Service Oriented Architecture and Business Process Management: 
A Case Study of a Healthcare Organization

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Abstract. Fragmented technological and organizational environment has compromised flexibility and efficiency of Finnish healthcare system. Managers have promoted process orientation as a solution for organizational problems while technologists have been praising service orientation for technological issues. As a result process perspective and service orientation are included in national development efforts aiming to change the Finnish healthcare system. This paper argues that broader issues of enterprise architecture planning and enterprise application integration form the theoretical landscape for which process management and service orientation are part of. Service orientation merges best practices in a theoretically and technologically coherent framework to support flexible information systems. However the technological change is not enough but one has to change also the way technology is managed and developed. Finally theoretical analyses are reflected against personal experiences in healthcare sector to construct a snapshot of a current situation of process management and service orientation in healthcare organization.

Keywords: Business Process Management, Enterprise Application Integration, Enterprise Architecture Planning, Healthcare, Service Oriented Architecture.

1 Introduction

Enterprises are huge organizations consisting of several hierarchical layers of collaborating and partly autonomous networked organizations. Modern enterprises are also constantly facing unpredictable changes in business environment. Changes in business environment create new business demands and opportunities. At the same time technological opportunities emerge and they must be rapidly adopted to form new and more effective ways to support the enterprise. On the whole enterprise's needs to be competitive in the market require the immediate support of advanced IT solutions. In fact it has been noticed that the more competitive and fluctuating the environment the more important is the role of IT in the minds of senior management [1]. Therefore one of the most important tasks for enterprises information management unit is to provide effective business and IT alignment.
Unfortunately, enterprise systems consist of technological networks of computers and applications linked together through a variety of ad hoc solutions. The diversity of applications and technologies, along with the local focus of application functionality, has been fragmenting enterprise systems. Similar issues apply also to a wide variety of human factors. Historical organizational structures, bounded educational backgrounds, and practitioners locally learned skills restrict and slow down enterprise ability to change while maintaining efficient internal performance. Together, technological aspects and human factors create major barriers and gaps for integration and flow of information, although they are necessary prerequisites for an agile and efficient enterprise. Lately, Service Oriented Architecture has been advocated as a potential solution for many of enterprise level IT problems [2] while Business Process Management or Business Process Re-Engineering [3] has been seen as a method to improve the organizational effectiveness of business activities by reassembling the course of local functions in a more flexible way.

Previously described technological and organizational problems are everyday life in Finnish healthcare systems and particularly in the hospital district of Southwest Finland. This is not a surprise since hospital districts are large enterprises of more or less autonomous service providers. Hospital districts are responsible for coordinating and supporting the cooperation of hospitals, healthcare centres, social services, laboratories, pharmacies, and other similar local healthcare and social service units. Hospital districts are not only limited to health services but their organizations include also support functions such as kitchens, laundries, and ambulances.

Nowadays, healthcare processes and IT infrastructures are being developed nationwide as well as locally. In fact, the National Healthcare Project includes several nationwide projects: Seamless Service Chains tie together isolated units and their activities; the Healthcare Guarantee protects the rights of a patient to healthcare services, and National Information System Architecture develops technological standards and builds integrated systems to support the flow of information across organizations. These examples demonstrate that issues related to BPM and SOA have been handled in Finnish healthcare development for years. Service chains are nothing more than domain-specific terms for healthcare business processes while National Information System Architecture will include many service-oriented elements. In practice, hospital districts will adopt and implement these national process and service development plans in their regions for their local hospitals and service units.

This paper is a project report for a seminar on enterprise information systems on special topic of Service Oriented Architecture and Software Engineering. The objective of this paper is to seek answers for the following research questions:

- What is the relationship between BPM and SOA?
- How they could be implemented into information systems development practices?
- What is the current state of BPM and SOA in the hospital district of Southwest Finland?

In this paper, the concepts of Business Process Management and Service Oriented Architecture are defined broadly to include both technical and human factors of enterprise systems. The scope of the analysis is strategic and business level perspective rather than technical implementation level.
Analyses are based on limited literature review of books and articles as well as practice-oriented whitepapers and documents. Theoretical considerations are reflected against practical experience and personal knowledge about healthcare sector. It should be noted that empirical part does not include any systematic interview, surveys or document analysis. It is practice-oriented and subjective summary of relevant topics and therefore heavily subjective and limited to general considerations.

The theoretical framework of service orientation and enterprise process management are handled in second chapter. The third chapter discusses practical and implementation issues of service orientation while fourth chapter describes shortly the current situation of process management and service orientation in hospital district of Southwest Finland. Finally the conclusions are presented in the Fifth chapter.

2 Theoretical Framework of Architectures and Processes.

2.1 Enterprise Architectures and Business Processes

Enterprise Architecture Planning (EAP) has been developed into an overall methodology to support top-down management and development of organizations and their technological environments in complex environments. The objective of the EAP has been to provide methods for the management to link business and resources management in a systematic way. In practice architectures are used to capture the current state of an enterprise from multiple perspectives, develop a desirable vision for the future and plan the gradual change for the organization to achieve its goals.

The Zachman framework (Fig.1) provides an overall picture to a wide set of different perspectives to an enterprise system [4,5]. The framework illustrated how several abstraction levels and different domains of blueprints were linked together in a systematic way. Thus the original framework built the foundation for the later development in the area of enterprise architectures.
Building enterprise architectures were later developed into a practical lifecycle process including step-by-step guidelines to constructing the blueprints in real enterprise environment [6]. EAP defined by Spewak and Hill begins by constructing business models and guidelines, defines data according to business needs and only after that it moves to application and technology levels. It is a straightforward process model which emphasizes top-down business perspective and technological independency. However business plans, architecture blueprints and strategic guidelines of top level architectures do not usually provide direct orders to tactical and operational levels of management. They just offer the overall framework which illustrates local constraints and opportunities for lower level decisionmakers. Also the abstraction level and the quality of information embedded in blueprints is often ignored by authors and considered local and practical problem. Regardless of its limits the EAP and its methods can be used for planning and design of a competitive and flexible enterprise system starting from strategic level and business perspectives.

Business Process Management is a small although one of the most important parts of EAP development process. Processes are one of the possible perspectives to a whole enterprise system and therefore process information complements other perspectives such as organization charts, stakeholder analysis and geographical maps.

However the maturity of process modelling techniques and tools is advancing and especially the emerging linkage between technology and business has given BPM a new boost. Technological infrastructure and software platforms are maturing to offer also process oriented support for business rather than supporting only isolated functions although currently they are in the stage of early adoption [2]. Joint advancement in organizational management techniques and technological infrastructures are developing isolated and functional units to a more comprehensive and process oriented enterprises.
EAP bridges the gap between management’s business perspective and the development of information systems by offering formal methods and guidelines for their common use [6]. Business processes are in the core of enterprise architectures and supporting them is one of the most important tasks for IT and business managers. In this sense EAP seeks to smooth the road across some of the biggest obstacles in enterprise management: different views and backgrounds of business people and technologists as well as the hard step from theoretical planning to actually building an executable business activity.

2.2 Service Oriented Architecture

The concept of Service Oriented Architecture (SOA) offers a framework for better-integrated software systems that meet business needs [2]. According to Bieberstein et al SOA is not only a narrow technical solution like web services and SOAP. It tries also to offer a more generalizable and reusable approach to integrate software systems than traditional Enterprise Application Integration (EAI). In its widest sense SOA approach includes also business planning and decisions. Therefore the alignment of information technology and business is in the core of SOA. It provides especially the commonly missing link between business planning and technological implementation of an integrated and flexible enterprise system.

Historically the principles and general methods of SOA have been used for long time [2]. For example loose-coupling has been used in message queue-based legacy implementations and technology-independence has been a common concept in general design studies almost forever. However software engineers have been developing SOA to help them match the needs of business by collecting a set of best practices and principles to form a solid approach of agile and effective software systems. In overall the SOA-concept combines a new rationalization of practices and techniques that already exist in process-driven, top-down, bottom-up, and meet-in-the-middle methods of software integration [2]. It is just the emerging technological maturity and overall perspective to design and implementation of a flexible enterprise system that makes SOA an evolutionary step rather than one more isolated solution.

Although SOA is linked to business processes it is also heavily technology and implementation oriented approach for software engineers [7]. While EAP is used for defining blueprints for the management these blueprints leave the implementation and execution details for others. SOA on the other hand is also an implementation approach. It provides technologies and industrial standards for executable information technology solutions. It offers methods to build software systems which can support the business needs of an enterprise visioned in the management’s blueprints.

2.3 Business Process Management and Service Oriented Architecture

SOA and BPM are complementary and closely linked perspectives to same enterprise level problem - how to manage and develop complex networks of activities in an unpredictable environment. Their differences are rooted in the origins of concepts and their primary stakeholder audiences. BPM is a top management activity and based
on management studies. EAP was developed to collect commonly used management
techniques and practices into a comprehensive methodology and link it directly to the
development of information systems [5, 6]. SOA has been doing the exactly same
although its origins can be seen in Enterprise Application Integration and
development techniques of software engineers [7]. SOA practitioners are building
implementation and technical level approach for flexible software systems and linking
their development techniques more directly to methodologies of business people.

There are two major process modelling standardization attempts which have almost
exactly identical objectives which is linking process modelling methods to technical
implementation. Business Process Management Notation (BPMN) from BPMI has
background is in management studies and business world [8]. Unified Modelling
Language (UML) from the OMG has been developed by technologists to support
implementation and modelling of software systems [9]. Especially BPMN Business
Process Diagram, and the UML 2.0 Activity Diagram, can graphically represent the
workflow patterns and these two process modelling techniques will probably merge
together in future [10]. They are heading for the same goal although they are coming
from slightly different directions. In other words both of these diagram notations
could be used to build same enterprise system based on service oriented architecture.

Process modelling techniques are being integrated to support also actual technical
implementation. BPMN is just a common language and vocabulary for technologists
and business people [9]. However it also links theoretical process models directly to
technical implementation of process oriented software systems. BPMN Business
Process Diagram maps directly to Business Process Execution Language (BPEL) and
therefore it allows direct synchronization of modelling and implementation [9]. The
relationships between these two are like E/R-diagrams and databases in modern
database management systems [11] which are capable of linking graphical modelling
and data definition languages directly to each others by using extensive metadata
embedded in database management systems. Technically SOA provides also a
platform for executing the more technical BPEL. Just like in database environment
there is other ways to store and update information there is also other ways to build
applications. SOA is just one possible approach and it is yet to see if it ever becomes
such a dominant standard in enterprise applications that relational database systems
are in data management environments.

In general BPM should be used to guide the overall development of information
systems in close cooperation with the business management. It can help to keep the
business needs in charge of information systems development by allowing business
analysts and managers to take a more concrete role during the development projects.
SOA on the other hand provides tools for software engineers and architects to build
systems which make all process plans a living reality. Together business process
management techniques and service oriented applications try to keep enterprise
system an agile and effective collection of human and technological resources.

Table 1. Theoretical characteristics of processes and architectures from business perspective to
technical perspective.

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<th>Perspective</th>
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3. Implementing BPM and SOA to Development Practices

3.1 Identifying Business and Service Opportunities

The purpose of SOA is to base activities on services: modular, reusable, loosely-coupled and autonomous actors providing valuable outcomes for their customers. It is crucial for an enterprise to find out the best potential services for all architecture levels. Even a small effort to build a service on one architectural level can make a huge difference for the other levels of enterprise architectures. Therefore identifying services is essentially multiprofessional interaction focusing on enterprise level plans including business, data, application and technological issues. Bieberstein et al [2] describe three different approaches to identify service opportunities: input analysis, top-down and bottom-up.

Input analysis means analysis of current documents. Existing business process diagrams, organization charts, data flow diagrams, application architecture models and other management blueprints might provide enough information to identify some potential services. Business level information might be found also from organizations strategic documents, internal management guidelines and handbooks, accounting manuals and customer research reports. Documentation such as application and database manuals, datawarehouse metadata and other similar resources provide more detailed technological information for technical service design.

Top-down approach can be used to gain more business level information if current blueprints or other documentation is not sufficiently accurate or it does not even exist. Business managers, business analysts and other non-technical people can produce general ideas for a further development during brainstorming sessions or stakeholder meetings. These ideas can be used as a starting point for new management initiatives such as improvement of process documentation, mapping application architectures or ordering customer research. In this way the quality of existing material can be improved for the future input analysis and newly constructed business documentation can be transformed to system requirements and implemented as web services [12].

Bottom-up analysis starts from technical perspective and it includes lower level SOA layers such as technology, data and applications. Technical staff should be able to generate services even without active involvement of business units. However there should be also technical personnel who understand the business side of enterprise. In
that way one could recognize the business value of a service although the idea for the potential service might come from technical perspective. It is very likely that people who see only one perspective, business or technology, do not notice small details which might be useful services from other perspective. Also they might not understand how some seemingly hard problems might be solved easily by reorganizing architectures or constructing services in other architectural level.

3.2 Organizing Service Oriented Development Practices

Building SOA-based enterprise systems is just like any other large scale organizational development. Development must be organized systematically or it will not achieve its goals. Relying on voluntary work of isolated individuals will not be enough no matter whether the approach is top-down, bottom-up or even input-analysis supported by excellent documentation. In fact these three perspectives are only complementary and all of them should be used to support each others. In general there are some considerations which should be taken into account while organizing service oriented development practices systematically.

The development can be characterized as enterprise level multiprofessional collaboration. No matter whether the SOA approach is top-down or bottom-up you need to focus on building opportunities and collaboration methods for multiprofessional teamwork. Business managers and analysts should be able to communicate with technical experts and software engineers regardless of who is the most active and powerful actor in development initiatives. Luckily SOA and its methods such as BPM and technical platforms are especially focusing on bridging the gap between business and technical staff and their working methods.

Large scale enterprise development should be organized formally while maintaining the scalability to different settings. However the current state of enterprises IS architecture might not be very scalable, flexible and formal technologically or organizationally. Information systems might be highly dependent on key persons, their tacit knowledge, previous local experiences and undocumented system features. SOA architecture means developing the technological infrastructure and work habits towards totally opposite direction which the organization might be used to. To fully exploit the advantages of SOA one should make also the development practices and management formal, systematic and scalable and not only formalize the simple technical solutions such as web services [7]. These principles, formalism and scalability, should be built also into the current business process modelling techniques and general enterprise architecture planning methods [13].

In any case building service oriented applications should probably start as a small pilot project although the long term focus and vision must be always on full scale platform. One should recognize that SOA might be expensive and seemingly unnecessary approach for most of the small scale projects. The strenght of reusability and loose coupling comes from large scale deployment rather than any single project. Starting simple internal and technical SOA projects just makes it easier to get started and in this way one can test organizations maturity for the development and maintenance of service oriented information systems [14].
Most importantly implementation of SOA and development of business processes need clear strategic objectives which should be aimed at. This seems quite obvious since the benefits of SOA come from large scale deployments rather than from isolated projects.

4 BPM and SOA in Hospital District of Southwest Finland

Process management and service orientation are hot topics also in Finnish healthcare sector. Finnish healthcare system has been traditionally very hierarchical, bureaucratic and autonomous collection of organizational actors. In practice this means slow information flow across vertical hierarchies and barriers to horizontal information sharing. Bureaucratic culture means laborous documentation for many small details while large scale decisions and collaboration are often neglected. Autonomy has lead to a limited local focus to organizing activities resulting in inefficient resource allocation and resistance to changes.

These problems are reasons for current healthcare development trends like process management, service orientation and national architectures. In practice healthcare sector just labels these concepts with domain specific terms such as service chains and national information system architecture. In other words BPM and SOA are especially relevant for Finnish healthcare sector since healthcare processes and information system architectures are being planned and implemented in large projects nationwide as well as locally in hospital districts.

Top-down development of business processes and enterprise architectures are getting attention in hospital districts. In hospital district of Southwest Finland processes are being modelled in several local development projects related to nursing work practices, information systems implementations and clinical process improvements. However these process developments are often too isolated and preliminary pilot projects. They do not have common notations and tools for documenting the development activities and therefore they lack a systematic way to share information across projects. It might be possible that the next huge organizational change, the construction of the new T2-hospital, will make process development more systematic and formalized part of everyday management practices. It should be noted that information systems development is not yet really connected to these process development projects and the whole department of information management is just planning to get familiar with process modelling principles, techniques and tools. BPM initiatives plan their process improvements in isolation rather than in close operation with information systems development.

SOA is being introduced to clinical information systems such as electronic patient record systems. One could say that the most concrete benefits have been achieved from this bottom-up approach. In practice legacy systems have been encapsulated by message-based adapters and application integration is getting more standardized and general. However there are not yet plans to adopt SOA and its principles to financial or human resource systems. On the other hand these supporting systems and processes might provide a lot of potential for services which would release clinical resources for more patient oriented clinical work. Currently doctors and nurses must document
manually a lot of information which is not really part of clinical decisionmaking but more like general resource allocation and financial routines.

There are plans for several national services such as code services and electronic signature. Code service will deliver important codes to standardize the classification of data related to healthcare activities, diseases, human resources, organizational units and similar issues. Electronic signature provides authentication and identification of individuals including doctors, nurses and researchers as well as individual citizens as patients. These nationwide services will have a major impact to information systems and clinical processes in Southwest Finland during the next few years.

4.1 Development Practices in the Department of Information Management

Traditionally the department of information management in the hospital district of Southwest Finland has been responsible for general maintenance and development of information systems. The focus has been in technical maintenance of servers and applications. Application development is mainly outsourced and procurement processes focus on buying an application or a service for a single function. During the last few years there has been also a major expansion to provide more user-oriented support for clinical applications. These are organized as help desk functions and local support users. In general the department’s culture is focusing on short-term operational management of highly technical server maintenance and on the other hand highly domain-specific application support for end-users.

Unfortunately there is very little attention paid to long-term development of applications and technologies. Software quality factors such as functionality, reliability, usability, efficiency, maintainability and portability [15] are seen very narrowly. Procurement decisions are based mainly on functionality and reliability from technical perspective related to a single organizational need. Of course also other aspects are seen as important but in reality other issues than technical functionality, maintenance and short-term requirements are more like buzzwords which are not measured or evaluated systematically. In this way hospital district of Southwest Finland is just like any other public sector healthcare organization. Hopefully national standardization and development efforts will support hospital districts to develop also long-term and business-oriented development practices.

There has been some preliminary steps to introduce EAP and therefore also process modelling to the development practices of information management department. In practice there has been identified a need for business process diagrams, application architectures, technology architectures and data models. The problem is how to turn this awareness of a need to actual practice in everyday work environment. There is no plan for adopting any specific and standardized notation or full scale enterprise architecture methodology for developing internal blueprints. However one team has internally agreed to follow a simple local notation and similar agreements should be made for the whole department. The tool has been chosen by the senior management of hospital district and all process models will be constructed with Microsoft Visio. On the other hand for example data models are an exception for this rule. There isn’t yet any systematic practice or tools for developing shared data models but this issue will be solved during the next datawarehousing project.
Currently the hospital district of Southwest Finland and its information management department follow mainly two principles while adopting BPM and SOA. The implementation of BPM and SOA are practice-oriented iterative piloting. Unfortunately in reality practice-orientation has turned out to mean simplicity and voluntariness. In other words there is some isolated models of some application domains. Some blueprints illustrate also change management but mainly from technical server and service perspective in one year scale. The timescale and scope of architectures should be broadened and the quality of blueprints should be improved.

The missing principles which should be embedded in development practices are a) clear long term vision, b) measurable short term objectives, c) formalizing activity and d) rewarding achievements. Practitioners should be able to see the benefits of long-term plans and common architectures. Large vision can not be built from the scratch but it has to be approached step by step. Finally voluntariness should be replaced with formalized responsibilities and rewarding mechanisms. Without these commonly known project or organization management principles BPM and SOA development will continue to be isolated and informal pilot projects of some individual practitioners.

The benefits of SOA can not be realized until department of information management adopts a long-term and enterprise level management style. Developing and supporting flexible information systems require not only changing the outsourced technologies but also changing the internal development practices [7].

5 Conclusions

Enterprise information systems should be flexible and scalable to support the business in fluctuating and competitive environment. Business managers have been developing architecture planning methods to align business and IT. Software engineers have been integrating applications to support a more complex and networked organizations. These two perspectives merge in SOA. It has been developed to bridge the gap between business and IT by collecting a set of best practices to build flexible enterprise information systems [2].

The implementation of SOA does not differ from other enterprise level development efforts. It is multiprofessional, large scale, complex and political struggling in a seemingly chaotic enterprise environment. SOA development must follow commonly known management principles. It will not achieve its goals if it is just a pet project, voluntary work in isolated projects or large futuristic vision. It has to be organized formally, supported by clear vision and objectives while paying special attention to maintaining the support of all stakeholders. It should be organized iteratively and prioritized carefully so the risks will be minimized and drawbacks can be handled without serious damages to any of the stakeholder groups and enterprises architectures. On the whole SOA means not only new technological solutions but also the development and maintenance practices must be changed [7].

Finnish healthcare and therefore also hospital district of Southwest Finland is undergoing a large process and information systems redesign. In other words BPM and SOA are going to have a major impact to hospital district of Southwest Finland.
Currently they are just small isolated pilot projects and early changes to legacy systems but national and local development efforts will broaden the scope and depth of process management as well as service orientation of information systems.

References