actor (Who), at particular time (When) and at particular location (Where).

The company has fleets that are being used to pickup order from one location and deliver to another. The movement of the fleet is limited to the confined limits of the city or a state. The Application starts when a customer uses his/her mobile or web based interface to login and request for a package to be dispatched by entering its pickup and destination addresses and other related information. Then the Dispatcher server would track the position of its fleet as well as their status (idle, busy or offline) and would determine the travel time between customer's pickup location and the current location of the fleet shown with status as idle or available. If the distance between the idle fleet and the customer location will result to a long delay before pickup, then the dispatch server would automatically allocate the pickup to a different fleet. Based on conditions and the parameters the best suitable fleet is chosen in regard to the proximity of the location. A company can use its business processes in a more efficient manner. This could also lead to a greater increase in the company's revenue and a reduction in the losses.

We have implemented "**I**ndependent **L**ogistic **S**ystem" (ILS) using latest JAVA technologies. We adopt one scenario of Independent Logistics business process case study where customer request for delivery of plastic sheets (product) at particular location.

Based on different approaches and technologies business processes can be deployed on mobile devices to enhance

its business process more efficient and easy to integrate as we discussed in section 3. The figure 4 represents the architecture of location oriented mobile business process deployment. The architecture shows different technologies used to deploy a business process both on mobile and non-mobile environments. We separate location aware development as a individual component that helps to customize and integrate location oriented business processes with other processes.

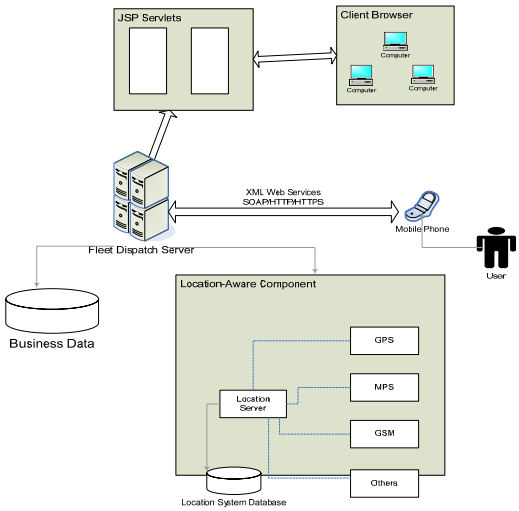

Fig. 4: Implementation architecture

First we define a delivery process for this particular system. In figure 1(a), business analyst define a process through an emulator by entering relevant information like process id, name, description, its type, start date and so on. Every process may or may not have sub activity. In delivery process sub activity is to find suitable driver for pickup and delivery whose status is available. Figure 1 (b), shows the activity of delivery process.

Figure 1(a) Defining Delivery Process (b) Defining an activity

In figure 2 (a, b), the customer needs to enter the username and password if he/she is a registered customer and if not then they need to sign up before using the system as shown in the screen below:

Figure 2(a) Customer Signing in (b) Customer getting registered

In figure 3, customer is presented with different options such as making a request for pickup, delivery or invoicing. After selection, customer enters all relevant details including pickup, drop-off location, product type, and

weight in the system. The system will automatically dispatch his/her request through his/her mobile device depending upon available resources. For example a suitable fleet where its available carriage weight is more then 1 ton will be allocated to this job.

Figure 3(a) Customer selecting the delivery option (b) Customer entering details for the Delivery Process

In general where a request is placed, the system will locate a suitable driver by fulfilling process conditions and available resources. The system uses global positioning system to locate all the available drivers within that particular range whose status are idle or available as shown in figure 4. The driver's information is stored within the system database. Once the system locates a driver then it sends a message to driver for his acceptance of a particular job. It might be possible that the available driver is not willing to accept this job; system will provide basic information about delivery job on his mobile device. Driver will only see pickup and drop off location (suburb only) and he is given two options either to accept or decline a job. Once the driver accepts this job, the system will provide all the detail information for him to perform a task. Figure 5 (a) and (b) shows the emulator's screen displayed to the driver before and after accepting the job. The drive is also able to get directions of location on his mobile device as shown in fig. 5 (c).

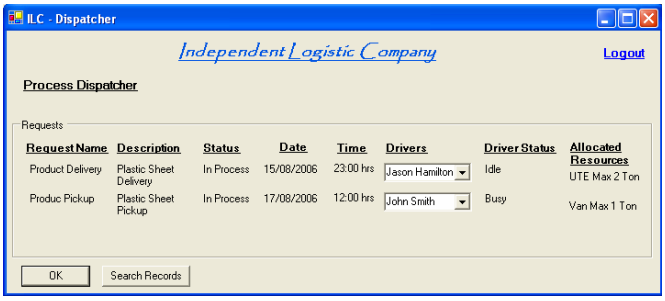

Figure 4 Service Dispatcher, Showing the list of Available Drivers

Figure 5(a) Driver asked about the Availability (b) Driver Shown with Full details.

Figure 5(c) Driver shown with map*

In our approach we provide a framework for both mobile and non-mobile devices to carry out their business processes. In existing business processes, it is hard to personalize and customized their existing processes especially when their processes are mobile. In addition, integration with other processes and customization according with its context are other issues that current businesses are facing. Making business processes more context-aware would result in applications becoming more efficient. And by this companies would be able to earn more revenues.

5. CONCLUSION & FUTURE WORK

In this paper we have discussed a framework that is used to implement and integrate the business processes into location aware environment. In our approach, we have divided the framework into different environments. Each environment has its own associated behavior and characteristics. All the similar functionalities are grouped into environments like mobile and non-mobile devices in one environment. Mobile and non-Mobile environments perform their business processes through server environment, which provides a communication layer between business process environments. We have introduced software agents to synchronize, integrate and execute all business processes that are defined in business process environment used for both mobile and non-mobile devices. We have proposed and implemented a case study on independent logistic company (ILS), in which we presented a practical application to support our theoretical research findings. By using our framework, businesses are able to handle business processes more efficiently into complex business process automation where business is dependent upon location information.

For Future work, we will be extending our location aware business processes into context aware. In the current mobile technology, context-aware applications are only restricted to location aware concept for mobile applications (Location Based Services). Our future work also involves deployment of a business process to a mobile application according to the indicators of the context-awareness such as identity, schedules, agenda settings, activity (talking, walking and running), and availability of resources.

* The image of particular location is generated through http://www.whereis.com.au

References

1. Dyal, U., M. Hsu, and R. Ladin. "Business Process Coordination: State of the Art, Trends, and Open Issues." in *Proceedings of the 27th. VLDB conference, Roma Italy, 2001*: 2001.

2. D.Rosca, and C.Wild, "Towards a Flexible Deployment of Business Rules". *Expert Systems with Applications*, 2002, p. 385-394.

3. Garicano, L. and S.N. Kaplan. "The Effects of Business to Business eCommerce on Transaction Costs: Description, Examples and Implications". in *Working Paper*: 2000.

4. Sloser, S.E., "Optio e.ComEngine and Optio e.ComIntegrate - From Optio Software". *First Impression*, 2000, p. 88.

5. Willis, D., "Twenty Questions on Virtual Trading communities for IPNet Solutions' CEO". *EAI Journel*, 2000, p. 108 - 110.

6. Tilson, D., K. Lyytinen, and R. Baxter. "A Framework for selecting a location based service (LBS) strategy and service portfolio." in *Proceedings of the 37th Hawaii International conference on system sciences.*; IEEE. Hawaii, USA.: 2004. p. 1-10.

7. Houssos, N., V. Gazis, and A. Alonistioti, "Enabling Delivery of Mobile Service Over Heterogeneous Converged Infrastructures".

Information systems Frontiers. 6(3), 2004, p. 189-204.

8. Barkhuus, L. and A. Dey. "Is Context-aware computing taking control away from the user? Three levels of Ineractivity Examined." in *Proceedings of the Fifth annual conference on Ubiquitous Computing (UBICOMP 2003)*: 2003. p. 1-9.

9. N.R.Jennings, "In agent-based software engineering". *Artificial Intelligence*, 2000, p. 277-296.

10. G.Wagner. "Agent-oriented Enterprise and business process modelling." in *First international workshop on Enterprise Management and Resource Planning Systems*. Venice: 1999.

11. Wagner, G., Y. Lesperance, and E.Yu. "Agent-orientd information systems". in *2nd. International workshop at CAiSE*00*; iCue. Stockholm, Berlin: 2000.

12. S.Ali, B.Soh, and T.Torabi. "An agent oriented framework for automating rules in business process". in *IEEE 3rd. International conference on industrial informatics (INDIN 2005)*. Perth, Australia: 2005. p. 17-21.

13. G.Weiss, "Multiagent systems: a modern approach to distributed artificial intelligence". Cambridge, Mass; MIT press, London: 1999.

14. T.Torabi, S.Ali, and W.Rahayu. "A specification for Business Model Components for B2B communication". in *IASTED Software Engineering Application Conference*. Marina del Ray, USA: 2003. p. 459-464.

15. S.Ali, B.Soh, and T.Torabi. "Using software engineering principles to develop reusable business rules". in *1st. international conference on information and communication technology (ICICT 2005)*. Karachi, Pakistan: 2005. p. 276-283.

16. Wikipedia, "Deployment," Wikipedia, encyclopedia. http://en.wikipedia.org/wiki/Deployment

17. V. Talwar, Q. Wu, C. Pu, W. Yan, G. Jung, and D. Milojicic, "Comparison of Approaches to Service Deployment," presented at Proceedings of the 25th IEEE International Conference on Distributed Computing Systems (ICDCS '05), 2005.

18. D. M. Rickman, "Model based process deployment," in The 20th Conference on Digital Avionics Systems, DASC: IEEE, 2001.

19. C. Taconet, E. Putrycz, and G. Bernard, "Context aware deployment for mobile users," presented at Proceedings of the 27th Annual International Computer Software and Applications Conference, (COMPSAC '03), 2003.

20. T. Fjellheim, "Over-the-air Deployment of Applications in Multi-Platform Environments " presented at Proceedings of the Australian Software Engineering Conference (ASWEC'06), 2006.

21. L. Lefevre and J. Pierson, "Just in time Entertainment Deployment on Mobile Platforms," presented at Proceedings of the International Conference on Internet and Web Applicaitons and Services (ICIW '06), 2006.

22. *jGuru.com, "Introduction to CORBA," Java Sun Developer Network (SDN).*

23. *W3C, "SOAP Specification," W3C, 2000.* http://www.w3.org/TR/soap/

24. *W3C, "Web Services Architecture," W3C, 2004.* http://www.w3.org/TR/ws-arch/

25. *G. Austaller, J. Kangasharju, and M. Mühlhäuser, "Using Web Services to Build Context-Aware Applications in Ubiquitous Computing (2004)," 2004.*

26. *A. Gokhale, B. Kumar, and A. Sahuguet, "Reinventing the Wheel? CORBA vs. Web Services," 2002.*

27. *IBM, "Business Process Execution Language for Web Services," IBM, 2005*

28. *H. Koshutanski and F. Massacci, "An access control framework for business processes for web services " presented at Proceedings of the 2003 ACM workshop on xml security, 2003.*

Saqib Ali received the B.Eng. degree in computer software engineering from SICT University, Shenyang, China, and the M.I.S. degree in information systems from La Trobe University, Melbourne, Australia. He is presently pursuing the PhD. degree at the Department of Computer Science and Computer Engineering, La Trobe University.

For his Ph.D. research, he is focusing on business process modeling encompassing business rules, rules ontology, and agent-oriented approaches. He has previously worked on software engineering projects for over 4 years involving systems analysis, design and project management. His research interests include mobile business process, web services, component-based development, and e-commerce. He is a member of IEEE.

Torab Torabi is currently a Senior Lecturer in Department of Computer Science and Computer Engineering, La Trobe University, Melbourne, Australia. He was Lecturer at Auckland University of Technology, Auckland, New Zealand, from 1997 to 1999.

He worked for more than ten years in industry as a Developer and Project Manager. He has been collaborating with more than 20 organizations in research and development of medium-size projects. His research interests include software engineering, software and business process modeling,, location and context-aware mobile services, mobile service integration, and model-driven architecture. He is a member of IEEE and IASTED.

Hassan Ali received Bachelor degree in Computer Science from La Trobe University, Melbourne, Australia. He is currently pursuing his Honours degree in Computer Science at the Department of Computer Science and Computer Engineering, La Trobe University.

For his Honours research, he is focusing on Mobile Business Processes, Deployment of Business Processes to Mobile and Non-Mobile Devices depending on the parameters of context-aware. He has also worked on various Software Engineering projects. During his Bachelor Degree he was named as the “Best System Analyst” for the Software Engineering Project. He has also represented La Trobe University in various nation wide competitions.