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Potential factors influencing adoption of a Service Oriented Architecture: Experiences from specialist healthcare in Norway

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Abstract

Specialist healthcare in Norway is an important part of the medical care "value chain" financed by the Norwegian government through the Ministry of Health and Care Services. The specialist healthcare sector in Norway is facing increasing challenges amongst others relating to; national reporting, frequent organizational and process changes, budget cuts, collaboration across organizational borders and judicial issues related to accessing sensitive information.

Previous research in other countries has shown the healthcare sector as a late-adopter when it comes to using new IT paradigms and IT technologies to solve collaboration challenges, even if they have the potential to create a more effective workplace. The Service Oriented Architecture (SOA) is a relatively new approach to structuring and managing IS portfolios in a way which could contribute to improved alignment of the use of IT to the strategic goals of the business. Establishing a SOA could therefore be one potential remedy to some of the problems faced by the specialist healthcare sector, but it probably needs to be matched by corresponding organizational and management remedies that support the roles and responsibilities needed to make the SOA operational at the national, regional and local level.

This thesis sets out to describe and explain what potential factors could be influencing adoption of a SOA in the specialist healthcare sector of Norway. Multiple case studies have been conducted using an empirical research strategy, with an interpretive point of view. This has implied an ideographic perspective, involving hermeneutics and subjective interpretation by an involved researcher. I have analyzed the data involving the concept of the hermeneutic circle extracting themes from the interviews and aggregating these themes into grand themes. Thereafter I have compared themes across interviews, viewing the final result through the lens of previous research.

My findings indicate that specialist healthcare has made the decision to adopt a SOA, but has in general not made significant advancements beyond that stage. There are indications that much remains to be done if the different stakeholders are able to benefit from the advantages promised by a SOA. The suggested conceptual framework indicates that process management, information management, IS portfolio management as an integrated SOA governance discipline, competence, stakeholder support, organization, information security, the adoption of the Web Services Architecture, healthcare vendors and standards compliance could all be potential factors influencing the adoption of a SOA in specialist healthcare in Norway.

These findings could be a useful starting point for further research on SOA adoption with a more general goal in view. This thesis could also possibly be a fundament for possible actions formulated by practitioners in specialist healthcare.

Keywords: Healthcare, Service-Oriented Architecture, IS Adoption, Enterprise Application Integration

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Abbreviations

Abbreviation	Term
IT	Information Technology
ICT	Information Communication Technology
IS	Information Systems
HIS	Healthcare Information System
SOA	Service Oriented Architecture
BPM	Business Process Management
BPMS	Business Process Management Systems or Suites
EAI	Enterprise Application Integration
API	Application Programming Interface
XML	eXtended Markup Language
SOAP	Simple Object Access Protocol
UDDI	Universal Description Discovery and Integration
WS-*	Web Service standards
BPEL	Business Process Execution Language
HL7	Health Level 7
CCOW	Clinical Context Object Workgroup
DICOM	Digital Imaging and Communications in Medicine
HOD	The Ministry of Health and Care Services
HDIR	The Directorate of Health
RHF	Regional Healthcare Authority
HF	Healthcare Provider
IHE	Integration the Healthcare Enterprise
KITH	The Centre for IT Competence in the Health and Welfare Sector
N-ICT	The National Board of ICT (for specialist healthcare in Norway)
OASIS	Organization for the Advancement of Structured Information Standards
COTS	Commercial Off The Shelf

Chapter 1 Introduction

1.1 Background

The healthcare sector in Norway as in most other developed countries is extremely complex and information intensive. The adoption and use of IT (Information Technology) is a critical requirement for handling the increasing number of patients on a yearly basis with the necessary quality, effectiveness, safety and adherence to rules and regulations that are involved in modern healthcare.

Healthcare organizations have over time invested in a number of different types of systems supporting functions at the enterprise and departmental level e.g. patient administration systems, laboratory systems, medical equipment software etc without necessarily investing in purchasing, implementing and integrating systems to support cross-organizational collaboration (Pouloudi, 1999). The literature has long suggested the need for integration of internal functions (Pagell, 2004). From this there is little doubt of the importance of integration related to collaboration in the healthcare sector.

Automated integration is unequivocally a critical, timely and effective component that can be used to alleviate inconsistencies between redundant data stores. But according to research literature, for example (Lenz & Reichert, 2007; W. Wang, Wang & Zhu, 2005), although there is a positive trend, the healthcare sector has remained slow in adopting new IT architectures such as the Service Oriented Architecture (SOA) and technologies available to create interworking, autonomous healthcare applications that in total implement the so-called Healthcare Information System (HIS) or Integrated Healthcare Enterprise (IHE). Ferrara (1998) points to integration of existing systems as representing one of the most urgent priorities of healthcare information systems in order to allow the whole organization to meet the increasing clinical organizational and managerial needs.

The Norwegian Government has during the last few years established goals (HOD, 2004) that implicitly define "effective collaboration" in the healthcare sector. These goals seem to be partially impeded by the complexity of the sector due to the number of potential stakeholders, disparate legacy systems and infrastructure that is currently in place within and surrounding each healthcare organization (Grimson, Grimson & Hasselbring, 2000)

Adoption of a SOA in specialist healthcare could potentially solve some of the current challenges that are hindering the establishment of an integrated HIS, amongst which the following are prominent:

1. Diversity of healthcare technologies that do not speak the same "language". The consequence is a technical "Tower of Babel," In the absence of effective device-to-device communications; human operators must often read data from one device and manually enter it into another, a highly inefficient and error-prone process. (Grimes, 2005).

2. Data on outcomes of medical cases that will enable effective choices and compensation of providers (Tsiknakis, Katehakis & Orphanoudakis, 2000)

3. Automation of repetitive, mundane tasks to place the focus on patient needs rather than paper-work (Tsiknakis et al., 2000)

4. Empowerment of patients to become more actively involved in their own healthcare (Tsiknakis et al., 2000) requires integrated healthcare solutions and a national, online Electronic Healthcare Record which is updated by hospital and GP patient administrative systems

5. Flexible remote access to relevant information in order to ensure continuity of care (Tsiknakis et al., 2000) e.g. in the case of Emergency Rooms treating patients that are far from home, their local GP's and hospitals

6. Escalating costs have forced dramatic changes in the healthcare industry, with a move towards managed care. Managed care seeks to integrate healthcare delivery processes and continuously improve them through feedback based on evaluation of care outcomes. The success of managed care depends critically on the collection, analysis and seamless exchange of information within and across organizational borders (Dutta & Heda, 2000)

7. Timely communication of accurate information is a key success factor for the provision of quality healthcare (Chiu, Kwok, Wong, Cheung, Kafeza & Kafeza, 2004)

8. The quality of data limits the ability of the end user to make correct decisions, which can have fatal consequences, especially in the health care provider's environment. (Kohn, Corrigan & Donaldson, 2000; Welzer, Brumen, Golob & Druzovec, 2002)

9. Medical errors caused by lack of correct and consistent information at point of care (Sutherland & Heuvel, 2006)

This thesis attempts to investigate some of the issues facing specialist healthcare organizations with an exploration of how a SOA can potentially solve some of the current challenges in specialist healthcare and what potential factors can affect or influence adoption of the SOA.

1.2 The Research Question

The healthcare sector is one of the most important sectors of society today and is under constant pressure by the public to become better at what it does i.e. treating patients. The sector has been quick to adopt technologies (Harkke, 2006) which can be directly used in medical treatments, but slow to use new IT technologies that can optimize processes related to patient administration and logistics.

The last few years has seen the popularity of SOA as an architectural paradigm and strategy for long term development of the IS portfolio including the means to encapsulate legacy systems and infrastructure so that existing software can be exposed as services that support both intra- and inter-organizational processes, and therefore contribute to more effective collaboration (Bellur & Narendra, 2005; S. C. Chu, 2005; Forslund, George, Koenig, Staab, Kratz & Carter, 2001; Mykkanen, Riekkinen, Sormunen, Karhunen & Laitinen, 2007; W. Wang et al., 2005).

Despite the wide range of advantages that many researchers associate with the introduction of a SOA, comprehensive SOA adoption continues to be scarce in practice (Legner & Heutschi, 2007) and is seemingly scarce within the healthcare

sector. An inquiry of existing research milieus in Norway i.e. Sintef and the University of Oslo indicated little research into SOA adoption in relation to the healthcare sector in Norway. According to Jarvinen (2004, p. 66) theory creating studies are suitable for exploratory investigations when there is no prior knowledge of a part of reality or a phenomenon. This study therefore attempts an exploratory investigation of specialist healthcare in Norway to see what the current state of affairs are related to a SOA, seeks to identify how a SOA can potentially solve some of the challenges facing specialist healthcare and investigates what potential factors are influencing or could influence adoption of a SOA in the Norwegian healthcare sector. My research question is formulated as follows:

> ***What potential factors are influencing adoption of a SOA in specialist healthcare in Norway?***

According to Jarvinen (2004, p. 8) there are four possible purposes of science; to describe, to explain, to predict and to control. The purpose of this thesis is to describe and explain and if possible establish a fundament on which new theory can potentially be formed by other researchers.

By identifying potential factors that could influence SOA adoption in specialist healthcare, I am also attempting to establish a tool that decision makers involved in the SOA adoption process in different specialist healthcare organizations can possibly utilize to advise in the establishment of the necessary mechanisms that could help ensure successful diffusion of the adoption decision at all levels of specialist healthcare in Norway. For example if the decision to adopt a SOA is made at the national level, one should expect each of the organizations at the regional healthcare authority and healthcare provider level to make their own decision on adoption

This thesis has been limited to investigating SOA adoption in specialist healthcare based on a relatively broad approach related to the stakeholders involved and by not defining the SOA upfront.

1.3 Motivation

My motivation for this specific study originates from my work as an IT practitioner, of which the last 4 years, I have been involved in multiple IT projects in the specialist healthcare sector at both the national and regional level. Through my involvement as an IT practitioner in the specialist healthcare sector, I have experienced that there is a need for a more structured approach to solving some of the challenges that this sector is presently experiencing. My hope is that this thesis brings more attention to the factors influencing SOA adoption in the specialist healthcare sector which can then serve as a fundament for optimization of intra- and inter-organizational collaboration processes (Granebring & Lindh, 2007).

My current involvement has posed a few ethical challenges due to the multiple roles I have had. I have had to be careful to avoid situations where my role as a researcher and the information elicited could have been compromised by either my employer, the customer who owns the projects I am currently involved in, or interviewees who could have been less willing to disclose information of vital importance to this study - viewing my role as a consultant as a possible threat. My approach to solving these ethical challenges has been to establish written agreements with both my employer and customer, which defined the 'rules of engagement' for me as an involved researcher. In addition I have been explicit on my roles when entering all interview situations.

I am presently employed in a role as a senior advisor by an IT consultancy company in Norway who specializes in the healthcare sector market. My employer is quite well known in the IT industry for work done on the SOA in the judicial sector. Most of the work I have done in the healthcare sector has been related to IT projects being run by the National ICT Board (N-ICT) and the South-East Norway Regional Healthcare Authority. My role in all of the projects has been related to IT technical management and coordination of activities at both the national and regional level. I have also been involved in establishing the solution architectures necessary to satisfy each of the project mandates.

Because of my work situation and interest in the complex challenges the healthcare sector is facing, I suggested to my contractor in the Regional Healthcare Authority I was working for, the possibility of completing a master thesis with their support. My proposal for the master's thesis was accepted and authorized by the Healthcare Authority's management team.

This thesis is the main component of the IS master study at the University of Agder, Norway.

1.4 Thesis structure

The structure of this thesis is centred around a traditional approach where Chapter 1 is introductory, Chapter 2 gives a description of the phenomenon being studied based on a review of the literature and the areas of knowledge that I wish to contribute to. Chapter 3 gives a description of the research method and design and presents the analysis enacted on the data collected, Chapter 4 outlines the case settings for the organizations and projects that were interviewed, Chapter 5 introduces the component themes and grand themes extracted and coalesced from the interviews, Chapter 6 discusses my findings in the light of relevant literature, Chapter 7 summarizes the research completed and indicates possible implications from the work done, for both future researchers and practitioners.
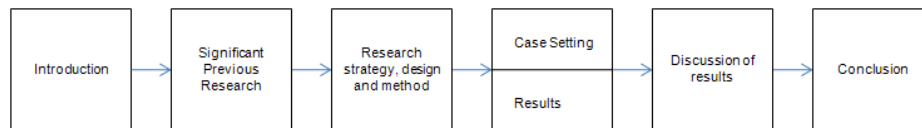
Figure 1 The structure of this thesis

Chapter 2 Significant Prior Research

2.1 Chapter Synopsis

This chapter seeks to frame my research question within boundaries set by the Service Oriented Architecture as the phenomenon being studied, the relevant challenges described in the literature which the healthcare sector faces also including the potential benefits of a SOA related to these challenges. I have made an effort to highlight some of the most important aspects of the SOA focusing on architecture, business processes and the concept of services, integration and some of the most important SOA enabling technologies. The main objective of the chapter is therefore to background the underlying dimensions of my main research question that are described in the literature and where I hope that my findings will be able to contribute knowledge.

2.2 Literature Sources

The phenomenon I have chosen to study is adoption of a SOA. Some of the sources which have been utilized as a part of my literature review have been:

- The ACM Digital Library
- IEEE Xplore
- Emerald Insight
- Science Direct
- Bibsys

I have used Google and GoogleScholar as search tools on the Internet. In addition I have contacted specific research environments in both Norway and in other countries with the purpose of obtaining insights into the state of research into SOA adoption and specific articles of interest.

2.3 The Service Oriented Architecture

2.3.1 Definition of a Service Oriented Architecture

There are many different types of application of the concept of architecture in the area of Information Systems (IS) which makes it important to clarify what IT architecture actually is before progressing into the concept of a SOA. IT architecture is defined by Hammer (1997) as:

> *"An IT architecture can be viewed as a high-level design that supports and restricts the construction of IT systems of a given type." (Hammer, 1997, p. 304)*

This definition differentiates itself from the concept of a system architecture or an application architecture which concern themselves with the description of a specific system or application in the IS portfolio of any given organization. The Service Oriented Architecture (SOA) seems to be a specific style of IT architecture, although there seems to be much confusion about the SOA in the marketplace amongst researchers, customers and practitioners. Some of this

confusion probably stems from much of the marketing hype (Hau, Ebert, Hochstein & Brenner, 2008) generated by some IT vendors.

Figure 2 describes the elements of a SOA as defined according to Marks and Bell (2006). Marks and Bell (2006) present a SOA as composed of a strategy, a governance regime, enabling technologies, services implemented on the enabling technologies chosen, and architecture model, a description of the behaviours and organizational culture, and lastly metrics which can be applied to measure the progress of the organization in relationship to achieving its SOA strategy. I will use this definition of a SOA as one type of 'control group' which other definitions are compared against. I do not describe in more detail all of the elements presented in Figure 2 such as architecture model, behaviour and culture and metrics.
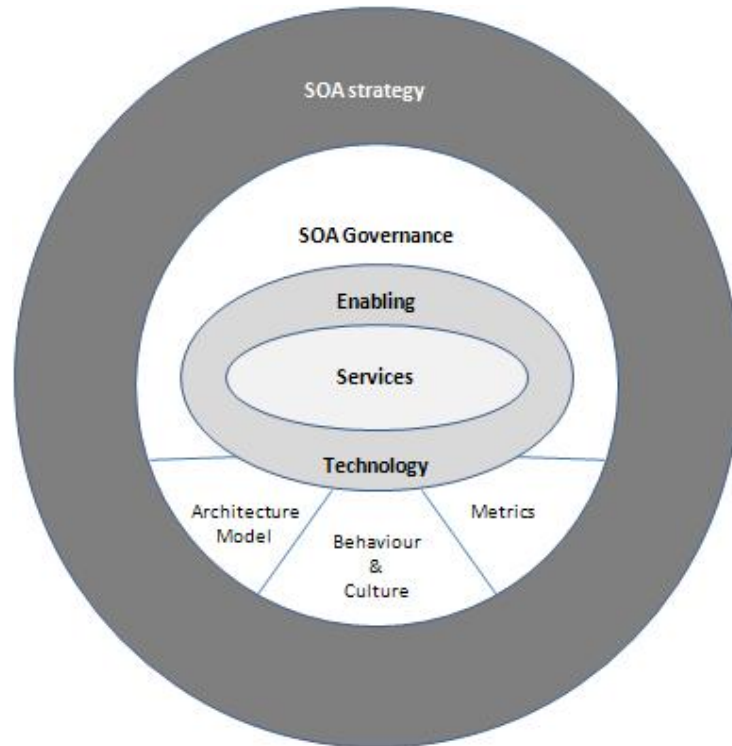
Figure 2 Elements of a SOA (Marks et al., 2006)

The literature indicates that a SOA is a an architectural paradigm (Shewmaker, Brock & Gardner, 2006) i.e. is a method of planning, organizing and building end-to-end business processes with IT support where adaptability, flexibility and alignment with business objectives are paramount (Marks et al., 2006).

Even though the SOA does not seem to be primarily about building software solutions with a specific technology such as Web Services and therefore can possibly be viewed as an evolutionary journey contra a revolutionary journey for healthcare organizations (Mulik, Ajgaonkar & Sharma, 2008), the literature is seemingly dominated by work in the context of the enabling technologies of a SOA and less on the SOA as a paradigm. A precise definition of the SOA which supports the worldview of this thesis has been suggested by Marks and Bell (2006) whom describe it as:

> *"…a conceptual business architecture where business functionality,*
> *or application logic, is made available to SOA users, or consumers,*
> *as shared, reusable services on an IT network. 'Services' in a SOA*

> *are modules of business or application functionality with exposed interfaces, and are invoked by messages." (Marks et al., 2006, p. 1)*

Figure 2 indicates the scope of a SOA that is implied by the definition that Marks and Bell (2006) propose. Their graphic indicates that a SOA encompasses much more than elements related to a technological perspective on building software. Indeed they seem to indicate that the organization's definition of a SOA strategy really is influential in defining the actual scope that a SOA should have with all the implications that has for SOA governance, the actual architecture model, the culture of the organization, the enabling technologies one requires and metrics to measure the organizations fulfilment of the vision and strategy defined.

Sprott and Wilkes (2004) propose a slightly different definition of the SOA which can be viewed as complementary to the definition quoted from Marks and Bell (2006):

> *"SOA is not just an architecture of services seen from a technology perspective, but the policies, practices, and frameworks by which we ensure the right services are provided and consumed." (Sprott et al., 2004, p. 1)*

This definition seems to encompass all of the elements of a SOA that Marks and Bell actually suggest in their book, but also indicates another aspect of the SOA which is currently hotly debated in the literature i.e. the concept of governance in its many forms. Figure 2 indicates that a SOA should be defined through a strategy and governed by a structure which takes the strategy and implements it accordingly.

2.3.2 Implementing SOA strategy through SOA governance

Adoption of a SOA implies organizational change not just at the IT level, but also at the organizational business process level. An organizations current IS portfolio is the consequence and result of a previous set of IT strategies and adoption of a SOA requires a description of the organization's "big picture" relating to IT support and where it wants to be within a defined time period.
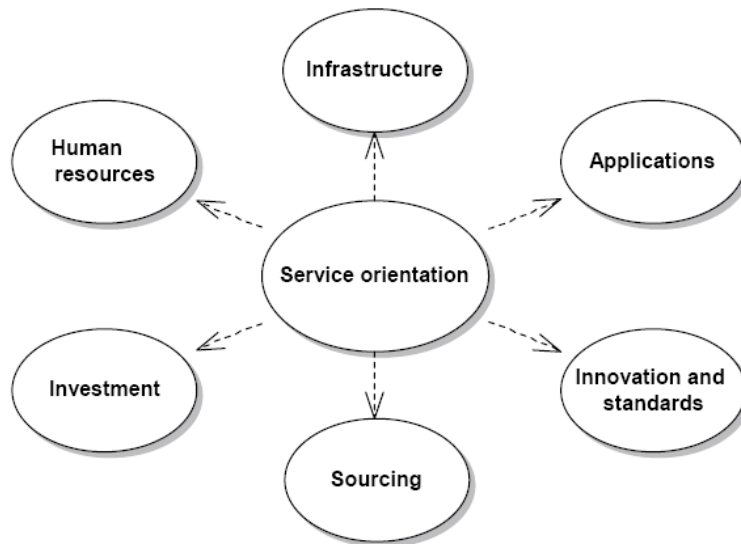
Figure 3 The influence of a SOA (Liegl, 2007)

According to Marks and Bell (2006) a SOA strategy is:

> *"A business concept, an idea or approach, of how IT functionality can be planned, designed and delivered as modular business services to achieve specific business benefits." (Marks et al., 2006, p. 2)*

Liegl (2007) argues that SOA adoption has the potential to impact many facets of an organization as indicated by Figure 3, and it is a recommended pre-requisite that a roadmap which integrates business, technology and application perspectives of the organization is an important success factor when adopting this paradigm. The three perspectives that Liegl (2007) indicates as important for an organization to govern by a roadmap could be interpreted as an argument that a SOA is not just confined to the realm of an IT architecture, but also borders on the realm of an Enterprise Architecture. This is in fact a conclusion suggested and supported by Knippel (2005). Knippel (2005) suggests that Enterprise Architecture (EA) and the SOA can be aligned by comparing SOA artefacts with EA artefacts. His findings indicate that the SOA can change the EA at a very high level of abstraction and adds new aspects to EA at a lower level of abstraction. Knippel (2005) concludes by proposing that an organization that has established both an EA and SOA discipline should harmonize them by extracting the best from both worlds and integrating them into a coherent whole.

According to Kanchanavipu (Kanchanavipu, 2008) a SOA will fail if a SOA governance practice is not put in place in the organization. He further argues that it is SOA governance that shapes the SOA and is directly responsible for all of the decisions that define expectations, grant power, or verify performance. His findings indicate that the SOA needs to conform to the strategy defined and this is achieved by governance. The reason that SOA needs governance, is that the concept has to be communicated to all the actors involved or affected by the establishment of a SOA i.e. business users, developers, architects, executives etc. Telling people what the SOA is about is probably not enough to assure conformity over an extended period of time. A SOA needs governance mechanisms that also assures conformance over time that are loyal to the vision and goals set forth by the SOA strategy.

2.3.3   Definition of a Service

The term 'service' is a key concept in a SOA. It is possible to view an organization containing a finite number of services all of which have different granularity and purpose (Kanchanavipu, 2008). The Organization for the Advancement of Structured Information Standards (OASIS) defines a service as:

> *"...a mechanism to enable access to one or more capabilities, where the access is provided using a prescribed interface and is exercised consistent with constraints and policies as specified by the service description" (OASIS, 2006, p. 12)*

Marks and Bell (2006) define a service in the SOA context as:

> *"...units of business capabilities, processes or functions that are delivered in a repeatable way to consumers of those services" (Marks et al., 2006, p. 31)*

One challenge when using the term service seems to be the gradual motion between services and processes. This motion seems to be between one technical

boundary, represented by the traditional Application Programming Interface, and another boundary represented by a Web Service encapsulating a number of activities some of which are manually performed by employees, whilst others are implemented by program-to-program automation.

A possibly simpler way of describing the term service is by way of metaphor. For example a shop window is an interface which potential consumers use to view the possible wares to be purchased from the shop owner. The counter where the consumer can purchase the chosen product is the interface or purchasing service offered. The activities the shop owner has to engage in to actually complete the consumer's purchase i.e. finding the product, packing the product, entering the payable amount into the till, giving the customer his receipt and product is the actual process ending up with the consumer or customer going home with the product.

From the example above it is difficult to differentiate where the service starts and where the process takes over and what the differences between them are. For all purposes the difference between a service and a process seems to be purely a matter of perspective i.e. if you are a service provider, the service looks like a business process. If you are service consumer, the service looks like a process endpoint e.g. the purchasing counter in a shop. This idea seems to be supported by Wang et al (2004). From the viewpoint of the shop owner, he is completing a process which essentially offers the consumer a purchasing service to buy products.

Mixing the concept of process with the concept of services also serves to add to the confusion related to the SOA. According to Sharp and McDermott (2001):

> *"…a business process is not just a random collection of activities –*
> *it meets precise criteria." (Sharp et al., 2001, p. 53)*

Sharp and McDermott (2001) define process as the following:

> *"…a business process is a collection of interrelated work tasks*
> *initiated in response to a specific event that achieves a specific*
> *result for the customer of the process." (Sharp et al., 2001, p. 58)*

I will implicitly use this definition of process for the duration of this thesis when the perspective of a service is the viewpoint of the service provider. The interface representing the process from the exterior therefore must include the event that triggers or initiates the process viewed from the perspective of the service consumer.

2.3.4   The Web Service Architecture

Much of the focus on previous research and literature into SOA seems to have gone into the technology aspects of a SOA. Technology is of course an important element of a SOA as a means to build operationally on this architectural concept. Without a set of enabling technologies there would probably be little point in the SOA. Enabling technologies described in the literature tend to focus on Web Services and related standards such as XML, SOAP, UDDI, WS-* and BPEL. In addition the literature is inundated by concepts such as Web Service Management and the Enterprise Service Bus which are suggested by some IT vendors as being prerequisites for adopting and using a SOA, for example Shewmaker et als (2006) description of the tools necessary to achieve SOA governance.

The purpose of including a brief description of the concept and technologies that are core to Web Services is to make clear that a Web Services based architecture is not the same as a Service Oriented Architecture (Rotem-Gal-Oz, 2006). But Web Services are an important enabling technology ingredient of an architecture enabling organizations to achieve the technical principles laid down in a SOA.

According to for example Woo et al (2006), Wu and Chang (2005) and Chu (2005) a Web Service typically consists of three main components, see also Figure 4:

1. A description of the operations and contract that the provider and consumer have to comply to. This description is published by the Service Provider. The description is created using a standard, XML based language called the Web Services Description Language (WSDL)

2. A library of descriptions where consumers can find the Web Service of choice. This library is implemented according to a standard called Universal Description, Discovery and Integration (UDDI)

3. A Service Consumer who uses the Web Service published by the Service Provider. A Service Consumer will use the Simple Object Access Protocol (SOAP) and http to access the operations described and published by the Service provider
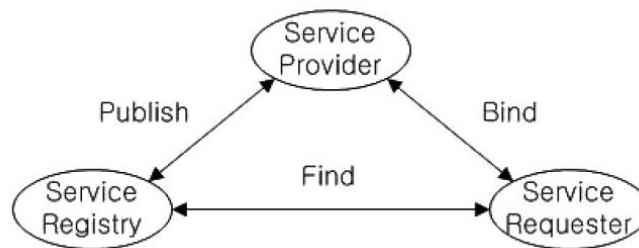
Figure 4 Basic Web Service Architecture (Woo et al., 2006)

The Web Service based architecture however requires an additional component if an organization is going to be able to utilize Web Services securely internally and externally. A number of additional Web Service standards have been published with the goal of supporting secure use of Web Services. These standards include:

1. WS-Security is an OASIS standard basically defining the security of the actual SOAP messages being exchanged over the wire in relation to message signing and message encryption to assure confidentiality and non-repudiation

2. WS-Policy which according to Schepers (2005) allows organizations that are exposing web services to specify the security requirements of their web services

3. The Security Assertion Markup Language (SAML) as a standard way of describing and exchanging user identities across security domains for authentication purposes

An organization publishing a large number of Web Services as a core part of its SOA strategy will probably need to manage those Web Services. Papazoglou and

Van der Heuvel (2005) argue that Web Services Management is a critical component of an organization's Web Service Architecture:

> *"Because Web services increasingly play mission-critical roles, the need to monitor and measure them has never been greater. Once services and business processes become operational, their progress must be managed and monitored to offer a clear view of how services perform within their operational environments; to enable management decisions; and to perform control actions to modify and adjust the behaviour of Web-services-enabled applications. These capabilities require distributed management solutions for Web services." (P.Papazoglou et al., 2005, p. 58)*

For example, publication of Web Services in healthcare could possibly be compared with publication, selling or borrowing of books. In the book world one either goes to a bookshop to obtain what one is seeking for commercially or one goes to the library to look for a book to borrow. Libraries and bookshops are the management tools and infrastructure we use for the proliferation of books. Web Services also need the same infrastructure if they are to be manageable and available for consumption across healthcare actors from a national perspective.

A Web Service Management regime encompasses the Web Service Registry as a component of the Web Service Architecture and is basically comparable to a library where one can find a description of the Service one is looking for, and a pointer (URL) to the actual service and its corresponding descriptions (schemas). Web Service registries are often based on a XML based standard called Universal Description, Discovery and Integration. This standard was originally proposed as a core component of the Web Service Architecture and is now a part of the Web Service Interoperability (WS-I) standard.

Another core SOA enabling technology that is often used to implement SOA initiatives is the Enterprise Service Bus (ESB). The main purpose of an ESB is to support system to system integration with an architecture based on Web Services and SOA principles. Web Service Management tools are for example used to publish Web Services and make them available on the ESB. The ESB connects and mediates all communications and interactions between services which may or may not be Web Services. A true Enterprise Service Bus has a completely distributed and loosely connected architecture in contrast to a hub / spoke solution being able to transparently persist and communicate messages across security domains using Web Service technologies and standards.

2.3.5   Business Process Management Systems

A Business Process Management system is defined by its components consisting of a process execution engine, process designer, organization designer, actual process descriptions, an activity monitor, and user interface (UI) which may be a combination of a Windows client application, HTML-based Work Portal, or an exposed API or Web Services interface. The main motivation for briefly describing BPM systems as a potential core SOA enabling technology is that:

1. BPM systems have the potential of establishing a system of process management which alleviates the challenge of process descriptions becoming outdated as soon as they have been implemented

2. BPM systems clarify the necessary services needed both internally and externally to support the business process being implemented

3. According to Gartner researchers Sinur, McCoy and Thompson (2003), BPM systems are possibly the only business aligned SOA technology available today that hold the potential of effectively integrating and coordinating collaboration between people and systems

4. SOA and BPM as disciplines seem to be converging (Kamoun, 2007). Convergence will also lead to the enabling technologies to merge into complete suites which support both a top-down process oriented business approach and a bottom up developer oriented service development approach

5. BPM systems illustrate a discipline and technology which has the potential to drive adoption of the SOA with a business alignment perspective moving the IT department's focus from systems development to business process development (Sinur & Hill, 2006)

Figure 5 Components of a typical BPM Suite (Ultimus, 2008)

In a BPMS individual business processes are defined in a process description and usually expressed in some variation of XML - Business Execution Process Language (BPEL) being the latest standard in this area. Each process description may be composed of both manual activities and automated activities. Once defined and validated within the process designer, processes are instantiated by a process execution engine. The execution engine can be composed of multiple components, such as an integration engine or integration broker, algorithms constituting out-of-the-box workflow resource patterns (Russell, Aalst, Hofstede & Edmond, 2005) and increasingly an integrated rules engine for ad-hoc and static rules descriptions.

An instantiated process description is called a process instance. The state, status and history of each process instance are persisted into an external data store. The activity monitor provides visibility into the execution status of the process instance, while the execution engine controls its state and execution of the activities and rules constituting the process description – where activities can either be invoked

applications (automated activities involving some form of a system-to-system transaction) or work items (manual activities distributed to human users or process participants). When a process instance is executed, work items are generated in response to activities and process rules, and distributed by the execution engine utilizing Workflow Resource Patterns through the organization model into an appropriate user's work list. The work list is a collection of work items from one or more process instances, each with its own state and status.

Work lists represent the integration between process participants and process instances and can be viewed as an implicit attribute of a process description and its associated rules. Process participants access work items from the work list, which is coordinated by the execution engine, organization model and Workflow Resource Patterns. Managing the exchange of work items between users and systems may appear at first glance to be the same as message queuing and other asynchronous approaches to application integration (EAI). Yet it should be understood that managing processes is not about data flow or moving data from one bucket to another nor responding to discrete events in isolation, but managing flow control across an entire business process instance. The ability to include manual activities as part of the process is a subtle but significant and critical point of differentiation between BPM and EAI solutions. As Khan (2004) puts it:

> *"The essence of business process automation is the ability to route the right information to the right individuals or computer applications at the right time so that the latter can make decisions or take actions. Human beings work together in complex ways. Even when there are rules that prescribe the proper way of conducting business, many actions and decisions are made on an ad-hoc basis for the purpose of expediting or handling new or special conditions that arise frequently." (Khan, 2004, p. 103)*

With BPM systems, the process description therefore becomes the application according to Ultimus (2005) a leading vendor of a BPM suite. When the process description becomes the application, one has also secured a state of a self-documenting system.

This approach differentiates itself significantly from a traditional application where function and data constitute the main perspective of the application to the viewer. Take any traditional application today and you will find a screen of data elements, menus and buttons representing functions. The actual process is hidden from the user within the application, becoming inaccessible to those involved.

2.4 Significant IS Challenges in the Healthcare Sector

2.4.1 The Healthcare Sector in Norway

The healthcare sector in Norway is organized predominantly by autonomous, judicial entities organized under the Ministry of Health and Care Services and the Ministry of Local Government. The regional organizations are organized into geographical regions i.e. Northern Norway Regional Healthcare Authority, Middle Norway Regional Healthcare Authority, South Eastern Norway Regional Healthcare Authority and the West Norway Regional Healthcare Authority whereof the South Eastern Norway Regional Healthcare Authority is the single largest of them all composing 61% of specialist healthcare in Norway. Each of these healthcare regions (RHF) consists of a number of specialist healthcare

organizations (hospitals - HF). The healthcare organizations by law are considered as judicial, autonomous entities each with its own Board of Directors.

There are a number of distinct differences between the Regional Healthcare Authorities in Norway viewed from an IT perspective, one of most important of them being that three of the regions have managed to consolidate their IS portfolio and the management of that portfolio at the regional level. The largest region has not managed to consolidate its IS portfolio yet, possibly due to the major transformation it is undergoing at all levels e.g. it is only last year that the largest region was established by merging two separate regions.

The Ministry of Local Government is the umbrella for all 430 local councils in Norway called a local council or commune. Each local council is democratically elected by the commune's inhabitants and is responsible for many tasks amongst which is local healthcare e.g. rehabilitation centres, old people's homes and in some cases community appointed General Practitioners (GP). Every inhabitant of Norway is appointed a GP by law with whom one can seek medical aid when needed. If a patient needs specialist care, the GP will refer the patient to the correct specialist healthcare unit to receive that help.

In addition to the actual specialist healthcare units involved there are a number of other organizations that deserve mention amongst which are the Norwegian Directorate of Health, the Norwegian Healthcare Network, the Norwegian Centre for Informatics in Health and Social Care, the Norwegian Medical Association, the Norwegian Patient Society, National IT projects, significant IT vendors, and patient interest organizations.

2.4.2 Diversity of Healthcare Technologies

During the last 30 years, specialist healthcare organizations have had the freedom as autonomous judicial entities to purchase the information systems they have required to support their business processes. It is no secret that specialist healthcare in Norway has a large systems portfolio where each hospital has certain freedoms to purchase, install and use information systems to handle both the clinical- and administrative side of medical treatment and care. A recent article in ComputerWorld Norway describing the Office of the Auditor General's evaluation of the use of IS in the healthcare sector which supports this conclusion stating that:

> *"…the problem is that it is major challenge to get the enormous amount of different systems to communicate with each other." (Ernes, 2008, p. 1)*

Grimes (2005) describes one possible goal for medical care in the United States of be able to establish virtual healthcare organizations that allow healthcare delivery to start earlier than it does today and not necessarily in the current hospital facility. One major challenge to this goal is that there is currently a large diversity of healthcare technologies in use in those same healthcare organizations that are striving to overcome this 'Tower of Babel'.

2.4.3 Improving Collaboration between Healthcare Actors

ComputerWorld Norway has recently published an artucle where Abelia's Rune Foshaug stated that:

> *"We have seen very little progression in the electronic collaboration between doctors, between doctors and patients, between GP's and*

The Norwegian Labour and Welfare Administration, and between specialist healthcare and local county council healthcare services. These collaborative arenas are not functioning very well. Today information flowing between these actors is in some cases still transmitted by paper, diskettes and cd's."(Schreurs, 2008, p. 1)

This statement supports and indicates that electronic collaboration between different actors in the healthcare sector is a major challenge to the whole healthcare sector.

The Ministry of Health and Care Services has recently in 2008 established a program (HOD, 2008) for the healthcare sector where 11 areas of efforts have been defined stating that there is to be an increased effort in the area of National Electronic Collaboration. This focus area defines the requirement to move the healthcare sector from a paper-based information exchange environment to an environment where messages are exchanged electronically between communication parties or actors in the healthcare sector.

2.4.4 Data Quality and Sharing

According to Wand and Wang (1996) the overall quality of data in an organization can affect the organizations performance. Their findings indicate that the quality of data is dependent on the processes that produce that data and the fundamental understanding of what data quality actually means from an ontological perspective. Based on a literature review, Wand and Wang (1996) found that accuracy, reliability, timeliness, relevance and completeness were the most important data quality dimensions cited. As the literature shows, healthcare systems environments consist of a large number of disparate systems that are non-integrated in nature and striving to share information. Integration can therefore still be viewed as a critical mechanism for getting these systems to 'talk' to each other (Khoumbati & Themistocleous, 2006; Khoumbati, Themistocleous & Irani, 2005, 2006a, 2006b) and ensure the smooth flow of information across organizational boundaries and information silos internally, for example between departmental systems.

Problem: Stand-alone "stove-pipe" applications have redundant data which are hard to keep consistent. "Islands of logic and information

Data consistency challenge.

Theory: Applications that share one database can avoid data redundancy, thereby avoiding inconsistent data.

Reality: A large enterprise has disparate versions of certain data in multiple business units and applications.

Domain$_1$ Domain$_2$ Domain$_3$

Figure 6 Sharing data works but only on a limited basis (Schulte, 2006)

Gartner's Roy Schulte (2006) has suggested that establishing one database to share data between all organizational units is a utopia which probably will never be achieved and in healthcare is probably not desirable. Schulte's argument adheres

roughly to the following structure, see also Figure 6; traditional systems purchased from various vendors and deployed in one organization often partially duplicate critical parts of the organizations informational, process or functional needs. For example you could probably find more than one customer database in a typical organization because the customer is a key part of any information model process portfolio if the organization's business is centered on product sales. To alleviate this situation organizations have often relied on various integration patterns to secure consistency between the various customer databases in the organization. However over the years, integration using traditional integration patterns has led to a brittle IT architecture due to the complexity of integration and the no of integrations an organization usually has to rely on. Changing integration interfaces has usually had repercussions that are difficult to predict due to the complexity of a large organizations systems portfolio (Zhu, Turner, Kotsiopoulos, Bennett, Russell, Budgen, Brereton, Keane, Layzell, Rigby & Xu, 2004).

In the healthcare sector, customers are often other hospitals, GP's and communities requisitioning treatment on behalf of their patients. Because of the need for specialist systems in healthcare organizations it is not probable that you will find one system that fits all possible healthcare organizations. In addition healthcare organizations are moving towards functional differentiation (National-ICT, 2008) where hospitals specialize in areas of medical treatment increasing the need for IS differentiation in each organization to support the special business processes of that organization. At the same time it will probably become increasingly important for a holistic approach to implementing business processes that support data sharing across organizational boundaries as more than one organization becomes involved in the treatment of a patient. This has indeed already been the case for many years if one defines GP's, hospitals and healthcare organizations in local communities as parts of one single healthcare delivery process instead of looking at the healthcare delivery process in a piecemeal fashion where each treatment is a separate part delivered by each organization.

The challenges of data sharing both internally in specialist healthcare organizations and between specialist healthcare organizations will probably become even clearer when hospitals move towards even more specialization and therefore a functionally differentiated reality.

2.4.5   Remote Information Availability

The need to share data within healthcare organizations and between healthcare organizations has been described in the previous chapter, but needs elaborating on from an information availability perspective.

Today healthcare organizations are challenged by the need to access the same information - information about Norway's citizens, patients, addresses, authorized healthcare personnel, other healthcare organizations etc. A good example is the need for emergency rooms (ER) treating patients that are on holiday far from their local GP or hospital and therefore far from the Electronic Healthcare Record which is needed by the ER. As mentioned before some of this information is duplicated multiple times between and within each healthcare organization involved in patient treatment processes.

Some of the information that is exchanged between healthcare organizations is defined as sensitive according to the Norwegian Personal Data Act of April 2000 which is supposed to ensure that 'personal data are processed in accordance with

fundamental respect for the right to privacy, including the need to protect personal integrity and private life and ensure that personal data are of adequate quality.'

One major challenge is related to overcoming the limitations that laws and regulations place on what information is being exchanged, how that information is being exchanged and policies for whom can access personally sensitive information as a part of the healthcare delivery process (Wimalasiri, Ray & Wikon, 2005).

According to Tsiknakis et al (2000) the trend that healthcare delivery is heading in a direction where healthcare personnel will be under increasing pressure to share their knowledge and expertise in a more distributed fashion adds pressure to solving the security issues related to information sharing:

> *"...Hence, telematic services need to be part of a collaboration environment that ensures the continuity of care and information sharing, under strict security and authorisation policies." (Tsiknakis et al., 2000, p. 280)*

Grimson et al (2000) support this view that security is a major challenge for collaboration between healthcare organizations stating that:

> *"...Guaranteeing the integrity, confidentiality and security of sensitive patient data is essential if patients and clinicians are to have confidence in the application of IT in health care as a whole..." (Grimson et al., 2000, p. 54)*

Wimalasiri et al (2005) indicate that there is a balance between the security of Electronic Health Records and the potential benefits the healthcare sector can gain from sharing this information even though healthcare organizations are responsible for the security of the information. They propose the adoption and use of a SOA enabling technology such as the Web Service Architecture to achieve the balanced objective of securing and sharing information in the Electronic Healthcare Record.

2.4.6   Availability of Accurate Information for Clinicians

It is probably obvious that it is extremely important for healthcare personnel to have accurate information available at their fingertips at all stages of the healthcare delivery process. This includes GP's, specialist healthcare organizations and local community healthcare organizations. Chui et al (2004) support this stating that:

> *"...Timely communication of accurate information is a key success factor for the provision of quality healthcare chain services." (Chiu et al., 2004, p. 1)*

I have tried to illustrate in the previous sections describing specific challenges reported in the literature which have not entirely been solved yet and which are probably fundamental to satisfying clinicians requirements of having accurate information available securely at their fingertips at all times for any patient they need to treat.

Clinicians use the information available about patients to make correct decisions relating to how to go about treating them. This seems to indicate that improving decision support for clinicians is dependent on the availability of accurate patient information (Mounib & DiMare, 2008; Nadkarni & Miller, 2007; Welzer et al., 2002) which could be alleviated by establishment of a SOA. Kohn et al (1999)

indicate that at least 44 000 people in the United States die as a consequence of medical errors. They define medical errors as

> *"…Medical errors can be defined as the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim."* *(Kohn et al., 1999, p. 1)*

One of the possible factors indicated as causing medical errors is related to the number of healthcare actors involved in the healthcare delivery process where none of them have access to complete information on the patient being treated. Accurate and timely information available for clinicians could contribute to lowering the number of medical errors that occur.

2.4.7   Improving Work Efficiency

One example of a type of inefficiency in the healthcare sector in Norway originates from personal experience. A family member was involved in a biking accident a few years ago and was transported to her local GP. After an hour stay in the waiting room, the local GP examined the arm which was the object of pain and being uncertain whether a fracture was involved made out a requisition for an X-ray at the local hospital. My family member with her paper-based requisition was transported to the hospital where the requisition was delivered to hospital reception. On receiving the requisition, the information on it was manually typed into the patient administration system for further processing. Thereafter it was off to the Radiology department's waiting room for a further period of waiting. This example illustrates one of the inefficiencies of having to manually enter the same data multiple times because information flow between GP's and specialist healthcare is often not automated. This challenge is well summed up by the following statement from research in the healthcare sector in New Zealand:

> *"…System inefficiency and ineffectiveness that can result in poor patient satisfaction are other key quality problems that often plague healthcare organisations."* *(S. Chu, 2005, p. 4)*

Sutherland and Van Heuval (Sutherland et al., 2006) point out that there is an issue related to misalignment between the implementation of IS and the actual work process requirements of clinicians that indicate another possible type of inefficiency:

> *"…A deeper problem is the majority of clinical decision support systems are failures or underutilized because of an impedance mismatch between the analytical, linear process forced on clinicians by automation, when the way they work is quite different."* *(Sutherland et al., 2006, p. 2)*

This observation seems to indicate that current business automation strategies are implemented from an approach dictated by IS instead of an approach which is harmonized with the actual work process requirements of the clinicians involved.

2.4.8   Reducing Operational Cost

Healthcare spending in many industrialized countries is rising according to statistics taken from a 3 year old report by Anderson et al (2005). According to Grimson et al (2000) the gap between demand and the ability to satisfy that demand is widening:

…"the gap between the demand for health care from an increasingly well-informed and expectant public, and the ability of the state and health care organizations to meet this demand is widening all the time. Efficiency and cost-effectiveness—balancing quality of care with cost containment— are two major driving forces behind this need to change as, for example, with managed care in the U.S."
(Grimson et al., 2000, p. 49)

It is probably reasonable to speculate that if countries are to close the gap between demand and the ability to satisfy that demand; major changes have to be initiated. However there are probably a number of other factors related to the rising cost of healthcare that are specifically outside the scope of this work e.g. the rising age of populations in many western countries.

In Norway specialist healthcare is undergoing a major transformation especially in the Regional Healthcare Authority South East which consists of just over 61% of specialist healthcare in Norway. One notable characteristic of this region is the number of autonomous hospitals with their own IT systems and IS portfolios. The other specialist healthcare regions have consolidated most of the IS portfolios across the healthcare organizations that they support. It is probably reasonable to assume that an analysis of the systems portfolio of the whole region would result in a number of systems overlapping in both functionality and information. Consolidation of the systems portfolio could contribute to a significant reduction of total IT cost if it was possible to establish a migration from the existing systems portfolio to a future systems portfolio.

Total health spending

Country	Per capita ($PPP)	Percent of GDP	Absolute difference as percent of GDP, 1992–2002	Average real annual growth per capita, 1992–2002 (%)
Australia[a]	2,504	9.1	1.0[b]	4.1
Austria	2,220	7.7	0.2	2.0
Belgium	2,515	9.1	1.1	3.0
Canada	2,931	9.6	−0.4	2.2
Czech Republic	1,118	7.4	2.0	5.3
Denmark	2,583	8.8	0.3	2.5
Finland	1,943	7.3	−1.8	0.7
France	2,736	9.7	0.7	2.3
Germany	2,817	10.9	1.0	2.0
Greece	1,814	9.5	1.6	4.4
Hungary	1,079	7.8	0.1	3.5
Iceland	2,807	9.9	1.6	4.0
Ireland	2,367	7.3	0.2	7.3
Italy	2,166	8.5	0.1	1.5
Japan[a]	2,077	7.8	1.6[b]	3.6
Korea	996	5.1	0.7	6.7
Luxembourg	3,065	6.2	0.0	3.5
Mexico	553	6.1	0.5	2.2
Netherlands	2,643	9.1	0.7	2.9
New Zealand	1,857	8.5	1.0	3.8
Norway	3,083	9.6	1.4	4.4
Poland	654	6.1	−0.1	4.1
Portugal	1,702	9.3	2.3	5.0
Slovak Republic	698	5.7	–[c]	–[c]
Spain	1,646	7.6	0.4	2.6
Sweden	2,517	9.2	0.9	3.3
Switzerland	3,446	11.2	1.9	2.5
Turkey[d]	446	6.6	2.8[e]	9.2
United Kingdom	2,160	7.7	0.8	3.8
United States	5,267	14.6	1.6	3.3
OECD median	2,193	8.5	0.8	3.4

Figure 7 Healthcare spending (Anderson et al., 2005)

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A particular facet of the transformation the South East region (East, 2008) is undergoing is reflected firstly by the Ministry of Health and Care Services merging Regional Healthcare Authority East and South in June 2007 to one Regional Healthcare Authority. Lastly this is reflected by the proposal to reorganize and to merger hospitals in the region into one judicial autonomous healthcare organization.

2.5 SOA as a Potential Solution

SOA is one alternative solution to the challenges that specialist healthcare organizations in Norway face, giving them the opportunity to more quickly combine, build and deploy new services across different systems, platforms and lines of businesses by virtually "plugging in" the new service to their existing infrastructure.

According to the industry hype on the SOA adoption and given that the concept of Enterprise Application Integration has evolved to encompass SOA enabling technologies, the use of a SOA holds the promise of a number of benefits which according to various researchers (Classon, 2004; Knippel, 2005; Mantzana & Themistocleous, 2004; Marks et al., 2006) include mainly the following:

1. **Business Agility and adaptability** – the business community, in this case specialist healthcare, can change business processes in a timely fashion without necessarily changing the underlying IT systems when consumers call for change

2. **IT Flexibility** – IT departments in specialist healthcare can change and add to the technology architecture without necessarily causing ripples in the overlying business processes already implemented. Today some companies complain of the inertia in IT or IT as *cement.* Marks and Bell (2006) indicate the zero integration enterprise as a positive effect of adoption of a SOA. Their proposition consists of a hypothesis that any organization which fully follows SOA principles will create a process or service oriented systems portfolio that implicitly includes open and well defined interfaces that can be consumed by any other process either within the organization or by other organizations. According to Marks and Bell (2006), the zero integration enterprise should therefore become an implicit bi-product of a SOA.

3. **Faster Time to Market** – the combination of the first two points can lead to faster time to market of new or changed business processes. Faster time to market often means a competitive edge for organizations that are able to achieve this. For specialist healthcare this means be able to offer new healthcare services with lower cost and make these services available to the public more rapidly

4. **Faster Mergers & Acquisitions** – encapsulating an organizations existing systems portfolio according to SOA principles can promise faster mergers between organizations due to the increased ability to identify common processes and information that can be shared or reused the organizations being merged into one judicial entity. This is especially relevant to specialist healthcare in Norway which is presently undergoing a major transformation (HSØ, 2008)

5. **Customer Satisfaction** – is a consequence of more effective collaboration in the value chain or process behind the service being offered to the consumer. For specialist healthcare this benefit could reflect in the patients satisfaction with the healthcare services being offered and used

6. **Cost Reductions** – a SOA holds the promise of cost reductions by the organizations ability to do more with fewer resources (Nadkarni et al., 2007)

7. **Revenue Growth** – more effective collaboration between all actors involved in business processes can lead to increased revenues for the company or organization because the SOA eliminates the friction in that collaboration increasing process throughput. In specialist healthcare revenue is roughly speaking generated by the number of patients and diagnoses hospitals treat. This simplisticly implies that the higher patient throughput a hospital can achieve the greater the revenue growth that hospital will see.

8. **Service Sharing** – services can be shared by other and new processes. This benefit can be important for the healthcare sector where information flows across organizational boundaries, where the systems portfolios of hospitals consists of many systems each representing an information silo. If we assume that the IT portfolio of a specialist healthcare organization supports the organizations core business processes, the integration of these business processes based on a SOA leaves a window of opportunity for the healthcare sector to possibly solve some of its problems related to secure and effective collaboration between actors in the healthcare sector i.e. GP's and specialist healthcare

To summarize the possible benefits of a SOA by approaching change from a business process perspective where integration is an integral part of the value chain being implemented promises better support for the alignment of the IT portfolio with healthcares core business of treating patients, also promising more flexible IT support resulting in improved adaptability. A holistic SOA approach to ICT could also benefit specialist healthcare by increasing productivity and decreasing process cycle time. These benefits could in turn imply cost reductions in the application of IT in a healthcare organization.

2.6 The Research Question and Significant Prior Research

So far I have attempted to present the underlying dimensions of the SOA, some of the inherent IT challenges currently facing specialist healthcare and the potential of a SOA to solve some of these problems. This assumes that adopting a SOA in specialist healthcare in Norway is the correct alternative to choose for solving the challenges described. However it would be valuable to have an indication which factors influence the actual adoption and diffusion of a SOA as a tool to implement the correct actions that could guide adoption to successful diffusion. The literature does not show a large amount of research in the area of SOA adoption, its focus currently on the adoption of specific SOA enabling technologies such as Web Services and the Enterprise Service Bus. In actuality I have only found a handful of research articles that have SOA adoption as the main theme.

The literature has shown the SOA as a paradigm and architectural style for IS where there are indications that it is insufficient to exclude the managerial aspect and only focus on the technological aspects of the SOA. I have also tried to show that the literature focuses on important SOA enabling technologies which are based predominately on the adoption of a Web Services Architecture and its associated standards and technologies.

Significant previous research has also shown that the healthcare sector in general continues to struggle with a number of IS challenges. It has shown that SOA as an architectural style including its enabling technologies has the potential to solve some of the challenges the healthcare sector is facing. The body of research which I hope to contribute to with findings from this thesis is SOA adoption and healthcare informatics.

Chapter 3 Research Design

3.1 Chapter Synopsis

This chapter describes my chosen research position, research strategy and method for data collection and analysis. I have approached my research question with an interpretivist stance, defining a qualitative multiple case study to get as many viewpoints as possible from specialist healthcare organizations that could influence or be impacted by the adoption of a SOA. Figure 8 shows the main elements of my research design.
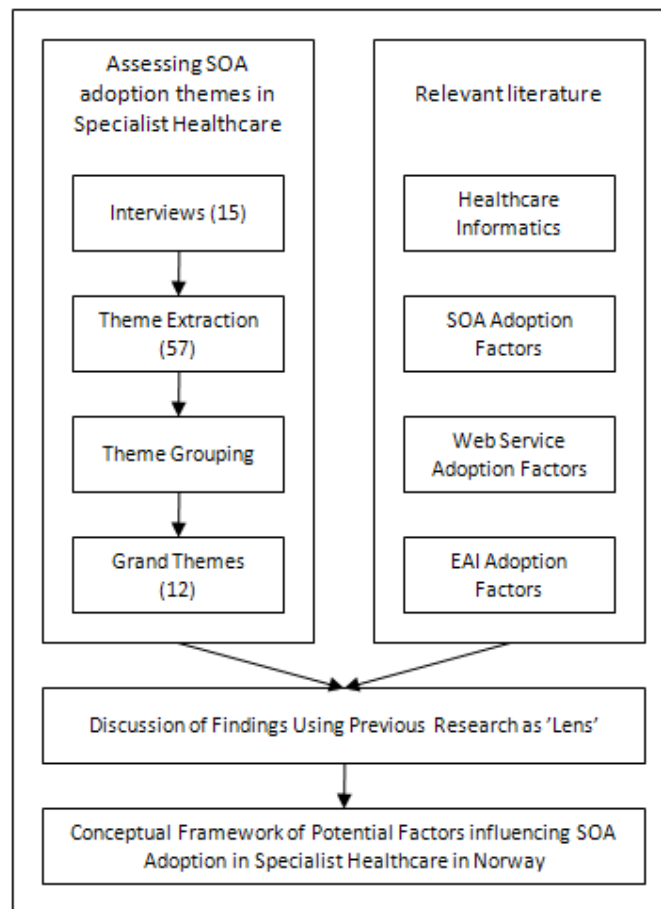
Figure 8 Research Design adapted from Dube and Robey (1999)

The sites selected for this multiple case study were initially picked by identifying the types of organizations I wanted to approach in specialist healthcare and by identifying the type of interviewee that would be in a position to understand the research question and have a possible involvement with any type of SOA adoption.

I have mainly used interviews as the data collection method, but also relied on relevant documentation to triangulate my findings to ensure that they are as reliable as possible. Being an involved researcher immersed in specialist healthcare organization projects at both the national and regional level, I have also had many opportunities to use observation as a data collection method. However I have

chosen not to do this because it has been important in my work to have clearly defined roles i.e. as a consultant, as an employee and as a student. I am however aware that events I have been involved in could influence my findings relating to adoption of a SOA in specialist healthcare.

The data collected through reviewing interviews and documents has been analysed using a mixture of techniques that allow the data to coallasce from specific themes that seem to have a contextual relationship to adoption of a SOA into grand themes using the principles of the hermeneutic circle to manage the process leading to my findings. Lastly I have reviewed the research process used to judge the validity and reliability of my findings. The review completed has relied on the application of principles proposed by Klein and Myers (1999) for evaluating interpretive research in addition to applying some of Sandberg's (2005) proposed techniques in an attempt to justify how my findings could represent knowledge in this interpretive study.

3.2 Investigative Stance

Ontology deals with what exists, what reality is i.e. what the nature of the world is. It is important for every researcher to have a clearly understood position on his or her worldview as that worldview will influence the research strategy and method that is chosen for finding possible answers to the research question. For example if the researcher has a positivist worldview i.e. views him- or herself as separate from the reality being viewed, then the underlying data analysis probably should have a stronger bent toward statistics and content analysis.

According to Walsham (1993), interpretive methods of research in IS are:

> *"...aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context."*

Walsham (2007) makes a clear distinction between an involved researcher and a traditional researcher where the involved researcher is directly involved in the action in the field beyond and above traditional interpretive approaches using interviews as the main data collection method. Walsham (2007) views involvement as a spectrum where you have the neutral observer at one end of the spectrum and at the other end is the fully involved action researcher. Walsham does not define the neutral observer as being unbiased as he views all researchers as being biased by their own backgrounds, experiences, prejudices and knowledge. According to Walsham the full action researcher at the other end of the spectrum is committed to being a catalyst for change in the way they think best.

I have defined my stance as interpretivist due to my direct involvement in the specialist healthcare sector, I therefore have chosen an investigative stance that approaches reality and the phenomenon being studied as a social construct where the data collected about it is described by Geertz (1973) in the following manner:

> *"...What we call our data are really our own constructions of other people's constructions of what they and their compatriots are up to."*

I believe that my direct involvement makes me inseparable from the reality that is fundamental to my research question. The belief that I am an inseparable part of the reality that I am researching implies that my own background, biases,

experiences, prejudices and knowledge will in some way or other influence my findings. An interpretivist stance also implies that I explicitly call attention to the ways in which my experience relates to the issues (Laverty, 2003). These claims have been described in more detail in Chapter 1.3.

3.3 Research Strategy

A research strategy should describe how the research is going to result in knowledge. In addition it should indicate something about the environment in which the research has been carried out. It should also specify how I have researched the phenomenon, in my case the SOA in specialist healthcare in Norway. Examples of research strategies are case studies, field experiments, laboratory experiments, simulations and small n-studies. Table 1 shows the characteristics of a single case study which was proposed by Benbasat et al (1987) and how these are applicable to this study.

Table 1 Applicability of case study characteristics to this study

Case Study Characteristic	Applicable to this study
Phenomenon is examined in a natural setting	Yes in the specialist healthcare environment
Data is collected by multiple means	Yes, interviews, documents and ad-hoc, unstructured, ad-hoc observations
One or few entities (person, group or organization) are examined	Multiple entities
The complexity of the unit is studied intensively	Yes within certain limits defined by the number of interviews scheduled per site and documentation available
The investigator should have a receptive attitude towards exploration	Yes
No experimental controls or manipulation are involved	No
The investigator may not specify the set of dependent and independent variables in advance	Correct this is an implication of the research design
The results derived depend heavily on the integrative powers of the investigator	Yes
Changes in site selection and data collection methods could take place as the investigator develops new hypotheses	No
Useful to study "how" and "why" questions	Yes

| The focus is on contemporary events | Yes |

I have chosen a research strategy based on multiple case studies. A multiple case study is defined by the researcher identifying and choosing a small number of units from the population. Often a limit of between 5 and 10 units is set on the number of units being researched. This limited number makes it possible for each unit to be studied in detail (Jacobsen, 2005). This has not been completely possible in this study due to the size of the organizations involved. A detailed study of the SOA for each of the sites chosen would have been difficult because of the number of interview objects I would have had to identify and choose. This would have probably been an insurmountable task given the sources and time limits given for this thesis.

The main objective for choosing a multiple case study strategy was to ensure as high a level of reliability in the findings as possible. In addition I hoped to gain a broader understanding of what was going on in specialist healthcare related to SOA adoption. This would probably have been difficult with just one single case study.

3.4 Site Selection

Site selection in qualitative research using an interpretive approach is usually based on selecting sites in a non-random manner. Specialist healthcare involves a large number of actors who are potential stakeholders in the adoption of a SOA, see Figure 9.
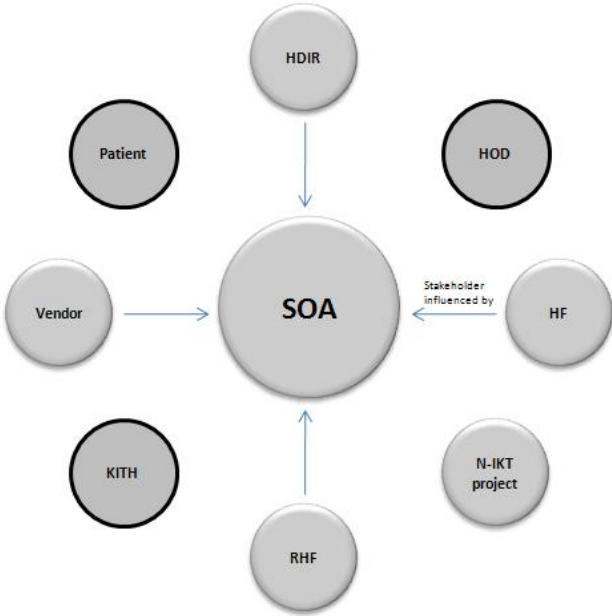
Figure 9 Stakeholders that could be influenced by a SOA adoption

Figure 9 shows the stakeholders that were identified as possible sites for selecting interviewees that could possibly have influenced or been affected by the adoption of a SOA. The stakeholders marked by a weighted black border such as Patient, KITH and HOD have not supplied this study with interviewees.

There have been a number of factors influencing which interviewees have been chosen as the basis for the data collection phase, amongst which have been my existing relationship, availability, timeframe, thesis subject and the suitability of the thematic questions in the interview guide to the actual interviewee identified. Another factor is that in specialist healthcare many key processes cross organizational boundaries, so that change at one end of a process could potentially impact the other organizations involved at the other end of the process. I have tried to take this factor into account in choosing the sites from which to identify potential interview candidates.

Initially the interview process was started with an introductory e-mail sent out by South East Norway Regional Healthcare Authority and the preliminary interviews were concluded by asking for potential respondents in other organizations (snowballing) that could add value to the information given by the interviewee.

After completing three interviews, I had achieved a greater number of potential respondents that fulfilled my requirements and were within the sites selected than I could have possibly handled within the time allotted to this thesis. The projects were either specific SOA initiatives or possible ones. All of the organizations interviewed were also involved in one or other of these projects and that's how they landed on the interview schedule.

Table 2 Sites selected and the roles of the interviewees

	Sites							
	Organization H1	Organization H2	Organization H3	Organization H4	Organization H5	Project P1	Project P2	Project P3
Managers	■	■	■	■		■	■	
Enterprise Architects		■						
IT Architects		■			■			
Integration Architects	■					■		■
Security Architects	■					■		

3.5 Data Collection

3.5.1 Interviews

The interview is one of the most important techniques for data collection in qualitative research (Myers & Newman, 2007), especially in situations where you have a low budget and resources for completing the data collection phase of qualitative research studies. Myers and Newman (2007) further describe the qualitative interview as being a craft, thereby explaining why interviews may not be as straight forward as they seem. I have chosen to use their specific guidelines for completing the interviews scheduled.

A specific disadvantage that Walsham (2007) mentions with being an involved researcher is the possible perception that the interview objects perceive that I have a vested interest. During the interviews held, most of the interview objects expressed very positive views on the actual thesis and its subject matter in addition to expressing a strong interest in acquiring a copy of the finished result when completed. I find this indicative that the perception of any vested interest I might have had in my results were also supported by the interview population as well. On reflection I found that this could maybe be related to their interest in the subject matter based on their own work situation and their need for outside support for

continuing this work. It has been difficult to decide whether this factor could have influenced the validity of the data collected.

Table 3 Roles of the interviewees split across the sites selected

Organization	Role	Date	Time
H1	IT Architect	18.02.2008	1230 - 1400
H1	Security Architect	15.04.2008	1400 - 1530
H1	IT Director	25.02.2008	0830 - 1000
H2	Program Manager	01.04.2008	1000 - 1100
H2	Enterprise Architect	01.04.2008	1100 - 1200
H2	IT Architect	01.04.2008	1430 - 1600
H2	IT Architect	01.04.2008	1230 - 1400
H3	IT Director	15.02.2008	0930 - 1100
H4	Director	06.03.2008	0830 - 1000
H5	Manager Security and Architecture	04.02.2008	0930 - 1100
P1	IT Architect	27.05.2008	1100 - 1200
P1	IT Architect	27.05.2008	0830 - 1000
P2	Project Manager	25.03.2008	0830 - 1000
P3	IT Architect	25.03.2008	1430 - 1600

To structure the interview in an open-ended manner, I established an interview guide which consisted of a number of thematic questions adapted from a previous study by Ciganek et al (2006) into Web Services adoption and my own experience within specialist healthcare, see Appendix A. Most of the open ended thematic questions which I formulated on this basis had the goal of eliciting possible factors which could inhibit or drive adoption of a SOA.

Each interview was booked well in advance of the actual meeting due to all of my interview subjects being extremely busy with their own schedule. All of the interviews apart from one were held on site at the subject's workplace. This was a deliberate choice as I wanted to make sure that each subject felt as comfortable as possible during the interview. All of the interviews were made face to face with the subject, lasting between one to one and a half hours. I received consent from all, apart from one of the interview subjects, on recording the conversation. To record the interviews, I used an MP3 player. I did not take notes during the sessions where I had received consent on recording the conversation because I felt that note taking would be a distraction to both me and the interviewee in having a natural conversation. My conclusion is that the interview situations where recording was allowed were more effective and productive than the interview situation where this was not allowed. The quality of the data collected also seemed to be higher. When approaching each interview situation, I was careful not to bias the interview object's own definition of what a SOA is, with my own definition.

The interview type chosen was semi-structured in style with a number of themes being explored related to a SOA using an open-ended style of questioning. As previously mentioned I utilized much of the advice expanded on by Myers and Newman (2007), especially approaching the interview situation as a drama. To make this possible I also arranged my interview guide as a drama with 3 acts where:

- **Act I** was focused on introducing myself in all my roles as employed practitioner, student and consultant in the sector

- **Act II** was concerned with the actual questions catalyzing the conversation
- **Act II** was focused on ending the interview and explaining my plans for completing the thesis

The dramaturlogical approach gave a certain overlying structure to the interview situation as a whole and seemed to create a 'safe venue' where a natural conversation could be held. Division of the interview situation into acts also seemed to give the conversation time to warm up in a natural fashion, making sure that everyone started off from a comfortable and safe vantage point. All of the interview subjects were more than open in describing their situation related to the research question and the phenomenon under study, something which can be observed in the transcriptions made of the recording conversations.

Myers and Newman (2007) describe in detail a number of problems and pitfalls which I will briefly summarize in the following table comparing these with my own experiences of the interviews completed.

Table 4 Problems and pitfalls (Myers et al., 2007)

Problem or pitfall	Own experience	My comments
Artificiality of the interview	No	I was known either by reputation or by previous interaction with the interview subject
Lack of trust	No	All of the interview subjects were positive and seemed to have invested a certain amount of trust in the situation
Lack of time	No	Enough time was allocated to go through the interview guide
Level of entry	Possibly	I entered the different organizations at different levels, but did not interview Executive management as this would have been difficult due to the phenomenon being researched has an IS perspective and would have required a different set of open-ended questions
Elite bias	Possibly	Most of the interview subjects could be categorized as key informants relative to the organizations they represented and therefore this could possibly cause a failure to gain a broad enough understanding of the SOA especially as clinicians were not involved
Hawthorne effects	Possibly	My role as a consultant in one of Regional Healthcare Authorities could have biased the responses drawn from the interview subjects
Constructing knowledge	Possibly	It was difficult to formulate some 'on the fly' ad hoc questions. Some

		of these on reflection might have been construed as leading. I was however aware of this and did my best to hinder these situations
Ambiguity of language	Possibly	Very few of the interview subjects felt that they had a clear understanding of what a SOA is and this has possibly biased the interview in directions which can be misconstrued by my analysis

3.5.2   Documents

Documentation can be used as a secondary source of data if interview objects are not accessible (Jacobsen, 2005). However it is important to be aware that documentation as a secondary source of information can be difficult to rely on if one does not know whether the documentation is produced by a party with first hand insight into the situation or event that I am studying.

I have accessed documentation from some of the organizations interviewed and used that as a supplement to the interviews and as an additional triangulation tool. I have had access to some of the project documentation for two of the organizations such as the IT strategies, project mandates, directives and memorandums from some of the meetings. All of the documentation I have had access to, has been produced by project participants that have had first hand knowledge of the situation I am studying.

Being an involved researcher, I myself have participated in the production of some of the project documentation. This in itself has posed an ethical problem related to whether I should include some of that documentation in my analysis or exclude it. I have chosen to exclude anything that I have been involved in producing, but another issue in this context is that I can never erase the memory or insights I have on either the situations and events that have been described in the relevant documentation or the documentation that has been produced, even if I have not been directly involved. It is reasonable to assume that these insights 'colour' my findings presented in Chapter 5.

3.5.3   Observation

I have not used observation in a systematic way or as a methodical part of this study although my role as an involved researcher in one of the projects chosen for this study has given me multiple opportunities the last 6 months to observe specific situations such as project meetings and workshops on an ad hoc basis. However no specific notes have been taken documenting the observations made.

3.6 Data Analysis

According to some researchers (Weber, 2004), the very essence of interpretivist research implies that the researcher him- or herself becomes the measuring intrument through their interpretation of the phenomenon being studied.

There are a number of different data analysis tools and analysis approaches available to the interpretive research, for example grounded theory that puts an emphasis on what concepts and hypotheses are relevant for the area that one wishes

to research and where data analysis is conducted by using 3 distinct data coding techniques i.e. open coding, axial coding and selective coding.
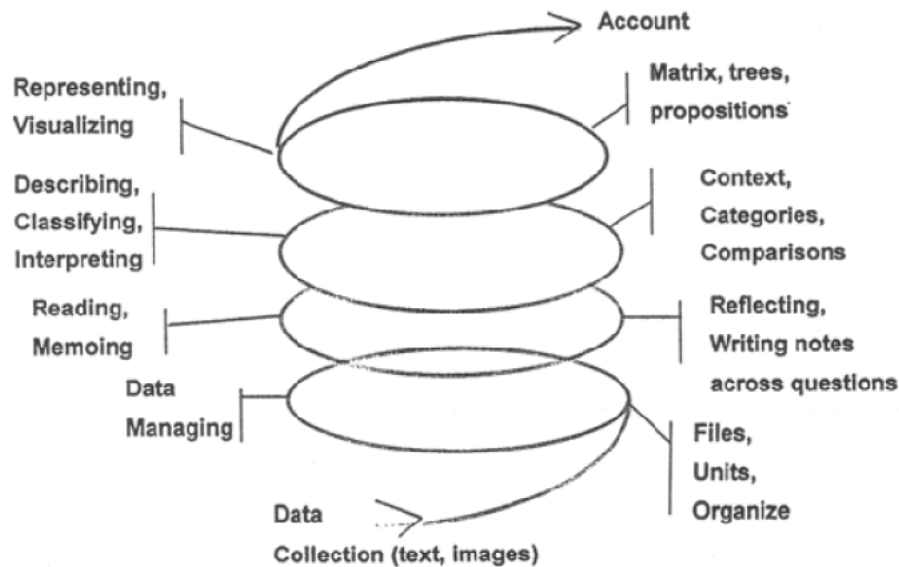
Another approach is based on the study of hermeneutics which is described as the theories and methods of the interpretation of all texts and systems of meaning, and where the concept of "text" has been extended beyond written documents to include any number of objects subject to interpretation, such as experiences. A hermeneutic is defined as a specific system or method for interpretation, or a specific theory of interpretation. Hermeneutics is therefore the process of applying this understanding to interpreting the meaning of experiences, written texts and symbolic artefacts (such as art or sculpture or architecture), which may be either historical or contemporary. Creswell (1998) describes this process of data analysis as iterative and interpretive which is visualized in Figure 10.

To analyze empirical material collected in interviews and documents, I basically used the iterative and interpretive approach best described by the hermeneutic circle visualized by Creswell (1998) in Figure 10 and applied this to each interview in each case study. For example I gained a holistic understanding of each interview transcription by gaining insights into the specific parts or themes the transcript consisted of. Conversely I gained further insight into each theme or transcript part by its relationship to the transcription as a whole. The process of the hermeneutic circle was applied at multiple levels starting with one interview from one site, all interviews from one site and then all interviews across all sites resulting in a large number of themes relating to possible factors influencing adoption of a SOA. More specifically, I carried out an analysis of each interview categorizing each statement with a label which tried to sum up the concept or theme that was being expressed. Thereafter I attempted to classify each specific label into an existing or new theme varying from the holistic to the part. This was done multiple times until I had a collection of themes from each interview substantiated with interviewee supporting statements.

I iteratively compared each of the themes defined for each interview with all of the other interviews to see if there were themes that could be similar across interviews.

Themes that were not similar with a minimum of one other interview were removed from the theme collection. Lastly I reviewed the final collection of themes to see if it was possible to aggregate themes into a few grand concepts basically using the technique suggested by Dube and Robey (1999).

After eliciting a lesser number of grand concepts across interview transcriptions, I attempted to see if there were any identifiable similarities between the aggregated grand themes and the literature. I was specifically looking for any signs of factors that could either positively or negatively influence the adoption of a SOA and that discussed findings in the context of process, integration, SOA adoption and healthcare. The findings identified were then integrated into a proposed conceptual framework which describes potential factors that could influence SOA adoption.

3.7 Validity and Generalization

Qualitative studies also have to undergo a critical evaluation of the validity of the findings or results (Jacobsen, 2005). Validity usually comes in two flavours; internal and external validity. However the concepts of internal and external validity are basically positivist in nature. Therefore an interpretive study such as this requires an approach that justifies the potential knowledge elicited.

Internal validity is conceptually a critical discussion of whether you can argue that your results are correct. According to Sandberg (2005) knowledge justification in interpretive studies can be achieved by applying the technique of the hermeneutic circle to attain something he calls communicative validity:

> *"…shifted the analysis from single optimizers and compared the different ways of understanding engine optimization across optimizers. First, I grouped the optimizers who had understood engine optimization in a similar way. Second, I compared them both within and between groups. This process enabled me to refine the coherence of my interpretations and thus to achieve high communicative validity." (Sandberg, 2005, p. 16)*

In this context you can only argue that you have valid results if two or more 'others' are in agreement with your description. The more 'others' that agree with your description of the world, the more probable it is that your description is correct. A test of validity will always be considered a test under the circumstances described above.

Klein and Myers (1999) propose 7 principles for evaluating one type of interpretive research, namely, the interpretive field study. I have used these principles as guidelines for judging the validity of the research presented in this thesis.

Table 5 The 7 principles of Klein and Meyers (1999)

Principle	Own judgement
The Fundamental Principle of the Hermeneutic Circle	The work completed in this research has been implicitly iterative especially within the areas of interviewing and data analysis where the parts are my own and the participants' preliminary understandings (i.e., pre- understandings) in this study. The whole consists of the shared meanings that have emerged from the interactions between these understandings. This principle has been used extensively in this thesis.
The Principle of	As an example of this principle applied, I have

Contextualization	attempted to illustrate how the legacy of IS in specialist healthcare is influencing the current challenges experienced by specialist healthcare today
The Principle of Interaction Between the Researchers and the Subjects	I have applied this principle by evaluating the interview sessions on guidelines from the literature. See Table 4 Problems and pitfalls (Myers et al., 2007)
The Principle of Abstraction and Generalization	Whether I have been successful in applying this principle is up to others to judge from the presentation of my findings with the following discussion. However using a multiple case study approach has probably been helpful in ensuring that any generalizations that are implicitly inferred in the findings and discussion parts of this thesis are supported by multiple actors from the selection.
The Principle of Dialogical Reasoning	I have tried to highlight in some detail that I am prejudiced due to my involvement and history as a practitioner in the specialist healthcare sector and therefore my research design and the data that has emerged from its application might not be supported by findings inferred by logical reasoning by an unbiased researcher.
The Principle of Multiple Interpretations	I have adhered to this principle by approaching this research as a multiple case study therefore actively seeking out different types of stakeholders to different viewpoints which may or may not be contradictory.
The Principle of Suspicion	I cannot say that I have followed this principle as there is only one possible example discussed in Chapter 6 which indicates that I might be attempting to "read" the social world beyond the meaning of words of the actors selected.

There are indications from the arguments presented in Table 5 that this research presents findings with a high level of internal validity based on the choices made for research design e.g. using an approach which is qualitative, interpretive and hermeneutical in nature.

External validity is concerned with the transferability of findings to other parts of the population which have not been included in the study often called statistical generalization. Qualitative, interpretive studies are not usually preoccupied with statistical generalization of findings due to the fact that most qualitative studies choose a small non-random, selection from the total population. In addition the interpretivist stance taken in this study is more focused on addressing the defensibility of my knowledge claims. The idea is that other researchers should be able to examine the evidence I have collected, the research process that I have used, the context in which I have conducted the research, and perhaps some aspects of my reality, and be able to conclude that the claims I have made are reasonable.

3.8 Reliability

All research methods have limitations and flaws. For example a specific research method such as interviewing can and probably will influence the interview subject in a certain way that could cast uncertainty on the reliability of the data collected

and thereby the conclusions drawn from the results. Many researchers therefore agree that induction cannot lead to absolute certainty (McGrath & Brinberg, 1983).

In Chapter 3.5.1 I describe the interview process and comment on some of the possible problems or pitfalls where the interview process could affect the reliability of the data collected and therefore also the results or findings concluded.

Each interview was transcribed using f4 (http://www.audiotranskription.de) audio transcription software word for word and sent to the interview object for verification. The recording quality was very good which contributed to transcriptions with a high level of precision. Each transcription was sent to the interviewee for validation. Only two replies were received with comments. These comments were judged to be only of supplementary value. One could construe that the interview transcriptions not commented on by the interview objects had a high level of reliability and accuracy, but there is at least one possible pitfall with this assumption. This pitfall has to do with the straightforward probability that most of the interview objects have very little time in excess due to tight schedules and heavy workloads. I have in any case given most of the interview objects roughly 2 weeks to 1 month to verify the accuracy of the transcription sent them. However earlier interaction with some of the interviewees indicated that they would have replied if they found a significant discrepancy between the interview transcription and the actual interview as they remembered it. Under this assumption I conclude that the data collected was reliable.

Chapter 4 Case Setting

4.1 Chapter Synopsis

This chapter briefly describes each case setting i.e. organization and project from two different persepectives; an organizational perspective, and a SOA initiative perspective.

4.2 Organization H1

Organization H1 is one of the major specialist healthcare providers within the South-Eastern Norway Regional Healthcare Authority. The organization numbers roughly 8 500 employees. Of the 8 500 employees circa 110 of these are employed in IT. As a healthcare provider, the organization treats about 45 000 inpatients on a yearly basis. The clinics complete roughly 400 000 consultations on outpatients per year. The organization H1 has a yearly budget of approximately 5.5 billion Norwegian Kroner.

Organization H1 has a complex IT infrastructure with hundreds of applications, of which about 20 are of an enterprise mission critical nature. The mission critical medical care systems centre on patient administration- and laboratory systems which also include an Enterprise Application Integration (EAI) platform from Microsoft (Biztalk). The healthcare organization has invested in establishing its own Integration Centre of Excellence as recommended by international analysts (Gartner Group), thereby reforming and focusing IT resources on a critical IT activity i.e. integration. This work is in a rollout phase.

The EAI platform is being used to integrate internal systems and integrate the healthcare organization with its 'market' within primary healthcare, which also includes other external partners. In-house IT resources are utilizing both Web Services and other messaging protocols hosted on the EAI platform depending on the specific project requirements. Web Services are at this point only being used internally due to security issues related to the consumption and publication of these to external actors.

Despite its large size, organization H1 has a cultural tradition for innovation within the fields of both medical care and IT. The organization is involved in a number of IT projects which have one affiliation or another to the concept of a SOA. All of the IT projects that have been elicited in interviews with key personnel as SOA type projects are of a national nature. IT resources in the organization have been champions of initiating some of the national projects relating to SOA and are therefore also heavily involved in these.

I have been fortunate enough to meet and talk to key personnel involved in all of the IT projects which contain a characteristic of a SOA at both the national and internal level. In addition I have managed to acquire valuable time in front of influential resources at both the management and IT architecture level, whom are directly involved with IT strategy and IT decisions in the organization.

The projects that can be categorized as SOA type projects are the National System Architecture Project, the National Patient Transport Project, the National Address Register Project and the National Emergency Network Project. Organization H1

does not currently have any direct ownership over any internal IT projects which could be categorized as a SOA project.

4.3 Organization H2

Organization H2 is an integrated part of one Regional Healthcare Authority and operates at the regional level. The organization is responsible for all of the IT systems in the region. There are about 20 000 IT users in the region who require 24 hours x 7 days a week support and these generate roughly 110 000 Service Desk requests per year. In total the organization is responsible for circa 600 servers and 12 000 PC's connected to the network. There are about 3 500 concurrent users at any given time of the day. Organization H2 ensures that the hospitals in the region are able to send 130 000 messages per month to GP's in primary healthcare.

Organization H2 is involved in one national SOA initiative i.e. the National System Architecture Project. In addition it has during the last 4 years taken steps to act upon its defined architecture strategy which defines a gradual move to a SOA. The organization has defined two main areas of change for the IT portfolio, one of which is building basic Web Services on top of its patient administration system and the other which is developing a new web based desktop for clinicians. The new desktop will utilize the basic Web Services built on top of the patient administration system (PAS). One possible reason for taking this approach has been to prolong the lifespan of its existing legacy PAS and at the same time offer clinicians an improved user interface.

4.4 Organization H3

Organization H3 is a an administrative body under the Ministry of Health and Care Services and the Ministry of Labour and Social Inclusion. The organization is administered by the Ministry of Health and Care Services. Organization H3 is responsible for monitoring conditions that affect public health, living conditions and trends in healthcare services. Organization H3 has an advisory role on strategies and measures aimed at central government, regional and local authorities, specialist healthcare organizations, GP's, voluntary organizations, the private sector and the population in general. The organization has a number of important administrative tasks, including the authority to suggest, apply and interpret laws and regulations in the healthcare sector.

Another specific task for organization H3 is ensuring that approved policies are implemented in the healthcare arena. The goal is that policies defined by central government i.e. the Ministry of Health and Care Services, can be achieved in accordance with the guidelines that the ministry issues in its annual letter of allocation and in other related documents.

Organization H3 is, because of its role in specialist healthcare, not specifically focused on establishing SOA initiatives although it is directly involved in supporting the goals of improved collaboration between primary healthcare, specialist healthcare and local community healthcare. The organization has been involved in a number of IT projects in the healthcare sector that are possible pre-requisites for a SOA adoption i.e. The National Address Register and work being done by the Centre for ICT Competence in the Health and Care sector - KITH on a future secure Web Service collaboration architecture (Vestad, 2008).

4.5 Organization H4

Organization H4 is owned collectively by the Regional Healthcare Authorities in Norway. The organization is responsible for establishing and managing an inter-sectorial healthcare "highway" offering common services, ensuring secure communications and collaboration between all organizations connected.

Organization H4's goals are in line with the political goals defined by the Ministry of Health and Care Services relating to Free Hospital Choice, Equal Healthcare Services Access, general efficiency and rationalization.

The communications platform that has been established by organization H4 is a prerequisite for secure communications and collaboration across the healthcare sector. In addition organization H4 has been allocated responsibility for operating a national Enterprise Service Bus backbone as a critical component of the National Patient Transport Service. The organization has had to build the necessary expertise to be able to run the backbone on a daily basis for the whole country.

Organization H4 has not initiated any specific SOA initiatives of its own, but is participating in a number of projects that are either prerequisites for establishing a SOA, or have specific SOA enabling technologies as a part of the solutions platform. Examples of these initiatives are The National Address Register and The National Patient Transport Service.

4.6 Organization H5

Organization H5 is a subsidiary of one of the Regional Healthcare Authorities in Norway. One of its roles is to act as the collective ICT department for hospitals in one of the regions in question and in some cases as a vendor of specific services such as Human Resources. Organization H5 has an estimated 250 employees.

The organization does not own any specific SOA initiatives, but has a participatory role in some of the national projects that have a SOA element in them.

4.7 Project P1

Project P1 is owned by all of the Regional Healthcare Authorities collectively. The projects mandate has been to define an IT architecture strategy for specialist healthcare for the period 2008 – 2015. The project involves participants from all Regional Healthcare Authorities and hospitals including resources with either a clinical or ICT background or both.

The project has focused on defining an IT architecture that encompasses a holistic view on specialist healthcare processes, terminology (information), services, technology and security.

The project was ongoing during the period that I was working on this thesis. I asked for and was given consent to interview participants involved in the project and have also had access to some of the documentation produced.

Project P1 seems to be the closest specialist healthcare has come to defining a national SOA and indeed the end result is a strategy document entitled "A Service Oriented Architecture in Specialist Healthcare".

I have referenced this document after it became officially available to the public and used it as the basis for triangulating my interview findings.

4.8 Project P2

Project P2 has been initiated and is owned collectively by all Regional Healthcare Authorities. Its mandate has been to take over responsibility for the administration of patient transportation from the Norwegian Labour and Welfare Administration. One component of its mandate has been to identify and implement a solution for administration of patient transportation between primary healthcare and specialist healthcare, home and hospital respectively.

Project P2 has delivered a solution which has tried to adhere to SOA principles by implementing an Enterprise Service Bus technology as a foundation for the actual application. The process that the application supports is inter-organizational covering requisitions for transport from non-healthcare businesses such as taxi and bus services. In addition all payments can now be validated against the correct requisition, actual transportation and the organization where the requisition originated. The solution therefore increases process oversight, lowers process costs, improves financial accountability, improves process efficiency and improves inter-organizational collaboration between specialist healthcare and transport service organizations.

Project P2 is implicitly a type of a SOA initiative as its underlying solution principles and enabling technologies are directly related to a SOA.

4.9 Project P3

Healthcare organizations are involved in processes spanning multiple organizations, for example a primary healthcare doctor sends referrals and requisitions to specialist healthcare units i.e. hospitals on behalf of patients. Specialist healthcare units are obligated by law to send answers ("epikriser" and laboratory test results) back to the referring or requesting organization or doctor.

The ability to identify the correct sender and receiver in these processes at the national level is often critical in delivering the necessary patient care and treatment in a timely fashion. Identification of the correct receiver is made even more complicated as the referring requestor could be an organization or a person and if a person, can work for multiple employers at the same time. In addition there is no way currently of uniquely identifying a requesting or referring doctor at the national or regional level.

Many of the systems installed in specialist healthcare organizations have local data stores which identify and contain information about the senders and receivers of information. This means that the number of data stores with overlapping incorrect or inconsistent information could possibly incur failure to correctly deliver timely information to the correct receiver. This could in some cases also have fatal consequences, but at a minimum probably degrades the quality of a patient's experience of the healthcare service.

Project P3 was originally initiated by the Directorate for Health in 2005 as a measure to secure correct addressing of all communications parties in the healthcare sector. A communication party is either a sender or receiver of information in the healthcare sector e.g. a GP can send a paper based referral of a patient to a specific hospital.

The solution delivered in 2006 included a centralized national data store for all communication party addresses including postal-, electronic- and certificate addresses and a Web Service interface so that Electronic Patient Journal systems in

primary healthcare and messaging services in specialist healthcare could be integrated with the system.

An interesting aspect of Project P3 is that it is does not seem to be in itself a SOA initiative per definition even though it has utilized some components of a Web Services Architecture. There are clear indications that the project is a prerequisite for a number of other projects which could be categorized as SOA initiatives e.g. Project P2.

Chapter 5 Results

5.1 Chapter Synopsis

This chapter is concerned with a presentation of my analysis results, grand theme by grand theme summarized for all sites selected. The last part of this chapter attempts to synthesize the results for each grand theme into one single conseptual framework, which in itself becomes the subject for Chapter 6 which discusses these findings in more detail in the light of prior research.

The following sections presents my findings based on the analysis described in Chapter 3.6. I have also included a number of quotes from the interviews which can corroborate the themes suggested. A summary comparison between the possible grand themes influencing SOA adoption elicited from each analysis and the case studies performed will be presented in Chapter 5.16.

Each case has been given anonymity to protect all interview objects to the extent possible. In addition I have translated the direct quotes from Norwegian to English to ensure a certain language homogenity in this thesis. I have been aware of the possibility of losing meaning in the translation, but have done everything possible to guard against this, such as checking that keywords in the extracted text have been translated as precisely as possible using an online dictionaries such as Lexin (http://www.lexin.no) and Thesaurus (http://thesaurus.reference.com).

5.2 SOA Definitions

One of the main thematic questions which I put to all interviewees concerned how the organization actually defined a SOA. Most of the people interviewed focused their descriptive definitions on aspects such as processes, an n-tier IT systems architecture and Web Services for integration purposes for example:

> ”… The most important aspect for us is to be able to divide existing applications into a 3-tier architecture where we have a well defined information model as the fundament for the database. We however have not put that onto paper yet.” (S4)

The above quote indicates that the interviewee has his / her own clear understanding of what a SOA is, but that the organization's understanding is not yet mature enough to document and communicate to all those potentially affected. One possible reason for this is that Project P1 had been initiated nationally and ongoing for a few months at the time of the interview. Another quote from another interviewee seems to indicate that monolithic IT systems were 'driving' the IT organization to re-establish core functionality in them so that they could provide better IT support for clinicians' work processes:

> *"…By a Service Oriented Architecture I understand that you expose functionality – we have historically monolithic IT systems – extract core functionality from them and publish them as services in the form of Web Services, so that you can reuse the functionality in new systems or that you develop a workspace that is loosely connected from the specialist healthcare systems, but where you can use elements of that core functionality. This again allows you to compose systems based on business processes and workflow, so that*

you do not see the underlying systems and so that the system concept becomes more transparent." (S6)

"...Yes I would define it as that as the system has an intention of and already has implemented an architecture based upon a number of central services and distributed application servers that present these services and create a presentation layer for the users. All business logic is executed centrally or in the SOA layer while data storage is centralized and information presentation is more regional and local." (S14)

Another interviewee focused his definition on the SOA being a set of principles for ensuring that systems are developed with well defined interfaces or services that could be exposed to other systems or consumers in a loosely coupled fashion. There were very few interviewees that directly stated that a SOA was very much more than an architecture for building more flexible IT systems. This finding was not completely consistent with or as broad as the definitions for a SOA proposed by Marks and Bell (2006) and described in Chapter 2.3.1.

5.3   The Decision to Adopt a SOA

I asked all interviewees how the decision to adopt a SOA had come about. A consistent answer was given by all of the IT architects. Their answers gave me the impression that everyone with an IT background seemed to be in agreement that establishing and adopting a SOA was the only practical way for specialist healthcare organizations to transform their current IT architecture to a more flexible and adaptable IS platform implying improved alignment with clinician requirements. These impressions are best indicated in the quotes below:

"...There has been a consensus amongst the participants in the architecture forum that the project should base itself on service oriented principles. The applicability of this has never been discussed." (S1)

"... No decision has been made on adoption of a SOA in the national measure 12, but all of us involved in the project – we technologists – will be proposing an architecture that makes it easier to communicate between specialist systems and achieve the communication that must be put in place." (S10)

These quotes seem to indicate that IT experts involved in the national projects, and possibly in general, have a strong position in specialist healthcare from the perspective of being able to define important IS regulatory principles for a future national IT architecture without directly involving the business side of specialist healthcare i.e. clinicians. However these indications should be tempered by the findings discussed on stakeholder support in Chapter 5.5.

A final perspective related to the decision making process that was supported by three sites interviewed, had to do with the perception of the SOA in the IT marketplace. The interviewees pointed out that it was extremely important that other organizations were achieving successful adoption and use of a SOA and that analysts were continually recommending a SOA to its customer base.

In summary the decision to adopt a SOA at the national level was based on a consensus among key IT personnel from different specialist healthcare organizations without any indication that the adoption of a SOA was discussed

relative to other possible strategic alternatives. In addition there have been no indications that key clinicians that could have potentially contributed to the quality of such a decision, have been involved in that actual decision making process.

5.4   Organizational Grand Theme

5.4.1   The Business Administration Model

I have used the term 'Business Administration Model' to indicate all the themes that originated in the analysis that have a relationship to decision making culture, organizational power and how specialist healthcare is organized in Norway.

As mentioned earlier, specialist healthcare in Norway is organized by law (The Hospital Act 2001) as a set autonomous, judicial entities consisting of regional healthcare authorities that own judicially, autonomous hospitals. This means that each hospital entity can basically prioritize its activities according to the budget allocated by the Regional Healthcare Authority it is associated with. However there is a yearly company protocol or directive consisting of a number of strategic goals which have been established by the Regional Healthcare Authority based on the priorities set by law and the policies established by the Ministry of Health and Care Services (HOD). The protocol can be updated if and when necessary during the year, but Regional Healthcare Authorities are careful to act only if it is clear that hospitals are not carrying out the responsibilities that they were given in the company protocol at the start of the year. There are some indications that this type of organizational model poses some practical problems related to the operationalization of decisions where large organizations such as hospitals are involved. As one interviewee pointed out:

> *"...the larger ICT oriented departments internally in hospitals are very important makers of premises for hospital production and therefore also to be viewed as power centres." (S9)*

This statement seems to indicate that decisions made either at the political or regional level may or may not be enacted upon according to the power accorded to the internal ICT unit in the hospital and the ability of hospital management to act out the goals set in the yearly company protocol and also be alerted when these goals are not met.

The complexities of a business administration structure in this type of organization is according to one interviewee exemplified by a national project in specialist healthcare that potentially made decisions on behalf of regional and local healthcare providers without cementing those decisions properly with those corresponding organizations. This suggests that it is extremely important to involve the specialist healthcare providers affected by any technology innovation adoption that is decided at the regional or national level as the local healthcare providers at the end of the day have to take responsibility (by law) for any and all consequences of national and regional decisions as they are the healthcare entities judicially responsible for the consequences of those decisions and actions.

Another interesting finding related to the SOA and the healthcare sector organized as judicially separate entities has to do with cross organizational collaboration. An interviewee in organization H1 pointed out that judicial autonomy is a possible driver for adopting a SOA because there seems to be a certain dependence on a

SOA if these judicial, autonomous entities are able to collaborate effectively from a business and IT perspective.

> *"...I think there is something in the collaboration with other hospitals that is also dependent on a SOA train of thought. You need a SOA to solve the type of collaboration where you have judicial autonomy between business partners." (S1)*

This concept becomes even more apparent when one also recognizes that collaboration in the healthcare sector often crosses the organizational boundaries defined between primary healthcare, specialist healthcare and local community healthcare where local community healthcare is organized under a different set of legislation and financing.

> *"...Local communities are under the Norwegian constitution separate democratic instruments which means that the way authorities govern communities is by measures and money." (S9)*

At one end of the scale, my findings indicate that the different ways the healthcare sector is organized across primary-, specialist- and community healthcare makes it complex and difficult to adopt technology innovations such as the SOA. At the other end of the scale there are also indications that the way the healthcare sector is organized and the necessity to collaborate across judicial, autonomous healthcare providers is both hindering and driving specialist healthcare towards the adoption of a SOA.

5.4.2   Size

I received indications that the size of the healthcare organization had an influence on the ease of organizational change from multiple perspectives. One indication came in the context of IS management where an interviewee noted that it seemed to be easier to change an IT department to a culture of process ownership from a culture of systems ownership in a smaller hospital.

> *"... Haugesund and I think that maybe Ringerike has worked with this (process ownership establishment) without knowing the details. It is probably easier in smaller hospitals" (S2)*

Most of the hospitals within specialist healthcare are relatively large seen from an IT perspective. And from an IT perspective most of the IS portfolios are large i.e. include a large number of systems especially in the South East Regional Healthcare Authority, which manages at last report about 2500 different applications. There were a number of other signs during the course of the interviews that indicated that the IS portfolio in itself by its size was complex to manage and change.

5.4.3   Innovative Culture

Adoption of technology innovations, in our case a SOA, presupposes an organization with an innovative culture. Organization H1 historically has a culture of innovation in both the medical and IT domains. Some evidence which seems to indicate this is:

> *"...This year celebrates a jubilee as it is 25 years since we started using IT in the hospital. There were IT systems in the laboratories before that, but organization H1 has always been a hospital at the 'bleeding edge' of technology adoption. We have an inheritance*

> *from the medical-technical milieu that developed the first artificial kidney. We have also taken some of that culture with us into the IT domain by being the first hospital in Norway to start using a Patient Administration System (PAS) with registration distributed out in the organization." (S2)*

This statement indicates that organization H1 has experienced a culture of innovation originating with clinicians and rubbing off on the IT department. Interviews in Organization H2 also indicate that an innovative culture is important for change based on the adoption of a SOA:

> *"...We cannot be innovative by just changing systems. No one has managed to show that a big bang change of all systems in a hospital leads to better innovation in contrast to those that through a SOA build brick by brick." (S4)*

Another aspect to innovation related to a SOA has to do with healthcare organizations being able to take the risk of being innovative. According to one interview it is important for the healthcare sector to allow for innovation to enable change and possible improvements.

> *"...If no one dares to sail uncharted waters, neither will there be any progress." (S2)*

This quote explicitly states that there is an understanding that innovation is important for progress or improvement of IS in specialist healthcare, but reading in-between the lines also seems to indicate that specialist healthcare is moving from an innovative culture to a culture of less innovation as the personal risks of being innovative are becoming too high.

5.5 Stakeholder Support Grand Theme

5.5.1 Management Support

My findings indicate that people with an IT background consider themselves as having a relatively strong position in specialist healthcare when it comes to making decision on IT related questions. I was given the impression by one interviewee that the adoption decision for a SOA was just an extension of their current IT architecture, culture and thought which has been based around their previous strategy of software modularization and componentization. Therefore as an extension of its historical IT strategy, it was not deemed necessary to have explicit upper management support for adopting a SOA.

> *"...exchangeable components from component based software development are strongly rooted in the whole organization, I think. That doesn't exactly include the hospitals management because they do not relate (to IT) on this level. From this, there is therefore an extension to the idea of a SOA." (S1)*

This also seems to have been corroborated by other interviews with statements such as:

> *"...Adoption of a SOA has nearly been obvious because that is where we all feel we must go." (S10)*

> *"…there has been a consensus amongst the participants of the architecture group that our work should be based on the SOA. This conclusion or consensus has never been discussed." (S1)*

The statements above seem to be in direct contrast to other statements in my findings which indicates it as necessary to root a decision or consensus on the establishment of a SOA with support from management:

> *"…in the first round it had consensus both within the IT department and was also supported by management in the regional healthcare authority. But it seemed that authorization by the regional healthcare authority of the architecture strategy was mostly a formality." (S4)*

> *"…but there again it is important to have management support when the architecture is to include a description of the business." (S4)*

> *"…at that time it was to obtain administrative management support in the regional healthcare authority and not with clinicians. We had a number of hearings with clinicians whom did not at that time have very much feedback to give on the types of issues that were raised." (S6)*

My findings indicate that this is an important theme especially when potential stakeholders outside of IT in healthcare organizations have to be involved in doing specific work which is not directly related to patient treatment e.g. clinicians. Clinicians are mostly employed to work with patients and not IT.

5.5.2   Resource Prioritization

Four of the interviews completed brought up the necessity of resource prioritization and allocation with the right competencies as a theme possibly influencing adoption of a SOA. It was strongly pointed out that it was important to allocate both IT and clinicians to SOA related activities if the organization had a goal of being successful in its adoption. One critique that was highlighted was the challenge of not being able to focus on SOA adoption due to all the fire fighting activities that occurred on a daily basis.

> *"…Suddenly there is something that doesn't work which we have to address. So there are challenges that consist of resources and how much time we can allocate to work with these issues." (S5)*

> *"…I tried when I was also responsible for security and architecture to start a project where we were going to examine architecture in the region, but I found out that I did not have the capacity to complete this project. So it has been on ice since 2005." (S10)*

Clinicians as I have mentioned earlier are mostly involved with treating patients and should not be expected to understand that a part of their job function should also include improving their own processes using new technology innovations.

> *"…that we need to make an effort because this will require a great effort, not the least some effort from clinicians that have a – for whom this is not their job function." (S5)*

This theme should probably be viewed in the same context as management support as management support could imply that resources would be allocated to work with adoption of a SOA.

5.5.3 Time and Budget

Management support for a project from a practitioner perspective usually realizes itself in the allocation of resources, a budget and time to use on the specific project or tasks. My findings indicate that the allocation of time is probably even more important when clinicians are required to participate in activities important to adoption of a SOA. One quote from an interview which supports this quite well is:

> *"…Clinicians are not able to allocate more of their own time anyway so more money does not necessarily help, he says." (S2)*

The quote is taken from a context where the interviewee is explaining one of the main reasons that throwing more money at a project in healthcare does not necessarily solve the problem as the lack of expertise in the areas necessary for support adoption of a SOA is probably even more critical. This challenge also seems to have a relationship with the availability of the correct skills or competence at the correct time for IS projects in healthcare organizations.

Management support in general also can potentially manifest itself in the availability of a budget to carry out projects. Management support is critical for the availability of funding and without funding the necessary projects will not be initiated.

> *"…We have at least had someone above us in the organization that has a certain faith in this. We have received funding to initiate a project whose mandate is to establish Web Services in the patient administration system." (S4)*

In summary there are indications that management support is critical to receive the necessary expertise, allocation of time and funding to be able to adopt a SOA.

5.5.4 Clinician Support

Another important theme occurring in two organizations in specialist healthcare was presented in the context that adoption of a SOA should directly involve clinicians even though the initiative to adopt a SOA originates with IT in the organization. One of the main reasons for involvement is that adoption of a SOA seems to require the establishment process descriptions. The following interview quotes indicate this:

> *"…We as IT people cannot sit and describe – we can facilitate modelling, but we are not the ones with the knowledge of how the processes should be. In this way you are dependent on having clinicians involved from the hospitals." (S5)*

> *"…The hospitals must in some way or other be able to describe their own processes and break them down into smaller parts so that they actually reflect their worldview." (S4)*

Clinicians as we would expect are mainly tasked with treating patients or hospital administration. Therefore they implicitly probably have the best insight into how these processes actually work from their point of view. They are also best suited to describe what does work and what does not work for each process investigated as a part of the organizations SOA adoption. It therefore also seems logical to expect that it should be required that clinicians support the necessary work involved in the establishment of a SOA if they firstly can be convinced on the benefits that adoption would give.

As mentioned previously, my findings indicate that the SOA initiatives that have been started or that are under way have not involved clinicians in the actual decision process. The following interview quotes give stronger support for these conclusions:

> *"...Clinicians have not been involved very much in discussions on a SOA. And it has also been a challenge for us that many of our hospital environments are still focused on buying new systems to satisfy their requirements." (S4)*

> *"...It is pretty clear that this is not satisfactory. You need support from the hospitals and clinicians, but I think that is probably difficult for them to understand." (S5)*

Another important theme was indicated by interviews at organization H1 is related to the decision making process and the different internal stakeholders involved in and affected by the adoption of a SOA. It was stated that the decision to adopt a SOA has been made at the national level without the direct involvement of clinicians in the decision making process.

> *"...There has been a consensus amongst the participants in the architecture group that one should base our architecture on SOA principles. We have never discussed whether it should be like that or not. It has been an implicit truth." (S1)*

One possible reason for this was alluded to and related to the knowledge domain that most clinicians represent. There seems to be little doubt that most clinicians are not familiar with communication protocols and formats and lose interest when the discussion has a technical approach. However clinicians of course are very familiar with how they practice their profession as mentioned above and are able to discuss the informational and activity aspects of their own work processes. The business process as an entity seems to be the common denominator between clinicians and IT reflected by the following quotes:

> *"...But I believe that a SOA is the simplest approach that will be recognizable for a clinician to understand architecture. No, that is not completely true. A classic hub and spoke architecture that uses proprietary formats and mapping models will probably be harder to understand. The model would become more distant from the understanding of the clinician." (S1)*

> *"...A common denominator is that you get an information model and service model that consists of a terminology or ontology that is rooted in both groups. An example in this context is related to our use of HL7 for a number of integrations. HL7 is a good old, classical message oriented standard that also has been modelled according to SOA principles in the context of discharge etc. But if you try and discuss HL7 with clinicians their 'eyes glaze over'." (S1)*

In summary it seems reasonable to conclude from my findings that clinician support is important when adopting a SOA as clinicians are the specialist healthcare resources that probably have the best insights into how their own processes work. In addition they are the resources that will probably ultimately be using the IS solutions established and should be involved. Description of healthcare processes seem to be the common denominator on which IT and clinicians can discuss and find common understanding over, which also implies improved

alignment between IT and the business. In adopting a SOA there a indications that it is extremely important that clinicians are allocated time to get involved in decisions relating to transformation of IS support for their processes and allocated time to become involved in describing their work processes in cooperation with IT.

5.6 Process Management Grand Theme

One concept that has been talked about in most of the interviews completed relates to business processes. There seems to be complete agreement across the board of sites selected that processes are an important factor influencing in multiple ways the adoption of a SOA. I have termed the grand theme 'Process Management' to indicate that this concept encompasses many aspects of Business Process Management from analysis and design to operationalization, management and optimization.

One of the first challenges related to the concept of process management that was pointed out has to do with a healthcare organization's focus on its own business processes. One interview at a large healthcare provider uncovered a need to migrate from the existing IS ownership model to a model of process ownership. The existing IS ownership model was contributing to a cementation of a monolithic systems approach to IS purchasing and IS support for healthcare processes. It was pointed out that one major challenge with building process ownership was finding the right place to root it:

> *"...There are no owners of a process generically in the hospital. It is owned within each specialist area, but not at the generic level. This makes it very difficult to support the process with services as you do not have a internal opponent to discuss the process requirements with." (S2)*

Other indicated issues establishing process management in specialist healthcare seems to be related to expertise or competence, methodology, notational standards and allocation of resources to 'do the job and keep doing it'.

> *"...We have observed that it is not easy to complete process analysis internally as there is no internal authority that has this as its area of competence and is responsible for supporting projects when they require a streamlining and improvement of the service they offer. As far as I have managed to identify the work that is done in this area does not follow a standardized notation or a methodology from a holistic perspective. Also the process documentation is not managed post project and therefore becomes a participation sport there and then to achieve the projects goals, before it dies" (S2)*

> *"...No it consists of process diagrams and that type of thing including UML models. We have observed that there is not much established and what is available is documented in many different ways. There has to be some form of standardized descriptions of processes, if we are able to transform clinician's requirements to IT solutions." (S4)*

Maintenance of process descriptions across a processes lifecycle is another important challenge to overcome best described by an example elicited from an interview:

> *"...I can remember that there were several meters of documentation. You didn't have to wait longer than a few months after the project*

was delivered before people started becoming uncertain of the condition of the documentation and whether it was still correct. Suddenly we had a couple of meters of worthless documentation because we didn't know what was correct and what wasn't." (S2)

The quote above indicates that the organization has to be 100% certain that process descriptions established have been updated and are continually being updated. If the organization becomes uncertain and gradually distrusts the descriptions then they will be discarded.

The following quote seems to imply that establishing tool support for maintenance of process descriptions is an important issue to handle, so that one benefit related to a SOA i.e. adaptability. The reason for this is indicated by the need to be able to do 'what-if' type analysis on business processes. This was mentioned by a couple of interviewees and is illustrated by the following quote:

"…because if you start establishing many process descriptions with relationships to the underlying IT portfolio and you need to change a process, you will need a large amount of manual effort to find out what the consequences are of each change." (S5)

In summary my findings indicate that process management is important in the minds of the interviewees in relationship to the SOA. However it has been difficult to ascertain from the interviews what that relationship specifically is as none of the interviewees have explicitly stated their reasons for their elevation of the importance of processes by connecting the dots with the SOA i.e. explicitly explained why they mentioned processes when talking about services and vice versa. Some interviewees have mentioned process descriptions as a communications tool for creating a common understanding between clinicians and IT and relating this to the SOA, but they have not pointed to any other benefits process management has in the context of the SOA.

Apart from this, my findings in summary indicate that the establishment of a process management regime consisting of process ownership, process expertise, a process management methodology, standards and tool support in specialist healthcare seem to be issues that are important in the context of SOA adoption.

5.7 Information Management Grand Theme

Healthcare is an extremely information intensive sector where information quality is indicated in the literature in the context of decision making, patient safety, and medical errors. It is therefore not surprising that 'Information Management' was a grand theme that ocurred more than three times in different interviews. Information management is related to the organization of and control over the structure, processing and delivery of information. Information management differs significantly from Information Governance as a discipline which has broader implications that are related to:

- Holding information securely and confidentially
- Obtaining information fairly and efficiently
- Recording information accurately and reliably
- Using information effectively and ethically
- Sharing information appropriately and lawfully

Some of the interviews illustrated that establishing a taxonomy or information model is important to ensure correct communication between stakeholders e.g.:

> *"…But we have focused on an information model. If we are to be able to exchange and use information in a SOA then we must have the same understanding of the terms and concepts that are in use by clinicians. Everyone has to agree upon what a patient is, what a procedure is and so forth." (S5)*

Project P1 which has established a description of guidelines for a SOA in specialist healthcare at the national level integrates specific standards into the proposed information model to ensure that specialist healthcare services in Norway are adopted and built on internationally accepted healthcare standards and taxonomy such as HL7 and DICOM. This decision could lead to the standardization of well defined interfaces in all services where information is exchanged between systems and organizations.

One interviewee indicated the importance of the information model and indicated that it was probably more important than the purchasing of specific technologies to build an operational SOA based platform. The following quote indicates an example of this:

> *"…but at the same time it is more important to focus on an information model and service implementation with the technology you already have." (S1)*

In summary my findings seem to indicate that information management is important from a number of perspectives amongst which were:

1. Ensuring that the correct terminology or taxonomy is used across the enterprise and indeed between healthcare organizations

2. Ensuring that healthcare vendors have well defined integration interfaces that are commonly understood and are fundamented in internation healthcare standards

3. That the IS portfolio is semantically consistent

There are a number of related issues to (or a part of Information Management) that occur in my findings that have been organized under different sections in this chapter. These related issues are information quality, information flow and information timeliness. I have organized these themes according to the context in which they surfaced in the interviews and grouped them accordingly in their respective grand themes.

5.8 Competence Grand Theme

The grand theme of competence or expertise is indicated by my findings as important in multiple areas that could influence adoption of a SOA. The interviewees pointed out areas such as process management, the Web Services Architecture, Information Security and the SOA in general are important to the adoption of a SOA. Some of these aspects are reflected by the quotes given below:

> *"…The challenge is to have enough competence. There are not many really good architects in the healthcare sector yet. There are a number of quality technology architects, but very few exceptional Enterprise Architects." (S4)*

Another aspect of the competency grand theme that has been mentioned by one of the organizations interviewed relates to the SOA enabling technologies that have to be adopted and used especially in the area of Web Service Security. An interviewee pointed out that:

> *"…even though the technology has been available a couple of years, at least as a kind of pilot, and can be found in more and more mature versions, it is the developers both internal and with our vendors who have not assimilated the knowledge to fully understand how this (Web service security) should work." (S1)*

> *"…yes it just indicates that the necessary maturity across the whole organization is just not in place." (S1)*

> *"…the lack of expertise could be an example of where one has created services – core services – that have in my opinion been too large, complicated and inflexible so that you are left with a system where the SOA functions only as an integration layer between multiple applications instead of being an architecture that the whole system is built upon." (S14)*

One interesting aspect not explicitly expressed in my findings was that no interviewee indicated the criticality of establishing the mechanisms for building the necessary expertise in the organization to support the adoption of the SOA. However the interviewee quotes above indicate the importance of having the necessary expertise in the organization and may take for granted building this competence. I have therefore concluded that my findings indicate that adoption of a SOA requires building the necessary specialist skill set in the organization both related to the SOA as a set of principles to be applied on the IS portfolio, being able to manage healthcare process descriptions and the enabling SOA technologies that it requires to implement them.

5.9   Web Service Architecture Grand Theme

5.9.1   Identity Federation

Adoption of this one key SOA enabling technology requires an infrastructure that applies the technologies mentioned below, the human resource skill set to adopt this infrastructure and a homogenous approach to trusting "users" or more precisely identity profiles across security domains and organizational boundaries.

> *"…Sorry I did not answer the question related to inter-organizational collaboration. There is an identity federation mechanism missing also." (S1)*

To put this more plainly my findings indicate that a clear end-to-end security architecture encompassing secure use of a Web Service Architecture over common communications architecture such as is provided by the Norwegian Health Network seems to be missing from the big picture.

The data also indicates that there are challenging discrepancies amongst specialist healthcare organizations' interpretation of the security code of conduct. Differentiated interpretations seem to be leading to differentiated implementations of security in IS solutions and infrastructure and how they can be used across organizational and security boundaries. Some healthcare organizations do not

presently allow use of Web Services located outside of their security boundary due to the simple fact that they have judged the risk of opening themselves up to attack from outside as too high even though the Web Services are located on the closed Norwegian Health Network. In contrast the Norwegian Health Network is viewed by government entities such as the Norwegian Directorate of Health as a secure electronic collaboration arena for all associated healthcare actors.

5.9.2   Service Location Transparency

Two interviewees mentioned the challenges of using Web Services outside their own security domains, for example Web Services exposed by other regional authorities and hospitals.

> *"…You will first see that this will be solved in a better way with a SOA if they are location transparent. They are most certainly not local in the sense that they are a part of the same process. They are most certainly distributed somewhere or other. Whether they are here, there or nationally – that shouldn't be important." (S1)*

The point being made in this quote is that specialist healthcare should be able to use established Web Services irrelevant of where those Web Services are located. Today it is difficult to support secure, inter-organizational online collaboration as some security managers will not allow Web Service traffic to pass back and forth through their firewalls due to a number of factors, one of which seems to be their interpretation of laws regulating the security of sensitive patient information.

5.9.3   Web Service Security

The interviews indicate little doubt that specialist healthcare is in the process of adopting a Web Services Architecture as a component of its SOA adoption. All of the sites interviewed have stated that they are in the process of adopting a Web Services Architecture or considering it. There seem however to be a number of challenges facing specialist healthcare relating to adoption of a Web Service Architecture:

> *"…It is necessary to establish Web Service Security and other security solutions because you are linking everything together and you therefore need security relating to authentication and authorization in place. This is an area where we have a number of shortcomings from my point of view." (S5)*

> *"…We are dependent on this becoming a strong structure and are therefore dependent of the complete Web Service Enhancements concept. All the concepts included in Web Services Enhancements (WSE) including WS Security, WS Transactions and all of those concepts." (S6)*

> *"…Our goal is to use standards such as WSE so that we can relate to standards instead of self developed hacks. I think that this would be better." (S6)*

One conclusion that could possibly be drawn from the indicated deficiencies in the collaboration architectures and security code of conduct established for the healthcare sector, is that cross-organizational electronic collaboration is presently only supported by an asynchronous, message based collaboration architecture and does not support an online, "synchronous" Web Service based collaboration

architecture. Other interviewees identified challenges relating to authenticating of Web Service users across security domains and organizational boundaries:

> *"…We do not have as of today any technical solutions that can give us a good authentication flow." (S1)*

The data indicates that there seems to be a consensus that Web Services are one key SOA enabling technology, but the national architecture and infrastructure for utilizing this enabling technology does not seem to be on any national ICT project roadmaps established for the healthcare sector.

> *"…We will probably do something around UDDI. I think something will happen around this. In addition I think something will happen around Web Services Management. I think we have to do something in this area, even though we do not have an extreme use of Web Services today." (S1)*

The quote above indicates that there is currently no urgent need for the establishment of a Web Service Management regime, although some organizations are preparing for the adoption of these SOA enabling technologies to ease the deployment, maintenance and use of Web Services internally. The lack of urgency gives the impression that the number of Web Service interfaces available in the organizations interviewed, were low enough to be managed without specific tools to ease management.

In summary my findings indicate that the enabling components for utilizing a Web Services infrastructure across security domains and organizational boundaries consist of technologies that address a standardized approach to:

1. Web Services **development** across all stakeholders using e.g. WS-I Basic Profile, WS-Security, WS- Policy, WS-Federation, versioning etc

2. **Publishing** developed Web Services across all stakeholders

3. **Finding** and reusing Web Services across all stakeholders

4. Authenticating and authorizing **use** of Web Services across all stakeholders

5. **Administrating** Web Services across all stakeholders

6. **Monitoring** Web Services across all stakeholders

5.10 IS Portfolio Management Grand Theme

One theme that was brought up a number of times in the interviews is related to the importance of IS portfolio management. Not all of the organizations interviewed have an IS portfolio management practice in place and it is only recently that a national Program Office was put in place to manage national projects. Whether the Program Office actually has a portfolio management system is unknown. There are some indications in my findings that IS portfolio management as a practice is a pre-requisite for the adoption of a SOA or an important component of a SOA adoption.

> *"…Yes. I am thinking that at the holistic level and between the different projects it is important to know which project should be completed first and last and by what time they must be completed. What is important and what is not." (S7)*

"…It is not possible to go in and see what we have and what is missing. Very often most of our needs are covered by 80% of what we have today and 20% should be new purchases. Instead 80% are new purchases and we reuse 20% of the old." (S4)

"…Through our portfolio management system and the SOA, we can rapidly go inn and find out could be simple to establish and what is more difficult." (S4)

There are indications that there are a number of challenges with healthcare and IT standards compliance. One interviewee pointed out that business processes are not standardized across hospitals:

"…The problem is that the underlying business processes are not standardized. It follows therefore that it will not help to standardize the messages on top of these processes if you do not have a fundamental common denominator."(S2)

"…We want mainly to become as standardized as possible in the description we establish, so that we can refer to standards that are under development typically HL7 and CCOW that are quality standards that we believe will have a long lifespan." (S10)

One of the main points in these quotes is related to the historical and current challenges that all of specialist healthcare organizations interviewed have experienced in their relationships with vendors who are the suppliers of the critical healthcare systems used in the hospitals. IS portfolio management might have ensured that purchasing decisions where consistent with IS requirements i.e. that healthcare vendors were required to comply with international healthcare standards.

It was also pointed out by two interviewees that it is important to address the issues related to configuration management of the services that are eventually deployed in the IS infrastructure. The interviewees were not totally clear on what specific problems were related to this issue, but seemed to indicate that version control would become a future problem when specialist healthcare organizations start sharing services across security domains:

"…Then you also have problems related to version updates. There will always be new versions. How are these updates supposed to be forwards and backward compatible?" (S10)

Service management could be viewed as related to Web Service Management and based on my findings it is possible that Web Service Management should be viewed as a component discipline organized as a part of the IS portfolio management.

The quotes given above indicate a number of different aspects of IS portfolio management that seem to be important to adoption of a SOA, amongst which are:

1. Enabling control of IS investments in the healthcare organization
2. Making correct purchasing decisions
3. Making the correct project sequencing decisions
4. Reuse of existing IS investments
5. Configuration Management

In summary there are indications that IS portfolio management plays an important part in SOA adoption because it is important to manage change in the IS portfolio, structure the change so that it reflects the goals formulated as a component of the SOA adoption and ensure that the relevant healthcare standards that have been chosen are complied with by all software purchases from healthcare vendors and internal development organizations.

5.11 Internal Collaboration Pressure Grand Theme

5.11.1 A Monolithic IS Portfolio

The current IS portfolio architecture predominant in all healthcare regions and hospitals, seems to be a cause of many of the problems described in this chapter.

> *"…Yes it is clear that there are a great number of challenges. One of them being, as mentioned earlier, that we have many monolithic systems." (S5)*

> *"…therefore we have historically a monolithic IT system." (S7)*

As mentioned earlier there are indications that many of the IT purchases made historically were made without IS portfolio management and in a departmental, ad-hoc fashion. In addition current healthcare market offerings are still considered by healthcare IT personnel to be monolithic (all encompassing) in architectural style.

> *"…The solutions we see in the marketplace today can only be described as giant bricks compared with this type of requirement" (S2)*

Another aspect that is forthcoming, but slightly more subtle seems to be related to the different worldviews of clinicians and IT. The following quote illustrates this:

> *"…I think that IT will be a giant ball and chain when it comes to change and streamlining because it does not seem that we have recognized that IT is such an important part of healthcare services." (S2)*

The above quote does not specifically mention clinicians, but my interpretation of the statement in the interview context was that there were at least two totally different worldviews on IT in the organization. The first worldview being IT's worldview that IT is an important and integral component of most healthcare processes and the second worldview indicated that clinicians have not yet 'discovered' the criticality of IT in healthcare processes.

One last aspect which I would like to point out from my findings is related to the requirements of inter-organizational process support. For example emergency rooms (ER) sometimes have to have access to a patient's journal which can only be found at a hospital in another part of the country. If a nurse at one hospital wishes to see the contents of the patient's journal remotely, the nurse has to acquire access to both systems i.e. first of all have privileges to access this patients journal in another system at another hospital and then access the patients journal for the present treatment in his / her own hospital which requires two sets of user identifications and passwords in addition to the necessary systems training to be able to operate the system at the other hospital.

"…The systems are very hospital specific. If we need to review a patient journal in two hospitals we have to enter two systems." (S4)

In summary my findings indicate a certain level of agreement across interviews that the purchasing process that specialist healthcare has used historically has lead to an IS portfolio consisting of monolithic systems that do not support intra-organizational or inter-organizational processes well. The monolithic nature of the IS portfolio therefore also has further implications which are described in subsequent sections of this chapter.

5.11.2 Data Redundancy

My findings show that one major problem in specialist healthcare organizations caused by the monolithic IS portfolio is data redundancy. As specialist healthcare organizations have historically purchased a number of different specialist systems to support their internal business processes, each purchase seems to have created information silos where data elements overlap. For example many specialist systems require local storage of patient information, information on the organizations involved in patient treatment and a patient's medical history.

"…And in addition most of the information that is stored in the registers is already stored in other places." (S1)

"…The way things are currently developing its looking like spaghetti where a lot of information is stored in many different places when a patient is being treated by different institutions. This becomes a security risk if you have to exchange information about this patient between those institutions." (S4)

"…We could avoid registration of the same data multiple times." (S5)

"…A number of redundant registrations." (S7)

There seems to be an understanding among the interviewees that a SOA might solve the data redundancy challenge by establishing consolidated data sources where commonly required information is registered once, made available to all information consumers using SOA enabling technologies and used multiple times in different contexts. There were few explicit statements about the consequences of data redundancy apart from other themes extracted that seem to be related to information flow, information quality and patient safety.

5.11.3 Poorly Integrated Systems

The findings indicate that the non-integrated nature of the IT systems portfolio in specialist healthcare is an impediment to the timeliness of information, information flow across the organization and this therefore seems to implicitly be a driver for efficient integration. One distinct promise of a SOA is zero integration i.e. that integration is built into the architecture of IS and when adhered to by vendors, results in integration being radically easier, lowering delivery time and therefore also integration cost. The following quotes give support to the description above:

"…So then one has purchased new systems that are expected to be an integral part of the existing systems portfolio. This is an understandable expectation and requirement." (S1)

"…But it is a fact that all of these systems actually have to work together and therefore it is no use having a specialist system that doesn't interact with the rest of the world." (S2)

"… There are very few integrations." (S10)

In summary there seem to be a number of possible explanations for the poorly integrated nature of specialist healthcare indicated by the interviewees, amongst which are:

1. The purchasing strategy historically endorsed by specialist healthcare organizations has lead to information and functional silos caused by a decentralized purchasing strategy in a hospital where clinicians basically go out and buy the systems they need to support their processes without taking a holistic approach to the actual end to end process they need to support

2. Integration costs which are high and inflexible in relationship to the size of the IT projects being run in specialist healthcare organizations result in "quick and dirty" solutions that possibly result in a more brittle IS portfolio

3. A non-holistic, systems oriented approach to IT process support instead of a process oriented approach to IT support of healthcare processes. There are indications that healthcare providers have approached healthcare process support from a 'departmental' perspective which does not highlight IS support for end to end processes, but highlights a specific system within a specific area of competence resulting in silo information systems

4. Integration competencies available to specialist healthcare organizations. IT resources with advanced integration skills have historically been scarce in specialist healthcare, although this is now changing. Some hospitals and Regional Healthcare Authorities now have in-house Integration Centres staffed by integration architects and integration developers

5. Integration technology maturity, including EAI platforms and standards, has gradually been improving and some of these platforms are now are being replaced or complemented by Web Service enabling technologies

5.11.4 Poor Adaptability and Flexibility

One of the challenges cited by interviewees from four of the selected sites had to do with the adaptability of the IS to change. This indicates that each of the sites regards adaptability as an important benefit related to a SOA adoption in addition to implicitly viewing their IS portfolios as having poor adaptability.

"…But it is clear that the end goal is that one achieves flexibility i.e. being able to change new systems and adopt changes in existing systems in a manageable way." (S1)

"…It is the ability to quickly change, that our organization really wants to achieve." (S4)

"…We can see that we are battling to change our large and complicated systems." (S5)

The interviews indicate that many critical IT systems in specialist healthcare organizations are based on a traditional client / server architecture. In addition there are many layers of management and technical complexity that increase the inflexibility of the IS portfolio.

> *"...We must be able to increase our flexibility so that we can increase our rate of change." (S4)*

> *"...You do not get the flexibility you need when you suddenly change a process at the top?" (S5)*

The poor adaptability of IT systems could be one possible cause of internal pressures between IT and clinicians. For example if a change is needed in a patient administration system, that change request has to be forwarded to the supplier of the system. The supplier evaluates the change request, gives a time estimate and plans for the feature to be added in the next product release cycle. When the next version of the patient administration system is delivered 6 months in the future, it has to be tested by the receiving hospital, which from my own experience is something that could take anywhere from 6 weeks to 3 months depending on the scope of the upgrade. After a thorough test has been run by the hospital, the vendor usually has to fix problems encountered during testing which are then retested by the hospital. The upgrade is thereafter deployed into the production environment as soon as authorization has been given. The example illustrates one aspect of the apparent inflexibility of IT in specialist healthcare that clinicians seem to be experiencing.

In summary this study indicates that IT in the specialist healthcare organizations interviewed are seeking a higher level of flexibility and adaptability that gives improved support to clinicians. There are indications that IT views the adoption of a SOA as the mechanism to achieving that adaptability and flexibility.

5.11.5 Poor Information Quality

Information quality was one topic which surfaced multiple times in a number of the interviews. Information quality 'obviously' seems important to clinicians when making decisions concerning patient treatment for a variety of reasons:

> *"...They have to be sure that they can see the complete picture before starting their treatment or they can be held responsible for their actions later." (S2)*

> *"...but the greater benefits are related to an improvement in information quality which can hinder misunderstandings, medical errors and the like." (S4)*

A definition of what information quality actually is, probably is relevant to each process which involves clinicians and / or administrators. Information quality is discussed in more detail in Chapter 6.3.9.

Business processes supported by integrated information systems in the enterprise might be one possible solution that supports a good flow of information. My findings from specialist healthcare in Norway give me the impression that this is not the case with current IS portfolios in hospitals. The following quotes give some examples of this situation:

> *"...It is important for me as a doctor to know whether an incoming patient which I do not have a previous relationship with, has a history of diabetes and is allergic to penicillin." (S2)*

> *"...We envisioned that – more correctly the input from clinicians also at that time was that the flow of information was too fragmented." (S7)*

"...We have proposed and maintain that clinicians have access to too little information in their work treating and following up patients." (S10)

"... SOA technology is very important in enabling transport across applications." (S10)

There seems to be a number of interviewees that agree that the flow of information across critical IT systems in hospitals is fragmented and that a SOA will contribute to a possible solution. Poor information flow is just another important aspect of the internal pressures I have found in the interviews completed and seems to be directly related to a number of the other internal problems described in this chapter.

5.11.6 Poor Information Timeliness

One of the most important themes that were put forward by 6 of the interviewees was related to information timeliness. Information timeliness is the ability to have good quality information available when you need it. This is extremely important for healthcare personnel because they are dependent on this information to be able to make the correct decisions when treating patients.

"...There are large amounts of paper that are involved in this and it is totally unsatisfactory just presenting paper on a screen. That is not suitable for a good use of information." (S2)

"...Clinicians are always occupied with the necessity of having access to real-time information. The greatest problem for a clinician is to have correct patient information when he / she needs it." (S10)

"... they always emphasize availability." (S4)

"...It is firstly to correct the information fragmentation that is prevalent in hospitals i.e. a holistic presentation of information, where you can rapidly get a clinical picture of a patient in a digital workspace." (S6)

Getting access to the correct information at the correct time seems to be a non-trivial pursuit for specialist healthcare organizations. My findings show that there are a number of possible reasons for this:

1. Information is stored in different systems and geographic locations

2. Information is not readily available to healthcare personnel due to security reasons

3. The necessary information is not flowing with the business process i.e. the systems supporting the business process are not integrated with each other allowing the necessary flow of information

4. Information is not readily available for exchange or access outside of specialist healthcare organizations due to security issues related to the regulatory laws and and the technical infrastructure

5.11.7 Poor Application Fit

Another extremely important problem expressed by half of the interviewees was given in the context of current applications satisfying clinician requirements and which I have termed 'Poor application fit'. A number of the issues on application fit are indicated in the following quotations:

"…We have a problem that the digital workspace is too general. Each screen is primarily developed for the main user of that screen. This becomes very effective for the main user of the screen and very complicated for all other users." (S1)

"…He fills out a leave of absence due to illness report on paper because this is much faster. It is difficult to define a user interface that is satisfactorily effective ensuring that the system gets adopted." (S1)

"…If it at the same time gives us a possibility for making it easier to construct digital workspaces that fit different professions." (S1)

"…it is not searchable which is in itself not satisfactory. There is nothing worse for a doctor than having to leaf through 40 pages to try and find something important for his case." (S2)

"…So we are looking at how we can move forward by supporting processes and patient treatment in a more satisfactory way than is supported currently." (S10)

"… but as a result of using SOA technology, clinicians can to a greater degree get access to an improved holistic view of and improved follow up of the patient that is undergoing treatment." (S10)

"…but it is the way we put it in and present it that is one of the greatest challenges we have moving forward." (S4)

"…But now clinicians have discovered that they do not want more systems. What they want is more collected in one workspace." (S4)

"…And then they emphasize what is available should fit their business processes." (S4)

"…These are more in the direction of components and services, and I think that they will feel that they have improved support in the IT systems by not needing to have to use so many different applications." (S5)

"…Someone working in a hospital clinic requires registering information in multiple systems during the day. You can support the requisitioning of services such as X-ray and laboratory analysis by way of a streamlined process that guides you through a user interface that supports what you need to do in your job function." (S7)

I have interpreted these quotes as describing current hospital IS portfolios as inadequately satisfying the requirements of clinician's processes that are invoked on a daily basis. IT support for these processes gives an inadequate user experience in the context of actually supporting the different job functions involved in any one business process implying possible ineffectiveness for some of the involved clinicians. The main problem themes indicated by the quotes are:

1. The ability to quickly generate a holistic informational view of the state of the patient being treated

2. The ability for clinicians to search in structured patient information quickly

3. The effectiveness of IS functionality in the context of the clinicians' work processes

4. The requirement to register the same information multiple times

5. The requirement to use multiple systems to do daily work instead of having a digital desktop that fits itself to the clinician that is logged on to the system

My findings indicate that most of the interviewees seem to regard a SOA as a possible solution to many of the issues described above because it allows functionality spread across multiple systems to be exposed and integrated into a digital workspace that actually supports business processes giving clinicians access to information that is relevant for their role at any one time.

5.12 External Collaboration Pressure Grand Theme

5.12.1 Legislative Pressure

The Ministry of Health and Care Services has recently published it's IT strategy for the coming 5 year period 2008 - 2013 (HOD, 2008). The IT strategy lends weight to the importance of prioritizing electronic collaboration in the healthcare sector. Electronic collaboration in the healthcare sector seems to be dependent on securing the information being sent between actors according to the rules, regulations and norms established for information security.

However the interviews and documents reviewed as a part of this research have shown that there seems to be a significant gap between the government entities expectations on utilizing strong information security protocols and the specialist healthcare sector's actual ability to enable security for cross-organizational processes that satisfies the complete norm for a Code of Conduct established. This seems to be indicated for cross-organizational processes dependent upon online services implemented with Web Services, an enabling SOA technology as indicated by these findings and illustrated by the following quotes:

> *"…Let us say that we changed our interpretation of the legislature related to Electronic Healthcare Record, or alternatively the legislature was changed so that it was possible for us to access the Electronic Healthcare Record between one healthcare organization and another if the information had been explicitly marked as 'can be delivered to others'." (S1)*

> *"…We don't need more regulations. All these rules and regulations are not founded in reality." (S2)*

> *"…We have also seen a number of challenges with legislation and interpretations of legislation. But that's a slightly different discussion." (S4)*

> *"…a SOA will only be a way to realize the vision. The challenge has to do with legislation and interpretation of that legislation." (S4)*

> *"…This isn't directly related challenges motivating a move to a SOA, but the exchange of information between specialist healthcare organizations is a problem due to legislation." (S10)*

"…You mainly have to have an active consent from the patient to be able to exchange patient information between hospitals." (S10)

"…In reality a GP has always printed a requisition and sent it with the patient. But this is in conflict with legislation." (S14)

"… So security requirements, the understanding of security measures and establishing an acceptance that they are good enough has been a definitive challenge." (S14)

"…Yes other barriers can be the security requirements that hospitals have to satisfy both locally and regionally. To get them to accept that a SOA based solution would give a satisfactory security solution even when transporting information across security domains and organizational boundaries has been a challenge." (S14)

The above sample of quotations from the data indicates that the national legislature relating to security issues is currently a major challenge when exchanging information across organizational boundaries in the healthcare sector. Interestingly enough the Ministry of Health and Care Services with its executive arm, the Directorate of Health (HDIR, 2008) is actually in the process of changing legislation to make it easier for inter-organizational collaboration and secure information exchange in the healthcare sector.

5.12.2 Inter-Organizational Process Support

Specialist healthcare is extremely complex when it comes to inter-organizational collaboration. For example GP's interact with hospitals, hospitals interact with each other, hospitals interact with community healthcare organizations, hospitals interact with the Directorate for Healthcare and hospitals interact with the Norwegian Labour and Welfare Administration.

A number of interviewees also pointed to the challenges related to the seeming lack of support for inter-organizational processes that require realtime information exchange. A sample of quotes follows that illustrate some of the challenges explained during the interviews:

"…I think that there is something to be said about inter-organizational collaboration between organizations that is also dependent on the SOA concept, where you have judicial autonomy and need a SOA to resolve the issues well – at least if we are to think nationally." (S1)

"… You have to merge their databases if two hospitals are to be connected, but you can merge in the context of the digital workspace or at the service level. It is clear that it is easier to functionally differentiate hospitals if you have that kind of flexibility than you can today." (S4)

"…Patients that receive treatment from their GP, from their local hospital, from their regional hospital and from a national hospital are implicated in a treatment value chain that is absolutely not integrated." (S4)

"…In addition we have a vision of a tighter integration between primary healthcare and specialist healthcare. Having a SOA in specialist healthcare would make it simpler for us to offer primary healthcare online access to information that they currently only

receive via the messaging system. I view this as a bad practice." (S6, 2008)

"...We have implemented a national solution which is based on an Enterprise Service Bus that is integrated with a central database, and multiple transport companies including specialist systems in the hospitals." (S10)

The quote samples above indicate that the current architecture predominant in specialist healthcare today does not support online access to information as it is required by inter-organizational processes. Currently the best practice for information exchange today is based on message exchange as this is harmonizes well with the current security legislation regulating the healthcare sector.

5.12.3 Information Sharing

The sharing of common information between organizational units internally in one specialist healthcare organization is a challenge indicated by my findings that is also duplicated at the regional and national level. Specialist healthcare organizations require the sharing of common information, especially related to patients, between themselves and other actors in the healthcare sector e.g. GP's.

"...Most electronic collaboration between primary and specialist healthcare is message based. That is moving information from one place to another. That is not the same as sharing information. Well it is sharing, but through movement." (S4)

"...I cannot understand why we have to duplicate this type of information with the help of messaging when the information is available in the hospital e.g. requisition replies, case summaries and the like." (S6)

"...That information is stored in many places, in many databases, many systems that one does not have access to today. By establishing a SOA, you make it easier to gain access to the information out there where it is needed instead of it being stored in proprietary silos." (S6)

"...When you get a patient on the table, and he or she has never been a patient in your hospital before and you do not know anything about the patient, it is extremely difficult to know where to start requesting information about the patient." (S10)

There are a number of scenarios where the interviews illustrate a need for information sharing between healthcare organizations. For example there currently is a need to be able to acquire a patient's journal from another hospital involved in the treatment of the patient especially when the treatment process spans multiple specialist healthcare organizations. There are indications that specialist healthcare organizations need to acquire key information about patient case history when patients are on holiday and become involved in accidents causing them to be hospitalized in a different geographic location far from their local GP. It would probably benefit the specialist healthcare emergency room if they could have online access to the patient's case history in the GP's Electronic Healthcare Record system.

In summary my findings indicate a specific requirement in specialist healthcare to ensure the ability of online sharing information quickly and securely between healthcare organizations.

5.12.4 Functional Specialization

Three interviewees mentioned that the functional specialization of specialist healthcare would increase the need for improved electronic collaboration between specialist healthcare organizations. This has become further substantiated by the merger between three hospitals in the Oslo region recently.

> *"…We have a long time ago left the idea of a complete hospital. There are no complete hospitals. Patients are treated across hospitals." (S1)*

> *"…That is to say that there are multiple actors that collaborate in getting a patient treated and healthy again. If he or she is mentally ill or somatically ill, then there are many actors in community healthcare, psychiatry and primary healthcare ready to treat you if you get sick." (S6)*

The sample quotes above indicate that functional specialization requires looking at inter-organizational processes in specialist healthcare from a holistic perspective. Functional specialization is indicated as an old concept if viewing the processes crossing between primary healthcare and specialist healthcare. In addition there seems to be a need to have an explicit overview over which key areas of competence the specialist healthcare organization prevails over e.g. Haukeland university hospital is well known in Norway for its burn treatment unit, Rikshospitalet is well known for its radiation treatment unit. Therefore functional specialization seems to imply a requirement to have a holistic and detailed insight into the specialities that each specialist healthcare organization actually provides services on. This overview is available and provided by a national register called the 'Inter-Regional Register Enheter i Spesialist Helsetjenesten' (NHN, 2008) which contains a description of all organizations in specialist healthcare. However this has not been indicated as a potential information source by the interviewees.

In summary functional specialization is a reality which has long existed in specialist healthcare and needs to be addressed. The interviews indicate that adoption of a SOA is one potential alternative that could improve support for the functional specialization that is taking place within specialist healthcare.

5.12.5 Synchronized Change

One interesting challenge that is indicated in my findings has to do with looking at changes from a holistic inter-organizational process perspective i.e. managing and synchronizing the necessary changes across all the actors involved in the inter-organizational process being changed. Two of the national organizations interviewed for this study indicated the need to synchronize proposed changes across stakeholders. It has not been apparent that specialist healthcare organizations have actually been able to see this requirement as clearly as the organization H3 and H4 that operate only at the national level.

> *"…This is one of the core reasons why things are out of step and why change becomes a challenge in a network of actors that are all very dependent on each others concurrence in time and solutions." (S9)*

> *"…The importance of concurrence – the understanding that one is a part of a greater value chain and that my cog actually depends on someone else or someone else is dependent on me. This understanding seems to disappear during the process."(S9)*

My understanding of the interviewees based on the quote samples given above is that change affecting stakeholders across the healthcare sector is very difficult to manage due to the number of actors involved in any given inter-organizational process and the fact that the individual actors do not necessarily recognize themselves as an integrated part of a value chain as they do not have this holistic perspective.

5.12.6 Trends

My findings indicate that the process of adoption of a SOA needs to be supported by external trends indicating that the paradigm is a beneficial way forward for large organizations with complex IS portfolios and that are facing a certain number and type of business and IT challenges that the innovation promises to solve. A few interviewees pointed out that current trends related to the SOA were important for their adoption decision and moving forward as indicated by the following quotes:

> *"... We had already decided on a SOA in 2004 as the fundament of our first architecture strategy. That was when we started on the SOA. But we are moving very slowly. The reason for deciding to adopt a SOA had probably more to do with the global hype around it at the time." (S4)*

> *"...At first it is a general trend. SOA is a trend today. Gartner says a lot about a SOA and according to the trend analysis that they refer to, the SOA seems to be something that is thought to be important of being a part of." (S4)*

> *"...So the SOA is a buzzword in IT." (S10)*

Keeping up to date on other organizations experiences of adopting and using the new IS paradigm seems to be important for the specialist healthcare organization during the period that it is evaluating and trying out parts of the paradigm. It was pointed out that there is absolutely no motivation hearing bout unsuccessful SOA projects in other organizations.

5.13 Healthcare Vendor Grand Theme

5.13.1 Willingness to Collaborate with Specialist Healthcare

A recurring theme amongst interviewees actually working within a specialist healthcare organization were related to a number of difficulties they had experienced working with their IT system vendors. One type of difficulty that was expressed by interviewees had to to with vendors competitive situation in the marketplace. Typically vendors that regard specialist healthcares' standardization efforts as detrimental to their own competitive situation, will probably not be very cooperative.

> *"...But we discovered over time that vendors and we had a considerable different take on what were important components." (S2)*

> *".. So it took a while for us to understand that vendors in the market place today did not have any interest, as 'a Radiology Information System vendor explained 'this ruins our complete market'." (S2)*

"…There is a lot of religion with vendors and how one should deliver. Most vendors live in a world where they deliver the whole stack in one system." (S4)

"…They want to have full control themselves and especially do not want to use a service that they perceive as proprietary." (S5)

"…Maybe there is a lack of will to establish the necessary knowledge to do it that way. At the same time vendors are often ingrained with old habits which are tried and proven and can be useable to achieve more rapidly the goals of satisfying requirements specifications. ." (S14)

The sample quotes above illustrate some of the cooperation challenges that specialist healthcare has faced and is facing currently. The main point of these quotes is to show that vendors are historically inclined to attempt to take control of the customers desktop and business processes by delivering the complete IS solution. Vendors have not been interested in watering out their competitive advantage by being just one potential supplier amongst many of one part of the healthcare process. Vendors' goals of owning the clinician desktop seems to be experienced by IT in specialist healthcare organizations as in direct conflict with IT's goals of achieving flexibility and adaptability for clinicians.

5.13.2 Willingness to Comply with Specialist Healthcare Architecture

Another important aspect indicated by the interviewees included the challenging lack of a national requirements standard that could be applied in all and any dialog specialist healthcare organizations were having with vendors where those vendors had a national customer base i.e. customers in each of the Regional Healthcare Authorities.

"…I am surprised over how little thought vendors have given to the reuse of their integration interfaces across all specialist healthcare organizations." (S1)

"…Our goal is to define a number of standards showing how things should be done so that all our systems vendors can follow this and do thing in the same way." (S4)

"…think through which applications are client / server, which applications are n-tier, and how we should build our applications, which requirements should be specified and required when purchasing new systems and that type of thing." (S6)

"… Their standards for messaging are not necessarily what we want to adopt." (S10)

There seems to be a perception amongst some of the interviewees that a SOA would implicitly define a number of requirements that vendors would have to comply with to be shortlisted in a purchasing situation.

Another related dilemma pointed out by some of the interviewees was the lack of a reference architecture that all vendors were required to comply with.

"…Another thing that was clearly a dilemma and was the main reason for us taking the initiative with Regional Healthcare Authority Central Norway was the lack of a national architecture for healthcare that vendors have to comply with." (S1)

"…How hard can you hit a vendor in the head if they do not actually follow your architectural requirements?" (S1)

"…Yes, most of the vendors of that type of system today have not taken into consideration a SOA when they originally built the system." (S6)

There are indications in my findings that specialist healthcare requires vendors to comply with an architectural blueprint that consists of a number of different requirement areas including utilizing SOA software development principles, utilizing IT and healthcare standards such as HL7, Web Services, DICOM and others, and in general supporting the specialist healthcare organizations' healthcare processes as components even if that could have implications for the vendors competitive situation.

5.14 Stakeholder Benefits Grand Theme

According to my findings there are a number of possible benefits perceived by the interviewees with an adoption (and use) of a SOA. The following chapter sections give a brief description of each of the benefits elicited from the interviews analyzed.

5.14.1 Flexibility and Adaptability

As mentioned in Chapter 5.11.4, there are indications that the flexibility in current IS portfolios in specialist healthcare organizations is relatively low and hospitals are searching for ways to improve this so that they can easily address changes without redesigning the whole IT infrastructure and also keep IT costs down. Multiple interviewees mentioned flexibility and therefore adaptability as a major benefit of adopting a SOA. This is illustrated in the following quotes:

"…Achieving a flexible architecture is the mantra and the primary benefit." (S1)

"…But it is clear that the real motivation is the thought of flexibility i.e. adaptability related to new systems and changes in systems." (S1)

"…If you are going to be able to move closer in on the central clinical processes in a hospital, you will need a type of solution that promotes high flexibility." (S2)

"…That there are loose couplings so that it is easier to achieve the flexibility you need." (S5)

"…You are then more flexible when you are required to change." (S7)

"…IT systems are starting to become flexible and include the functionality in a way that maybe will allow you to start mapping against processes." (S7)

Flexibility seems to be a pre-requisite for adaptability. If your IS portfolio is based on a flexible architecture e.g. SOA principles in this case, then this implies that you have built-in support for adaptability i.e. the ability to quickly react according to changing business requirements.

5.14.2 Increased Process Efficiency

By increased process efficiency, I mean processes that stakeholders are involved in can be completed more efficiently, possibly with fewer resources and therefore implicitly lower cost. This theme is indicated as having a possible influence on the adoption of a SOA. The concept of increased process efficiency was supported by many of the interviewees represented by the following quote samples.

> *"...For the hospital it is an enormous benefit if we can get rid of – if we can digitalize the whole process thereby improving quality. We then know that the paperless office will become a reality." (S1)*

> *"...It is clear that an enormous amount for time is lost in the hospital in comparison to how it could have been." (S2)*

> *"...Economic benefits can also be had by the clinical processes becoming shorter in time and faster." (S6)*

> *"...Moving on it was the actual time that was being used for administration of and printing paper requisitions – 4 million paper requisitions and ordering these transports in the healthcare sector that was a potential benefit." (S14)*

The quotes above indicate different aspects of increased process efficiency. The first aspect that is mentioned is the improved process quality that could be achieved by adoption of a SOA. The second quote indicates that processes supported by a SOA could improve efficiency for healthcare providers internally. The third and fourth quotes indicate the potential economic benefits that more efficient processes could have if process cycle time could be reduced.

In summary it seems that the adoption of a SOA could lead to the benefits indicated for healthcare processes.

5.14.3 Role Based Process and Information access

A theme which emerged from a number of interviews was related to clinicians' perceptions of how well current information systems satisfied their requirements and was user-friendly as well. A number of statements were given that illustrated the current challenges faced by IT in specialist healthcare:

> *"...Doctors emphasize functionality they need to complete their job when they are working in a polyclinic." (S4)*

> *"...That it is a better fit at any time for each clinician's role." (S5)*

> *"...But firstly that is why for that process that each clinician requires opening a digital workspace that is differentiated e.g. cardiologists, orthopedicians and nurses have totally different approaches to a digital workspace. When they log in the nurse needs access to 4-5 systems and the cardiologist needs access to his systems." (S6)*

The statements provided above seem to indicate that an important benefit of a SOA is the ability to provide clinicians with a digital workspace that is customized to their specific requirements depending on their role at any point in time during their daily work. The digital workspace does not only give access to the information systems and processes needed to support the clinician's role, but also filters the information available to the clinician down to what is essential for them to do their

job. The concept of improved application fit by being able to offer access to processes and information also seems to be a prerequisite for improving the quality of information and improving process efficiency.

The data seems to indicate a requirement for IS to support healthcare processes and clinicians' digital workspace with a radically different approach than is used today. The current IS portfolio consists of traditional applications that have been found wanting by the resources that use them as indicated by my findings. Most of the interviewees have expressed that a process-oriented approach to IS support for healthcare processes is important when considering adoption and diffusion of a SOA to achieve the potential benefits therein. However no interviewees have indicated that the current approach and requirements from vendors and internal development organizations should be changed accordingly i.e. that ensure implementation of IS solutions that take a process-oriented approach and consist of visible processes instead of hiding these behind the traditional function / data view that has dominated systems development the last 30 years.

5.14.4 Patient Safety

Patient safety as a benefit was described and supported by five interviewees independently. Five of the interviews completed seem to indicate a possible similarity between the quality of information available to clinicians, the quality of their decision making ability and consequently the level of patient safety achieved by the healthcare process. Some quotes extracted from the five relevant interviews are reproduced beneath:

> *"…I believe that this will be a future dilemma because you do not know what is there and what is missing. It is a risk if you do not know if the information is complete or not." (S2)*

> *"…but the most important benefit is in improved information quality, fewer misunderstandings, fewer medical errors and that type of thing." (S4)*

> *"…Therefore you are able to avoid accidents where you are looking at a patient in another system or reading off the wrong laboratory reply which results in a medical error. This could be a consequence that you have to navigate through many different systems. So the safety of patients is definitely very important to clinicians." (S5)*

> *"…Currently there are a number of pitfalls with using our information systems. One of them has to do with clinicians' reluctance to access all the systems that could possibly provide relevant information about a patient because this is not very user friendly. In addition there could be systems containing relevant information that clinicians do not actually have access to." (S6)*

> *"…Further to the snapshot information available in general it is a question of what does the clinician see before having to make a decision." (S10)*

Based on the indications above, it is reasonably safe to assume that patient safety is probably one of the most important factors that clinicians take into account after the successful treatment of patients. Most of the interviews completed for this study involved IT resources. It seems that their perception of the benefits of a SOA to clinicians could possibly be in alignment with clinicians' probable perceptions.

5.14.5 Lower Process Cost

According to five interviewees lowering process cost was a probable benefit of a SOA adoption although none of the interviewees had been able to establish a quantitative assessment to support this perception.

> *"...You have through a SOA established an integration infrastructure that hopefully is more well defined and reusable so that costs related to new connections are lower than today." (S1)*

> *"...Our systems portfolio satisfies most of our current requirements, but it needs to be continually adapted and changed according to hospital requirements. It is not possible to buy new systems every time a new requirement is expressed." (S4)*

> *"...Then we will be able to support the business in a better way with what we produce. In addition we will probably be able to bring down development costs." (S4)*

> *"...They are more available. When we have purchased a system from a 3ʳᵈ party and built our own systems, it is much easier for us to say 'here is our WSDL, here is a description of how it works." (S6)*

> *"...It becomes expensive to run and maintain and is probably not a good thing for clinicians either." (S7)*

> *"...An important means is the efficiency part leading to cost reduction and efficient processes in hospitals." (S10)*

The quotes presented indicate a number of different perspectives and kinds of cost reduction benefits that are perceived by the interviewees to be possible through adoption of a SOA:

1. There is a perception that costs can be kept in check by reusing available functionality in new ways if the architecture is flexible and adaptable enough to allow this

2. There is a perception that integration costs will be lowered because the systems portfolio is self describing and standardized where it comes to integration interfaces

3. There is a perception that improved process efficiency could imply a reduction of cost currently built in the way processes are implemented today

4. There is a perception that it is easier to develop new solutions with a lower cost than is currently possible today

5. There is a perception that if something is not done IT costs will continue to rise to unacceptable levels

Lowering IT costs seems to be an obvious, but unproven, perceived benefit of a SOA adoption.

5.14.6 Functional consolidation

Two interviewees described functional consolidation as a possible benefit of a SOA adoption. Functional consolidation implies the hospital having a process for keeping stock of the IS portfolio, so that redundant functionality can be removed

when necessary. Findings that indicate functional consolidation as a possible benefit of adoption of a SOA are:

> *"...And then you have some projects where you can start to remove redundant functionality." (S4)*

> *"...At the same time portfolio management gives you an overview of projects with common interests so that this can be separated out and established as a common." (S4)*

> *"...After a short time we could see that this was having a positive effect on integration and the tidiness of the IS portfolio." (S6)*

> *"...you start to consolidate common data and common functionality." (S7)*

Functional consolidation can imply or be used as a means to lower IT cost in addition to being a possible outcome of a IS portfolio management strategy.

5.14.7 Portfolio Longevity and Migration

The lifespan of critical information systems in specialist healthcare organizations seems to be a relatively long period of time e.g. one Regional Healthcare Authority has been using the same patient administration system for more than 10 years. In addition critical information systems in specialist healthcare organizations are not easily replaced without careful planning that takes into account the necessary migrational requirements that have to be satisfied.

> *"...And then you can ensure the prolonged longevity of some older systems by encapsulating them in with a SOA." (S7)*

This perceived benefit is probably only possible if the specialist healthcare benefit has established portfolio management as a prerequisite or fundamental component of a SOA. My findings seem to show indications of a relationship between the actual establishment of portfolio management practice, a SOA and the longevity of the IS portfolio.

All of the sites selected for this multiple case study have a legacy IS portfolio to manage and one distinct challenge facing these specialist healthcare organizations is related to migration from old to new systems over time. An important benefit perceived by the interviewees on adoption of a SOA is the ability to have a structured way of encapsulating the existing legacy systems portfolio in such a way that it is possible to exchange old systems for new systems. Five interviewees pointed this out as extremely important to IT in hospitals as illustrated by the following quotes:

> *"...How is it possible to make the next migrational change when you have a large monolith where you have to replace all or nothing?" (S2)*

> *"...There is better payback by making sure that you keep some of the earlier investments made in systems, development, functionality, etc and establish a smaller investment to satisfy the new requirements instead of replacing the whole thing at once." (S4)*

> *"...Then there will be services on top of the PAS that are generic so that you can renew elements in your portfolio when it – our PAS is starting to become very old – by having generic services available you can renew a specialist system without...you can do it gradually*

and more elegantly without having to redesign half the hospital."
(S7)

The idea behind encapsulating the existing IS portfolio with services that expose reusable information and functionality is that this establishes an abstraction from how the system is actually implemented which therefore allows gradual migration to new systems. In essence the IS portfolio becomes a black box supporting business processes through a standardized set of reusable or shareable services.

5.14.8 Reuse

Four interviewees brought up the concept of reuse of functionality in existing systems as a potential benefit when adopting a SOA in addition to making information available from its source instead of duplication information across systems.

> *"...We know now why we want to do this. We want to do this because reuse is a necessity." (S4)*

> *"...We are using some of the services there and we can see it is possible to build new workspaces gradually and hopefully with process support. And in the portal reuse the services that we have built 'on top of' existing systems." (S5)*

> *"...so that you can reuse the functionality in new systems or that you can build a digital workspace decoupled from the underlying specialist systems where you reuse elements of the functionality that system exposes." (S7)*

According to the interviewees, reuse enables building new digital workspaces that can ensure an improved workspace for the different clinical job functions in a hospital providing support for differentiated functionality and information needs. In addition reuse enables the opportunity to build new business processes that share the same set of services, but which are used in different configurations thereby offering new process support faster. Reuse also implies a lowering of IS cost as it increases the longevity of the existing IS portfolio.

5.14.9 Improved Process Oversight and Optimization

Two interviewees described the benefits of gaining improved oversight over the process implemented on the basis of a SOA adoption. However in both of these cases, it is important to note that the project referred to seemed to be more focused on implementing SOA enabling technologies than actual adoption of a SOA. As pointed out previously, SOA adoption encompasses more than the adoption of SOA enabling technologies.

> *"...Migrating from a manual transportation office to an integrated solution between the systems involved gave the opportunity to call for tenders and gain more process control which was very important." (S10)*

> *"...The last important element was being able to collect key performance indicators. In the old system the Norwegian Labour and Welfare Administration were not able to gain oversight over the number of transportation requisitions being made, where they were, how much they cost and which organization actually was generating the cost." (S14)*

In one of the interviews there was an indication that process oversight was important from the control aspect as the legacy situation seemed to imply that resources were being misused and transportations were being paid out to transportation companies from the Norwegian Labour and Welfare Administration without them actually knowing whether the requisitions were real or not. Another implication related to improved process oversight was the ability to control and predict transportation costs.

5.15 Healthcare Standards Grand Theme

Currently healthcare standards in Norway are developed and maintained by the Center for ICT Competence in Health and Social Welfare Sector (KITH). One of the main focus areas for KITH is developing standards for secure electronic collaboration in the healthcare and welfare sector.

Multiple interviewees indicated that the strategy of outsourcing the development of healthcare standards to KITH is all and well, but with one inherent challenge which is directly related to whom the standards actually are supposed to apply for. An interviewee pointed out that most of the IS portfolio that their hospital used was purchased from international, commercial vendors. They indicated that international companies offering healthcare systems are probably not very interested in complying with local standards developed for specialist healthcare in Norway. They therefore concluded that specialist system providers support for international standards as a basic and essential requirement when establishing and adopting a SOA in specialist healthcare.

> "…We could define a Web Service based SOA in Norway, the Norwegian National Systems Architecture for Specialist Healthcare – but if the service layer is maintained by KITH who are very good at such work then this has no support other than nationally. With the internationalization we now are seeing amongst vendors in Norway then these standards will not have any value. For example if Siemens chooses not to use these standards or accepts using them the price tag will probably be set so high that it is probably not in our interest to accept the offer." (S1)

> "…Another thing that I am preoccupied by is international standards or standards that are both international and national. I think that we should build our architecture as a SOA based on standards where possible." (S5)

The most important international standards mentioned by interviewees were Health Level 7 (HL7) and Digital Imaging and Communications in Medicine (DICOM).

5.16 Results Summary

5.16.1 The State of SOA Adoption

My findings indicate that specialist healthcare in Norway at the national level and as a result of P1 has made the decision to adopt a SOA. Due to the organization of specialist healthcare that does not necessarily mean that all specialist healthcare organizations in Norway will adopt a SOA as that is dependent on whether regional healthcare authorities and hospitals actually choose to do so.

The decision to adopt a SOA at the national level has been achieved by the consensus of the IT personnel involved. It is unclear whether the actual decision to

adopt was made by the management groups involved in the National ICT organization or was just a formality based on the recommendations from Project P1. It is also unclear whether the 'voice' of clinicians were heard during the consensus established by IT personnel in the decision process established by Project P1. It is probably reasonable to assume, based on the organization of specialist healthcare, that the decisions made as a result of Project P1 do not mandate 'enforcement' of any decisions made at the national level in regional specialist healthcare organizations.

I have attempted to 'measure' the adoption of a SOA in specialist healthcare by mapping each of the organizations and projects selected onto a simplified version of the SOA Maturity Model (SOAMM) proposed by Inagenti and Aravamudan (2007a), see Figure 11. The SOAMM shows the organizational nature of business processes along the x-axis and the incremental levels of SOA adoption proposed by Inagenti and Aravamudan (2007a) along the y-axis.

Level 1 indicates a basic level of SOA maturity where organizations are just starting to think of the relevant architectures and are possibly experimenting with SOA enabling technologies. Level 2 indicates a concious attempt to adopt a service design according to the principles of a SOA, including investment in SOA enabling technologies. Level 3 suggests that the business side in the organization has adopted a more involved posture in specifying the correct granularity of services that can be orchestrated, shared and reused in multiple business processes. Level 4 indicates that the organization has adopted a system of optimizing its business processes to improve performance and fine tune process efficiency. The last maturity level indicates that the services or processes are able to dynamically re-tune themselves according to load.
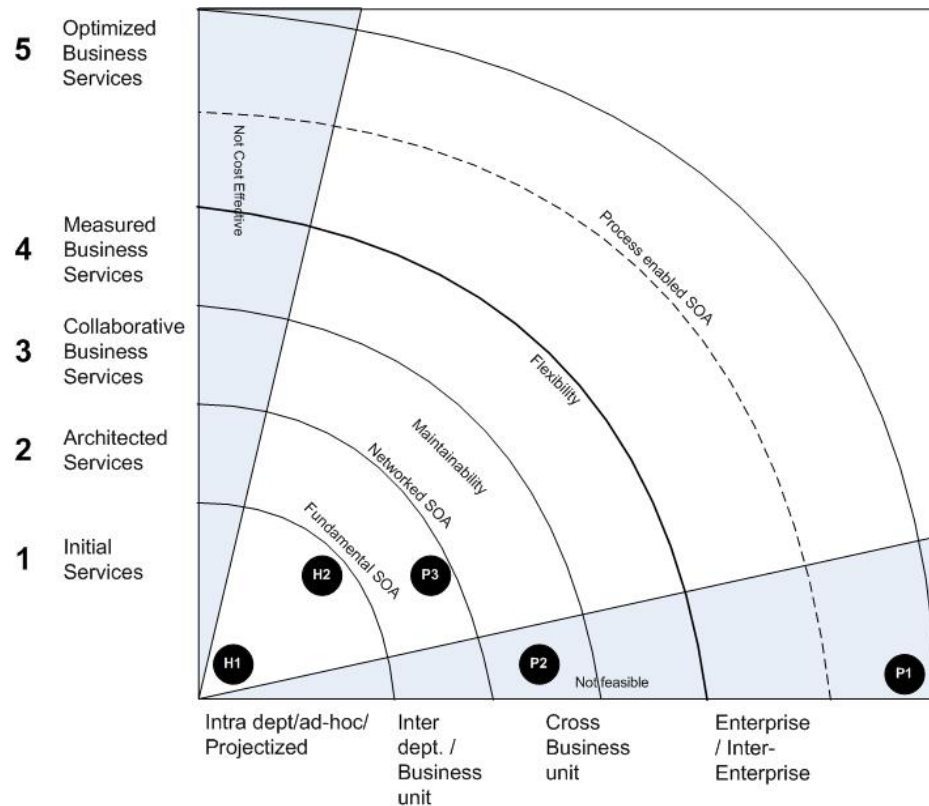

Figure 11 SOA Adoption Maturity Model adapted from Inangenti et al (2007a)

There are two areas in the model which are indicated as either unfeasible or too costly and seem to be related to the state of a SOA adoption and its use at the enterprise and inter-organizational level. For example the model proposed suggests that an organization should not be at the 'Initial Services' adoption level if the adoption is enterprise and / or inter-organizational in level. Conversely the model also suggests that the organization should not be at the 'Optimized Business Services' level if the adoption is within a project, department or between a few departments.

I placed project P1 in the 'not feasible' area because this project delivery is applicable to all specialist healthcare organizations in Norway and addresses both enterprise and inter-organizational adoption. However the placement of this project was difficult as the project P1 was national in nature and involved personnel from all parts of specialist healthcare in Norway. My difficulty in placing the organizations and projects in the model indicate that specialist healthcare in Norway does not fit the model very well which probably indicates a fallacy with the model. In addition the delivery includes a specific decision to adopt a SOA in specialist healthcare and a document describing the requirements regulating how this should be done. It is unclear in the SOAMM model used whether this indicates just adoption or both adoption and use as the paper does not reference earlier works in the literature related to technology and innovation adoption e.g. Venkatesh et al (Viswanath Venkatesh, Morris & Davis, 2003) and Davis (Fred D. Davis, 1993).

I also placed Project P2 in the 'not feasible' area as this project is also national in nature and the delivery from this project included a solution relying on SOA enabling technologies such as Web Services. However adoption of the solution has not happened yet possibly due to multiple issues indicated in this thesis i.e. the Business Administration Model, Information Security and Web Services Architecture Adoption. Based on the information available on this case, the SOAMM indicates that an organization has to be at a certain level of SOA adoption to be able to adopt a solution offering Web Services at the intra business unit level, which in our case maps to specialist healthcare organizations and services published at the national level within specialist healthcare. This is not the case for Project P2 as indicated. Project P3 is the only intra-business unit project which utilizes SOA enabling technologies in a fashion which could be interpreted as an architected service.

The specialist healthcare organizations interviewed – H1 and H2 – are in the early stages of SOA adoption as visualized by the SOAMM even though they have been involved in project P1. Specialist healthcare organizations H3, H4 and H5 have not had specific projects which could be labeled SOA projects in the context of the SOAMM and have therefore not been placed in Figure 11.

SOA adoption in specialist healthcare in Norway is still in its early stages according to the indications given by my findings, even though there are a number of initiatives that have been categorized by interviewees as SOA initiatives, the most visible of them being project P1 whose main delivery is a document describing a future Service Oriented Architecture for specialist healthcare in Norway. The other SOA initiatives are predominately focused on utilizing SOA enabling technologies to achieve specific project goals without the support of a defined SOA strategy that views organizational and IS change holistically.

5.16.2 Grand Themes Related to Adoption of a SOA

Most of the interviewees agree that the SOA is a paradigm encompassing how software systems are structured and built. However very few of the interviewees pointed out the importance of managing the SOA environment from an integrated business, technical and application perspective although the management and description of business processes which use services, information management and management of the IS portfolio were indicated as being important to most. I did not get the impression that SOA governance was being actively pursued as a discipline by top management or IS management.

More than half of interviewees indicated that management and clinician support were important for the successful adoption and diffusion of a SOA because of the indicated implications it has for the whole organization and IS portfolio. To be able to achieve the benefits promised by a SOA adoption, it was pointed out that resource prioritization, allocation and budgets were important themes that required attention by management and clinicians.

From a holistic perspective these findings indicate that interviewees from the same stakeholder group i.e. IT, agree that the SOA is predominately about encapsulation of the existing IS portfolio using Web Services. A number of the interviewees seemed to be preoccupied with the importance of the Web Service Architecture and security issues related to electronic collaboration across security domains. Web Services support the loose coupling of systems where systems communicate using a standard protocol across well defined interfaces established on standards such as http and XML. The importance of other SOA enabling technologies such as Enterprise Service Buses and Business Process Management Systems did not seem to be that important to the interviewees even though they were mentioned multiple times in different contexts. One of the projects mentioned, P2, has adopted an Enterprise Service Bus as the underlying technology for the solution being delivered and another interviewee mentioned the requirement to support workflow from a newly proposed clinicians digital desktop.
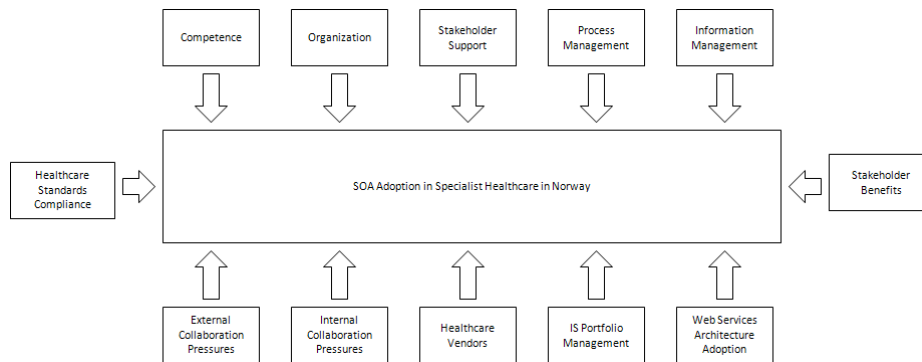
Figure 12 Summary of Grand themes related to SOA adoption

Another important perspective that has coalesced from the data relates to both internal and external collaboration where service integration as a solution to some of these challenges is indicated as a key benefit. The interviewees indicated that well defined and standardized interfaces between systems in the IS portfolio ease the complexity and cost of integration thereby streamlining information flow and improving the availability of information when clinicians require it. They also indicated that a loose coupling between existing systems in the IS portfolio allows

for the creation of new business processes and user interfaces that share and reuse the basic building blocks defined as services. In summary my findings indicate there is a perception amongst interviewees that the adoption of a SOA could solve some of their integration challenges by making IS integration easier, cheaper and more adherent to healthcare standards.

There are also a few tendencies that indicated in Table 7 in Appendix C that should be mentioned. Organization H1 and H2 as specialist healthcare providers seem to have a slightly more consistent and extensive perspective on all of the aspects of a SOA than the specific projects that they and others were involved in. Organizations that have a direct relationship to specialist healthcare in Norway represented by organizations H3, H4 and H5 seem to have more 'distance' to the SOA and perspectives relating to specialist healthcare. This could be due to the number of interviewees that participated in this study and their area of expertise. Projects P1, P2 and P3 all had specific perspectives that coincided with organizations H1 and H2 in many theme areas, but were not as extensive in the number of coinciding themes that were expressed.

Figure 12 attempts to visualize a summary of grand themes related to the adoption of a SOA in specialist based on the findings described earlier. One important aspect which is "hidden" in the grand themes 'External Collaboration' and 'Web Service Architecture Adoption' is the theme of Information Security which is probably more important than its current placement that the figure indicates. The theme of Information Security should probably be a peer in relationship to the other grand themes indicated in Figure 12.

It is not possible with this type of study to 'measure' the importance of each grand theme as a potential adoption factor or define any specific causality. In other words, my findings indicate that the grand themes could be possible factors influencing adoption, but it is difficult to ascertain the importance and causal relationship of each grand theme to the phenomenon and in relationship to each of the other grand themes.

In the next chapter I will discuss the foundation for the conceptual framework suggested by Figure 12 and propose a revision based on a discussion of my findings in the context of the literature. Appendix C gives a graphical overview and of the grand themes and themes elicited for each interview.

Chapter 6 Discussion

6.1 Chapter Synopsis

This chapter discusses my findings in more detail with a comparison of the SOA adoption process and each grand theme with the literature that could possibly give support or refute them. One of the main goals of this chapter is through that comparison to reorganize the grand themes and their contents so that they are as consistent and logical as possible in relationship to the literature.

Factor frameworks and models are usually proposed in positivist research. The most one singular interpretive study of this kind can identify are the tendencies which are shown in the data. This therefore implies that my thesis should not proceed further than proposing potential factors that can influence adoption of a SOA in specialist healthcare in Norway. Therefore I use the term 'potential factors' to label an intermediate stage between the identified grand themes in this thesis and actual factors. The argument for each of the grand themes as potential factors is another goal of this chapter.

Each section describing the possible transformation of grand theme to potential factor is acompanied by a figure which depicts an intermediary state of the potential factor and its components. These figures also include an extract of references to the literature that have been interpreted to give potential support for the transformation suggested. Some of the figures are missing literature references for a specific theme which indicates that I have not been able to find literature supporting the specific theme, even though the theme has been extracted and aggregated from multiple interviews. These potential gaps could represent interesting areas for further research, although these literature gaps could of course be due to weaknesses in my search technique.

The chapter ends with a brief summary of the potential factors illustrated by Figure 24.

6.2 The SOA Adoption Process in Specialist Healthcare

The literature points to a number of challenges which can potentially be solved by adopting a SOA in the healthcare sector as described in Chapter 2.4. My findings indicate a number of similarities between the literature and the actual problems experienced in specialist healthcare today.

Higa et al (1997) argue that adoption of an innovation and diffusion of the innovation are two separate concepts. They define adoption as the decision to make full use of the innovation because it is the best option at hand. In their study of adoption of telemedicine in two clinical units at the same hospital they found that the adoption decision was made without any consensus on the decision, without any defining investment requirements or the taking into consideration of stakeholder attitudes towards the innovation being adopted. The consequence of these oversights later led to the innovation being discarded. They further proposed a factor model which 'straddles' simultanously both the innovation and organizational dimensions, because according to them there is no guarantee of technology superiority or organizational fit. My findings indicate that a consensus was achieved amongst IT personnel, but which did not include clinicians or any investment requirements being defined. According to Higa et al (1997) a lack of

these elements could possibly lead to the failure to adopt the an innovation such as the SOA.

My findings suggest that specialist healthcare has a large number of requirements that seem to be solveable by the adoption and diffusion of a SOA. Adoption of a SOA alone is of course insufficient as the SOA has to be operationalized to give value to healthcare organizations. Higa et als (1997) factor model seems to lend support to my finding and argument for what I have called the Business Administration Model which seems to have implications for whether the innovation is adopted or not. In their model, organizational structure is related to the degree of centralization and power distance involved, an aspect which seems to be similar Business Administration Model grand theme.
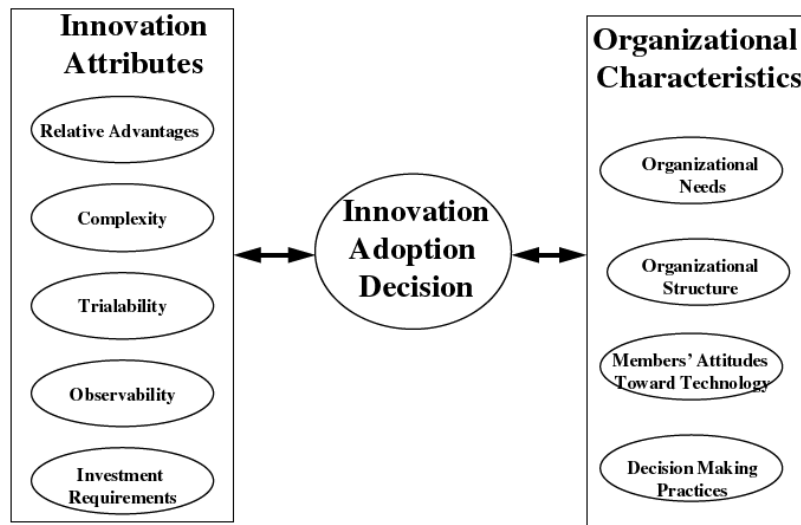
Figure 13 Factor model for organizational adoption (Higa et al., 1997)

My findings indicate that there seemed to be agreement that adoption of a SOA was probably the only way for specialist healthcare organizations to move forward in transforming the IS portfolio in specialist healthcare to a more flexible IS architecture based on SOA principles. This implies that most of the interviewees attitudes were positive to the innovation being adopted. There was wide agreement that the decision to adopt a SOA was made by the establishment of a consensus amongst those termed as 'eligible to have an opinion i.e. IT people'. However the literature (Boonstra & De Vries, 2004; Higa et al., 1997; Mantzana et al., 2004; Mantzana & Themistocleous, 2005, 2006; Mantzana, Themistocleous., Irani & Morabito, 2007) points out that all stakeholders opinions should be considered in the decision making process in order to ensure adoption of an innovation. The literature recommends that IS adoption such as a SOA is dependent on the acceptance of all stakeholders affected, for example clinicians.

6.3 Evaluation of Grand Themes Found

The aim of this section is present any similarities with previous research findings, that my evidence shows. An overview is given in Table 8 of the grand themes and themes I found and their comparison with literature found containing potentially

similar factors which could indicate support for the revised conceptual framework suggested later in this chapter.

6.3.1 Organization

Evidence from my interviews indicate that stakeholder support, organizational size, resource allocation, time and budget are important themes that suggest them being components of the organizational grand theme related to and possibly influencing a SOA adoption.

Boonstra's research (2006) shows how a hospital, which proposed a new system for sharing information between hospitals, general practitioners and pharmacies, failed to receive the other stakeholders' support even though all the stakeholders were in agreement on the benefits of such a solution. This is turn led to the breakdown in adopting the relevant technology (Electronic Patient File) due to the powerbase of the other stakeholders enabling them to not take part in the adoption process. The literature therefore seems to corroborate my evidence described in Chapter 5.4.1 which illustrates evidence for stakeholder power issues related to the business model chosen for the specialist healthcare sector seen from a holistic perspective. Kim et al (1990b) give further support for this when they point out the political barrier as a possible inhibitor of the strategic use of IS:

> "… Political barriers become significant issues as isolated systems that operate independently throughout the organization are brought together." (Kim & Michelman, 1990a, p. 203)

Premkumar et al (1997) identify and suggest four factors that differentiate non-adopters from adopters of Electronic Data Interchange (EDI) in the transport sector being size of the organization, competitive pressure, customer support and top management support.
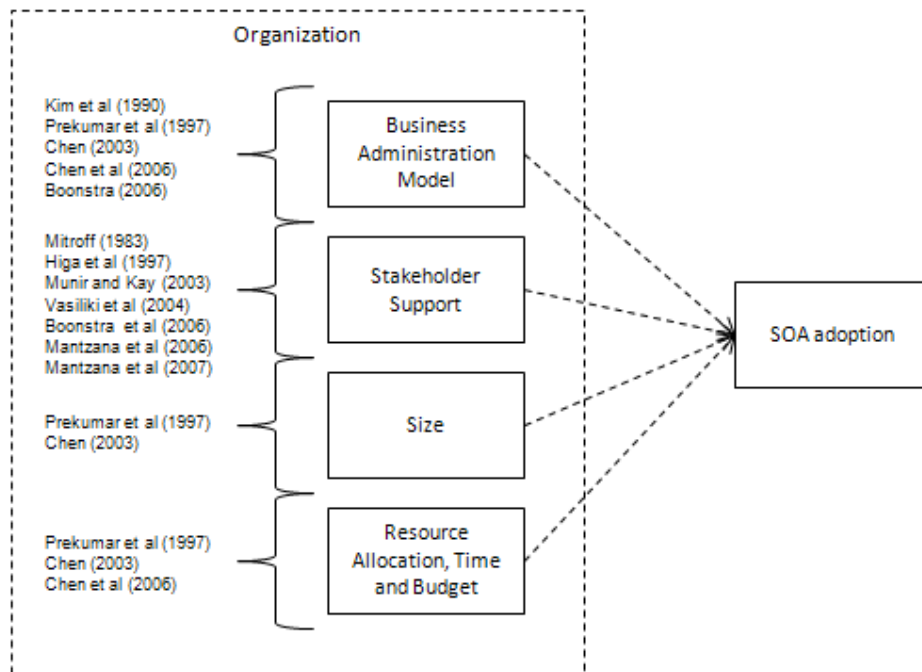

Figure 14 Organizational themes potentially influencing SOA adoption

Chen (2003) identifies four organizational factors important to adoption of XML and Web Services as being the size of the company and industry, organizational culture where innovation is specifically named, IT architecture and IT skill set. All of these factors support my findings although not according to the same thematic grouping that has been established in this study.

Chen et al (2006) also indicates support for my findings related to financing, resource prioritization and time allocation as these are suggested as important factors. This should be viewed in the context of enabling clinicians to become more involved in SOA adoption and diffusion. As mentioned earlier most clinicians are preoccupied with being doctors and nurses and therefore probably have little surplus time for IT.

Based on the support found in the literature for my findings, albeit from different sectors and with IS related to a SOA, it seems reasonable to conclude that the organizational grand theme described can be transformed to a potential factor influencing adoption of a SOA.

6.3.2 Stakeholder Support

According to the research literature (Legner et al., 2007; R. Mahajan, 2006), adoption of a SOA is supposed to positively affect organizations' business processes making them more flexible and productive. This statement implies that a number of stakeholders are both involved in and affected by the adoption of the SOA paradigm e.g. suppliers of consultancy and technologies relevant to the SOA, suppliers of healthcare systems, governmental organizations, healthcare organizations and ultimately patients, doctors and nurses to name just a few.

A complicating attribute of the SOA is that it seems to be an "invisible" paradigm and technology to most of the stakeholders affected by its adoption (Liegl, 2007). Doctors for example do not have to know anything about or relate to the SOA technologies ensuring timely and effective delivery of information relevant in processes supporting medical care of patients. Allegorically, households do not have to know anything about the delivery of electricity to the electricity outlets inside of homes that make electrical appliances work. Even so a doctor or home owner is a stakeholder affected by the possible adoption of the technology in question and implicitly has the power to either accept or deny that technology's adoption.

The example above indicates that the possible benefits of adopting a specific paradigm or technology can be critical to the decision making process. For example a home owner can either accept or deny use of electricity in a home. As history has shown the benefits of using electricity in a home have so far outweighed any possible and known adoption disadvantages.

I have so far shown rhetorically that the adoption of the SOA could affect and be affected by a number of different stakeholders. Previous research notably Mitroff (1983), defines a stakeholder as:

> *"All those parties who either affect or who are affected by an organization's actions, behaviours and policies" (Mitroff, 1983, p.?)*

I have interpreted this definition to support the idea that adoption of an IS can also be an organizational activity and therefore can affect other parties. According to Boonstra (2006) there is a difference between identifying stakeholders and managing them which therefore can lead to a management problem.

> *"The management problem arises from Mitroff's observation that stakeholders do not generally share the same definition of an organization's problems, and hence do not share the same solutions"* (Boonstra, 2006, p. 4)
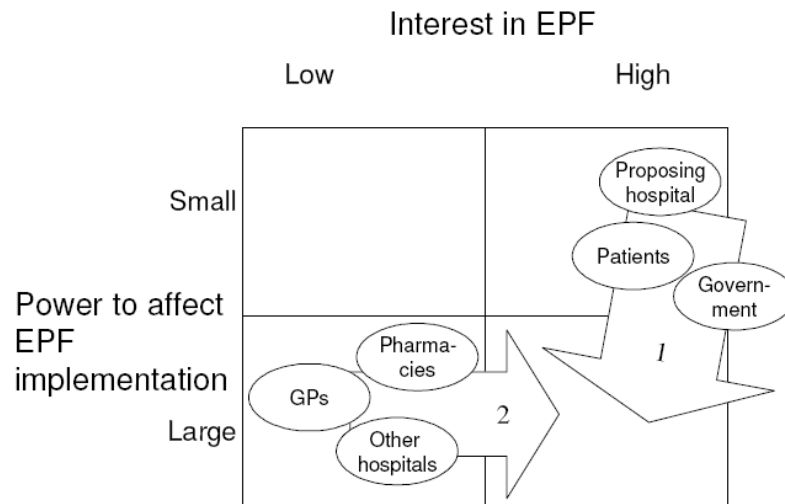
Figure 15 Power / interest matrix (Boonstra et al., 2004)

If the observations of Boonstra, Mitroff and others (Mantzana et al., 2006; Mantzana et al., 2007) are valid i.e. that stakeholders probably do not always share the same solutions, then it seems important that organizations adopting a SOA should consider measures to ensure support from all stakeholders as indicated by Figure 15.

As an example, Munir and Kay (2003) show that doctors as a stakeholder, perceived moving from a paper based process to electronic processes in a Clinical Information System as too slow and inflexible compared to using the paper based process. On the other hand the nurses considered the Clinical Information System as adding to their workload as they were often afflicted by having to correct the doctors' input and sometimes even having to input data for them as they did not want to use the system

The literature indicates that completing a stakeholder's analysis and formulating a management strategy for managing the identified stakeholder's interest and power to affect organizational related technology adoption should be lent more weight. The power / interest matrix in Figure 15 visualizes a strategy for moving all stakeholders to the quadrant of highest interest and power (Boonstra, 2006; Boonstra et al., 2004).

A general recurring theme in the interviews was related to challenges in the relationship with healthcare vendors. Healthcare vendors should probably be considered stakeholders in an adoption of a SOA due to the indications given that most of the IS portfolio of healthcare providers are supplied by healthcare vendors. This seems to imply that it is important to have a stakeholder management strategy as described by Boonstra et al (Boonstra, 2006) that also includes the management of healthcare vendors.

My findings indicate that clinicians as a stakeholder group are important to the process of adopting a SOA. The literature points out the importance of involving

and managing the different stakeholders influenced by IS adoption as each stakeholder type has the potential to undermine the IS adoption decision. This leads me to conclude that stakeholder support could be a potential factor influencing adoption of a SOA in specialist healthcare.

6.3.3 Competence

My findings indicate that there are a number of areas such as SOA governance including for example process management and information management where competence is insufficient in specialist healthcare and where there are indications that competence could be an important adoption and diffusion factor influencing SOA adoption. Chen et al (2006) findings indicate that:

> *"…In introducing any new technology, one of the major concerns of senior management is the resources associated with the change."*
> *(A. N. K. Chen et al., 2006, p. 790)*

Chen et al (2006) indicate that organizations should focus their resources according to where their 'market' potential is and where they are weakest in competency. For example organizations that want to adopt the Web Service Architecture and provides services to other companies should build significant expertise in the area of constructing, publishing and managing secure Web Services.

In the case of specialist healthcare in Norway, my findings suggest that expertise should be established in the specific areas of clinical processes, process management, information management, information security and Web Service Architecture adoption. Clinical process expertise as this is a prerequisite to establish process descriptions of a high quality and relevance to clinicians. Process management because this seems to be the common denominator of collaboration between clinicians and IT, information management because this is important as the foundation for a living terminology, information security as this is viewed as one of the more demanding collaborative issues identified, seen from a judicial and technical perspective, and the Web Service Architecture because this enabling technology will be important for both intra- and inter organizational healthcare processes.

6.3.4 Process Management

An important multi-faceted theme that coalesced from the interviews was directly related to the concept of processes. In most cases it was difficult for the interviewee to clarify why business processes were important to SOA adoption, although they mainly concluded that processes were the common denominator and lingua-franca which both IT and clinicians could understand.

My first point is that business process descriptions can be the common denominator of understanding between IT and clinicians. Mahajan (2006) lends some support to this finding. Mahajan (2006) describes a large US city government that adopted a SOA to achieve its key strategy of doing more with less. The lessons learned by the city in question were that a SOA has to be adopted by the business to be a success and that business processes are the common language between IT and the business.

However specialist healthcare in Norway is not completely in line with Mahajan (2006) when it comes to adoption of the SOA by business. In healthcare the business is medical treatment and care of patients by clinicians. The suggested misalignment with Mahajan (2006) stems from what I have indicated earlier, that

clinicians have not been very involved in SOA adoption for a number of possible reasons. And the lack of which seems to suggest that clinician support could be an important factor influencing adoption of a SOA.

My findings also indicate that specialist healthcare has approached SOA initiatives mainly from a national perspective which seems to be in line with Mahajans (2006) findings relating to global vision and local adoption. His findings support this by describing a SOA as enterprise in nature which requires a global vision, but local implementation. This principle seems to have been applied at the national level in Norway instead of at the enterprise level. The last lesson described by Mahajan (2006) was that governance is a key capability that has to be implemented to enable identification of reuse opportunities.

The second point I would like to make is that establishing a Business Process Management (BPM) discipline requires, as my findings indicate, a number of measures for example to ensure that all BPM initiatives use the same standard notation (Richardson, 2006) that is interoperable across toolsets so the models can be exchanged easily or are available easily e.g. on web sites. In addition organization H1 expressed the importance and difficulties of establishing a process for transitioning from a monolithic systems ownership model to a process ownership model that could aid in ensuring migration from a departmental view of business processes to a holistic, enterprise view of all business processes in the organization. According to Maurizio et al (2008) BPM replaces the traditional views of business based on discrete functional organizations, systems and metrics with those based on cross-functional core processes aligned with high-level business objectives. The only clear evidence in the literature that I have found that suggests the importance of reorganizing the IT management function to include a process-oriented approach are Richardson's (2006) recommendations for a BPM Centre of Excellence and BPM best practices suggested by Galinec and Vidovic (2007).

Business Process Management as a management discipline suggests a requirement for specialist healthcare organizations (Richardson, 2006) to establish organizations that can facilitate, maintain and publish process descriptions that are continually updated. If process descriptions are not updated, specialist healthcare organizations will lose their trust in the quality and relevance of these models. Richardson (2006) points to interdepartmental process initiatives often becoming bogged down in internal political conflicts and miscommunications without a clearly defined map of roles and responsibilities that can move BPM initiatives forward. This indicates that there seems to be a relationship between stakeholder management and adoption of a SOA when the organization is introducing changes to improve process efficiency.

One of the most important conclusions elicited from the interviews, is the importance of having mechanisms in place to make sure that process descriptions exist and are continually updated for the processes lifespan so that they are to be trusted. If process descriptions cannot be trusted then much of the value of establishing them is lost. This conclusion is supported by some of the lessons learnt from the era of Computer Aided Software Engineering (CASE) in the 1980's and early 1990's. According to Schmidt (2006) one of the reasons CASE was not adopted was because there was not direct relationship between the models defined with the CASE tools and the subsequent implementations. Developers tended to view the models as untrustworthy as they were rarely in sync with the actual implementations. The challenge of outdated descriptions therefore becomes a challenge of establishing mechanisms that ensure that the process descriptions created become the actual application or are kept alive by an organization that can

vouch for the trustworthiness of the process descriptions in play. Currently there seem to be few other viable alternatives to Business Process Management Suites (BPMS) as the platform for process description and deployment that satisfy the requirement of process description trustworthiness.

My main conclusion therefore is that process management is an important component in a SOA governance strategy requiring the organization to evaluate how to go about establishing a process management discipline, why such a discipline is important to the organization, how the organization keeps process descriptions updated and trustworthy, and how to justify the management cost of keeping process descriptions updated and trustworthy.

6.3.5   Information Management

Rowley (1998) describes information management as a multi-faceted discipline defined as:

> *"The aim of information management is to promote organizational effectiveness by enhancing the capabilities of the organization to cope with the demands of its internal and external environments in dynamic as well as stable conditions. Information management includes organization wide policy planning, the development and maintenance of integrated systems and services, the optimization of information flows and the harnessing of leading edge technologies to the functional requirements of end-users, whatever their status or role in the parent organization. Information management has two dimensions, the management of the information process and the management of data resources." (Rowley, 1998, p. 361)*

This differs significantly from information governance which has broader implications by definition and is all about holding information securely and confidentially, obtaining information fairly and efficiently, recording information accurately and reliably, using information effectively and ethically and sharing information appropriately and lawfully.

In the early 1990's the CEO of Microsoft Bill Gates proposed a slogan of 'Information at your fingertips' (Markoff, 1990). Nearly two decades later it seems that clinicians are still waiting to have that vision fulfilled. Multiple interviewees expressed challenges related to information management in specialist healthcare which seems to originate from the largely non-integrated nature of the IS portfolios controlled by the hospitals and exemplified by organization H1. Currently specialist healthcare organizations are trying to address the challenges of delivering quality information to the correct clinician at the correct time, securely by adopting a SOA.

The majority school of thought indicated by the interviewees, was that adoption of a SOA achieves a number of benefits such as role based information access and availability, information timeliness, information quality, etc that directly relate to clinicians amongst which easier integration was the main enabler of those benefits. This idea is supported by Legner et al (2007) who found that the main goals of SOA adoption was easier- and standardized integration.

A number of issues comprising information management that were mentioned by interviewees on which there was no clear conclusion, were related to data ownership and data redundancy. Interviewees mentioned that many of the monolithic systems that they had implemented internally duplicated both

information and functionality. This also became a challenge especially where there were no policies for data ownership defined. For example medical coding systems such as SNOMED (Systematized Nomenclature of Human and Veterinary Medicine) are used in multiple specialist healthcare systems in a hospital (Gupta, 2005), but there is seemingly no policy established for updating and distributing new versions of the coding systems as they become available i.e. there is no master data policy applied on the application portfolio as there is no established information management discipline in the organization.
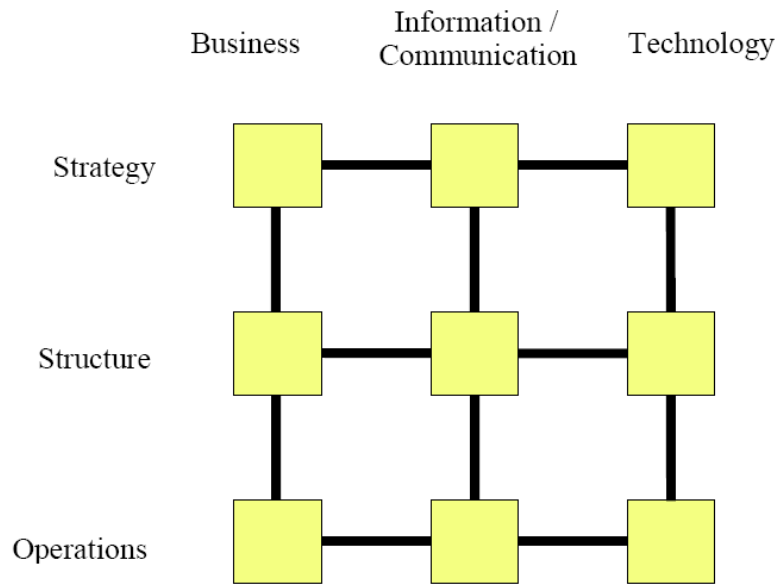
Figure 16 Integrative framework on Information Management (Maes, 2007)

Maes (2007) has argued that information should be handled from multiple perspectives following a lifecycle paradigm where data is produced, interpreted and used (from right to left in Figure 16). The framework above indicates the integrative nature of information management and the extent to which an information management discipline should go if consistency is to be maintained between the producers of data and users of information that are also creating knowledge. This framework seems to map directly onto specialist healthcare organizations where clinicians represent the business and technology represents IT.

My findings indicate that information management is supported by the literature and therefore could be a potential factor influencing adoption of a SOA in specialist healthcare.

6.3.6   IS Portfolio Management

Three interviewees specifically mentioned IS Portfolio Management as an important factor influencing adoption of a SOA. Without a deliberate and sequenced roadmap for SOA adoption using IS portfolio management as a tool, it is thought that the ultimate goals and benefits will not be achieved. For example establishing a Web Services Architecture without adoption of the necessary infrastructure to securely consume Web Services across security boundaries is probably not going to promote adoption and diffusion of the Web Services Architecture. This idea is supported by Deb et al (2005) whom argue that for a

SOA to transform the IT landscape, business owners i.e. clinicians must take ownership of the business architecture by going one step further and establishing a business service portfolio. Now Deb et al (Deb et al., 2005) do not explain how they suggest that business services be discovered and managed, but it seems reasonable to suggest that process management might be a possible discipline that could achieve just that (Inaganti & Behara, 2007b).

Inangenti and Behara (2007b) argue that based on their project experience, one should either elicit services with a top down business oriented approach, a bottom up technical approach or a mixture of both. The approaches are very different in nature as the top down approach only elicits the services necessary to support the business processes being described whilst the bottom up approach exposes functionality from the existing systems portfolio that IT think should be exposed. Organization H2 is following a bottom up approach to exposing services, but does see the need to also describe the business processes in a top down manner. One of the main challenges for them is getting clinicians involved in this work.

6.3.7   SOA governance

One of the interviewees in organization H2 reflected on governance as a missing element of their SOA strategy especially in the area of having specific goals defined, a SOA diffusion plan and mechanisms for measuring how far along the path to SOA adoption the organizational had actually come:

> *"…If I were to mention the process that we are using, then I think that we probably have goals and a position, but I am unsure where we should have been more specific on planning the complete journey from start to finish. In addition we should evaluate what we are doing in each project to see if we are going in the right direction. That has been my mantra in all of this. We should be in a position of measuring ourselves and handling any deviations from the course. I believe that if we are to be an organization fully utilizing a SOA then that requires hard and intense work. I am unsure of what we are doing to be in that position." (S7, 2008)*

Kanchanavipu (2008) suggests that SOA governance as a discipline should shape the actual SOA, measurement and the operationalization of it.
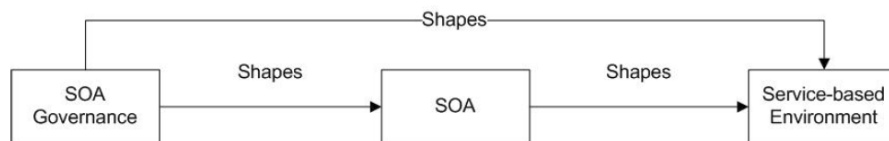
Figure 17 How governance shapes a SOA (Kanchanavipu, 2008)

This quote seems to give an impression that even though the organization has made the decision to adopt a SOA, it has not followed through and established a SOA governance model to shape the SOA moving forward. At the moment it is too early to be specific on the outcome the lack of a SOA governance model will have for that organization, but some of the interviewees are clearly worried that there seem to be little focus on this by management.

Business Process Management, Information Management and IS Portfolio Management are all disciplines that each incorporate an element of the concept of

governance i.e. the policies and processes necessary to govern their component contributions to IT. IT governance is defined by Weill and Woodham (2002) as:

> *"...specifying the decision rights and accountability framework to encourage desirable behaviour in the use of IT." (Weill et al., 2002, p. 1)*
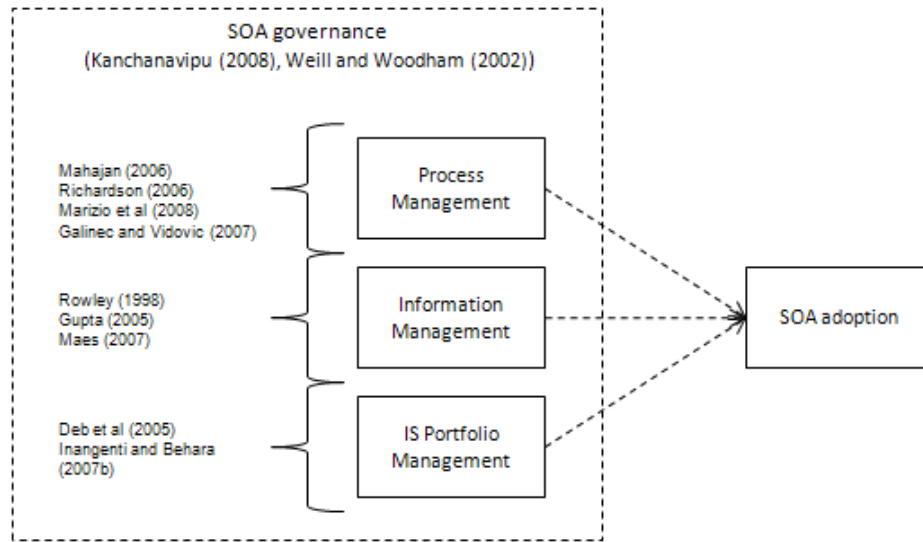
Figure 18 SOA Governance themes related to SOA adoption

Based on my individual findings related to the above disciplines it could be argued that Process Management, Information Management and Portfolio management as disciplines should also be considered important components of a SOA governance function. Even if this is not the case both Kanchanavipu (2008) and Gartner Group suggest that a SOA will fail if management does not have enough focus on SOA governance. Based on this supposition, the revised conceptual framework indicating potential factors influencing SOA adoption incorporates Business Process Management, Information Management and IS Portfolio Management as key disciplines contained within a SOA governance framework.

6.3.8   Web Service Architecture Adoption

According to Legner et al (2007), SOA adoption tends to focus on three main goals:

1. Achieving a standardized integration infrastructure to alleviate process integration. *This is comparable with well-known objectives of Enterprise Application Integration (EAI) (Legner et al., 2007)*

2. Achieving decoupled application domains to minimize dependencies between systems

3. Achieving flexible user and/or business process integration to enable simpler and faster adaption of cross organizational business processes

Legner et al (2007) research indicates that some of the goals of a SOA adoption (or benefits) are similar or associated with traditional EAI. Another common

denominator in both EAI and SOA domains seem to be related to SOA enabling technologies such as Web Services. Heather Kreger (2003) adds some support to Legner et als (2007) findings, observing that:

> *"Web services technologies are being developed as the foundation of a new generation of business-to-business (B2B) and enterprise application integration (EAI) architectures." (Kreger, 2003, p. 29)*
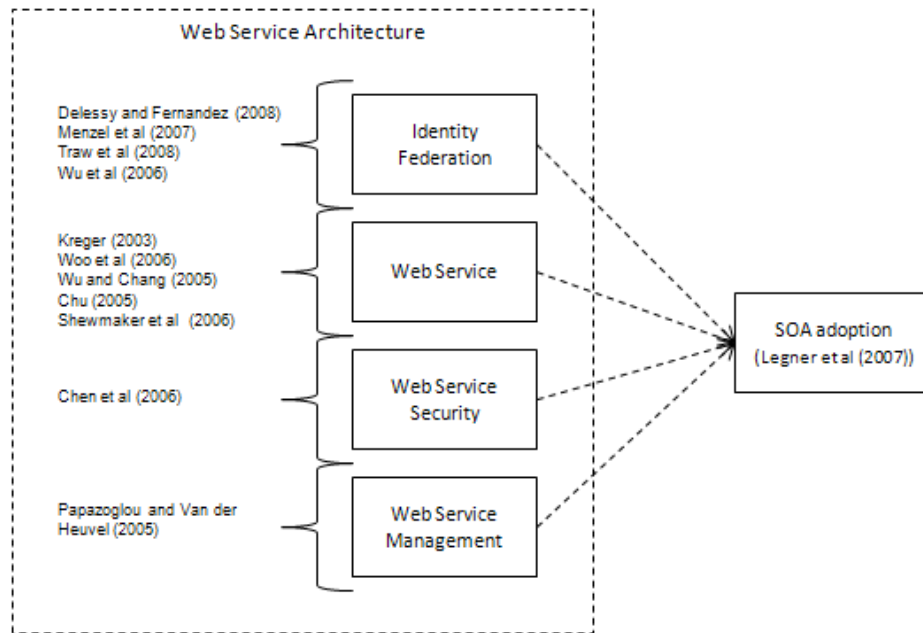
Figure 19 Web Service Architecture themes related to SOA adoption

These observations also seem to apply to specialist healthcare organizations in Norway and therefore give further support for a similarity between my findings and the literature. All of the interviewees were involved in one way or other indirectly or directly with projects that either consumed or published Web Service interfaces for integration purposes.

According to Chen et al (2006) Web Services that are made available across security and organizational boundaries require security measures to protect information being accessed or distributed through them. My findings indicate that these Web Service Architecture related security measures are not yet sufficiently established within specialist healthcare organizations either in hospitals, regionally or nationally. For example project P3 is a national service that exposes a Web Service interface to Web Service consumers in hospitals. This Web Service cannot currently be used directly from hospital security domains due to the legislation issues involved and the lack of security measures that need to be in place to support a secure Web Service collaboration architecture crossing organizational security boundaries.

My findings have indicated that one important security measure to establish when attempting to achieve inter-organizational collaboration over a Web Services Architecture is the concept of Identity Federation where Service Providers i.e. services offered by one healthcare provider can be consumed by a Service Consumer by presenting a token which represents the authenticated identity in the

Service Consumer security domain (Identity Provider). This concept is based on a form for trust which has been labelled identity federation. There is some support in the literature (Delessy & Fernandez, 2008; Menzel, Thomas, Wolter & Meinel, 2007; Traw, Yang & Comitz, 2008; M. Wu, Liu, Ding & Chen, 2006) for the importance of Identity Federation in relationship with the adoption of a SOA, although I have not specifically found this appearing in the literature as a factor influencing the adoption of a SOA.

In summary, it is currently difficult to see any viable alternatives to the standards based Web Service technologies available to healthcare organizations as one basic component for enabling adoption of a SOA. My findings indicate the Web Service Architecture is required for inter-organizational collaboration, but is incomplete for supporting secure healthcare processes that cross organizational and security boundaries. There also seems to be an indication that there is a lack of project sequencing i.e. Web Services being published nationally without the necessary infrastructure to utilize from the security domains of healthcare providers. This indicated shortcoming could possibly be due to the lack of a SOA governance framework which includes an IS Portfolio Management discipline. There seem to be sufficient similarities between my findings and the literature to suggest that a Web Service Architecture adoption could be a potential factor influencing adoption of a SOA.

6.3.9 Internal Collaboration Pressures

Two specialist healthcare organizations (H1, H2) interviewed seemed to be reasonably consistent on the major internal pressures which were driving them towards adoption of a SOA.

The most important issues indicated by more than four interviewees were the fact that the systems portfolio consists of monolithic applications which was acting as a driver for integration, that they perceived the portfolio as having inherently poor flexibility and adaptability, that information quality, flow and timeliness was insufficient to satisfy the requirements for clinicians and that current applications give poor support to the different stakeholders within specialist healthcare organizations.
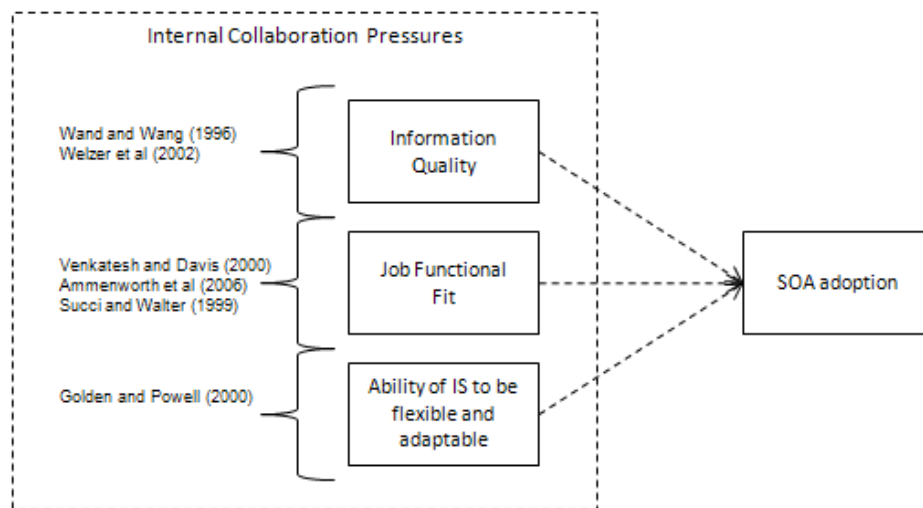

Figure 20 Internal Collaboration themes related to SOA adoption

Based on these issues, there seem to be three major challenges which are acting as drivers for SOA adoption in the two specialist healthcare organizations, the first being that clinicians do not have timely access to information with sufficient quality when they need it. The second being that healthcare personnel do not seem to have the IT support which fits their specific job function requirements well. The third and last major challenge which seems to be consistent across the organizations interviewed is that IT is experiencing the existing systems portfolio as a direct inhibitor to solving these challenges.

According to Wand and Wang (1996) the understanding of information quality is an important factor towards achieving information systems design that delivers high quality data. This suggestion is extended by Welzer et al (2002) whom propose that data quality at the point of delivery in medical care processes is extremely important because of the sensitivity of any decisions made to directly affect patients. They also argue that the same argument applies at management levels where decisions based on data which has low quality could adversely affect the optimal functioning of that organization. The literature examples therefore indicate support for my finding that information quality is an important issue related to SOA adoption.

Ammenworth et al (2006) suggest that IT adoption in clinical environments is dependent on the fit between individual, task and technology. Their argument is that the quality of fit depends on attributes on the individual level such as IT knowledge, motivation, interest, flexibility and openness to new ways of working, attributes on the task level such as organization of the tasks to be completed, the complexity and interdependence of tasks and finally the attributes on the technology level such as stability and usability. Succi and Walter (1999) lend support to the concept of task fit, but extend it by proposing that adoption of IT should take into account professional status. Their proposed arguments and extension to the Technology Acceptance Model (Fred D. Davis, 1993) indicates that stakeholder characteristics such as professional status could influence IT adoption. The themes extracted from the interviews indicate that there is evidence which is supported by the literature that IS functional fit to stakeholder's job functions and professions are an important issue driving adoption of a SOA in specialist healthcare organizations. Currently, it seems that there is a perceived lack of task functional fit to the requirements of clinicians.

Some of the interviews indicate that there is a perception that the IS portfolios of specialist healthcare organizations are difficult to change and inflexible without directly indicating the cause of this. Golden and Powell (2000) define flexibility as the capability to adapt and suggest four dimensions along which flexibility can be measured; temporal, range, intention and focus. The *temporal* dimension can be described as the length of time it takes for an organization to change. The *range* dimension can be described as the degree to which an organization can adapt to foreseen and unforeseen changes. The *intention* dimension describes the degree to which the organization takes an offensive or defensive stance towards flexibility i.e. those who take an offensive approach to flexibility are attempting to take control so that they achieve a competitive advantage. The last dimension *focus* describes the areas in which flexibility is created e.g. internally or externally. Based on a review of the literature Golden and Powell (2000) further suggest that the metrics of flexibility are efficiency, responsiveness, versatility and robustness.

IS portfolios in specialist healthcare are probably only as versatile as the vendors that deliver their solutions. Based on Golden and Powell's (2000) definition of flexibility, one could possibly argue that the main characteristics of specialist healthcare IS portfolios such as monolithic applications, information silos, the

number of different vendors, the non-integrated nature of applications and the 'hardness' of the software to change contribute to negative values for the metrics of responsiveness, versatility and robustness that measure the IS portfolios flexibility. Some of the interviewees explicitly pointed to vendors being a specific contributor to an inflexible IS portfolio due to the multiple issues which are described in Chapter 5.13.

My findings indicate that a majority of the interviewees experienced their IS portfolio as being inefficient related to supporting clinicians healthcare. One interviewee pointed out the length of time it had taken its organization to achieve its current state of early adoption of a SOA being notably four years after the decision to adopt a SOA had actually been made.

In summary the literature seems to indicate support for my findings that there are three important issues that have the potential to influence the adoption of a SOA being information quality, task fit and the ability of IS to be flexible.

6.3.10 Information Security

Most of the interviewees have indicated information security as an important issue to manage especially when information is flowing between organizations and thereby crossing security boundaries. One of the reasons that security is indicated as a major impediment to a SOA adoption is that information in healthcare is regulated by a number of laws such as:

- **The Personal Data Act** - The purpose of this Act is to protect natural persons from violation of their right to privacy through the processing of personal data. The Act is supposed to ensure that personal data are processed in accordance with a fundamental respect for the right to privacy, including the need to protect personal integrity and private life and ensure that personal data are of adequate quality ("The Personal Data Act," 2001)

- **The Personal Health Data Filing System Act -** The purpose of this Act is to contribute towards providing public health services and public health administration based on information and knowledge without violating the right to privacy, so as to ensure that medical assistance may be provided in an adequate, effective manner. ("The Personal Health Data Filing System Act " 2001)

- **The Code of Conduct for Information Security in the Health Sector** - The purpose of the Code is to instruct healthcare organisations to define a information security governance model which includes the organization's security strategy, goals and scope of acceptable risk applying to the confidentiality, integrity, quality, and availability of patient data. In addition, the governance model needs to outline what personal data is stored and used by the organisation, and exhaustively specify the business processes that personal information is involved in. Operationalization of the code of conduct is an important component which establishes recommendations on how to provide adequate authentication and authorization, how to perform configuration management, how to handle messages internally and externally and eduction of staff on information security issues. ("The Code of Conduct for Information Security in the Health Sector " 2007)

The legislation described above and the code norm makes collaboration inherently more complex than if this could be disregarded. If one also takes into account the complexity of the technical aspect of information security, security becomes a seemingly significant issue and challenge for healthcare organizations to overcome when adopting a SOA. According to Grimson et al (2000) the ability to guarantee the integrity, confidentiality and security of sensitive patient data is essential if clinicians and patients are to have confidence in the application of IT in healthcare as a whole. Another security aspect in Norway fundamentet by law is called 'active consent', which means that a patient needs to be explicitly asked by healthcare personnel that are not directly involved with treatment of the patient, if they can receive access to the patient's electronic healthcare record. As one can see this can cause some challenges for healthcare personnel if the patient is not available when healthcare personnel need to access the patient's journal.

According to Wang et al (2004) and Schepers (2005) the Web Services Architecture as a specific enabling technology for a SOA adoption, brings a number of additional security issues that de facto firewall technology and security protocols cannot initially contain. These security issues are related to the difference between securing single hop and multiple hop messaging. For example Secure Sockets Layer (SSL) is an often used security protocol that can secure (encrypt) the communications channel between two machines. However it is insufficient in a scenario where one machine executes a Web Service on one machine which then calls a Web Service on another machine. A type of end-to-end security is needed to secure the complete Web Service execution chain. Add this to the fact that Web Services involve an exchange of messages which also implies the importance of securing the actual message exchange to make sure that these have not been manipulated by 3rd parties during the actual message transportation. This is succinctly formulated in the following quote by Vita (2004):

> *"…Since SOAP is more commonly transported in HTTP, any potential threat to HTTP will be inherited by SOAP. An additional concern in dealing with text-based XML documents - unlike conventional middleware data wrapped in binary documents - is that, if intercepted in transit, it can provide information of data and the structure of the data [64], since XML-documents are structured and marked with tags." (Vita, 2004, p. 32)*

Yunus and Mallal (2005) point out additional security issues related to the Web Services Architecture which include threats such as viruses, worms and spyware. All of the security dimensions add up to a totality which could be a significant inhibitor to adoption of a SOA as implied by the interviews.

One conclusion that can possibly be drawn from the descriptions above, is that inter-organizational collaboration that is based on a SOA and utilizes Web Services as its SOA enabling technology, should ensure that the complexities of securing the flow of information between organizations does not impose a major challenge for SOA adoption. This grand theme and its underlying component themes indicate that the current understanding of SOA adoption in specialist healthcare currently does not incorporate the necessary decisions and actions nationally that seem to be related to adoption of a SOA.

6.3.11 External Collaboration Pressures

Comparison of the interviews indicates that external collaboration pressures such as information security, inter-organizational process support and information

sharing were themes that four or more interviewees related. The issue of information security has been discussed previously and seems to be well supported by the literature.

Specialist healthcare in Oslo, the capital of Norway, is undergoing organizational transformation. The South-Eastern Regional Healthcare authority that owns the hospitals in this area recently decided to merge three of the main hospitals in Oslo into one organizational entity (Martinsen & Noer, 2008). Each of the hospitals involved, Aker university hospital, Ullevål university hospital and Rikshospitalet have extensive IS portfolios. The merger has the potential to increase the requirement for information sharing across these hospitals' organizational boundaries in the interim because it will take time to migrate the IS portfolio of the three hospitals into one IS portfolio supporting all business processes of the new entity. There will presumably be pressures to share patient's Electronic Healthcare Record (EHCR) between these hospitals.
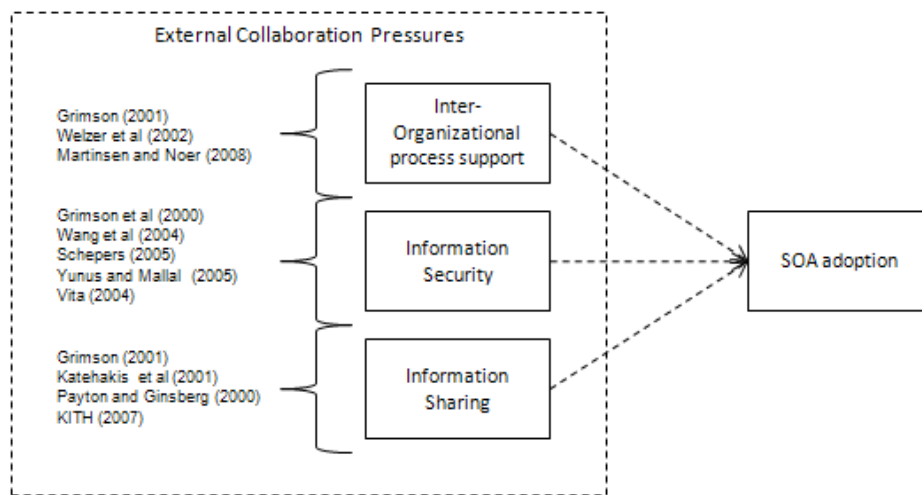
Figure 21 External Collaboration themes related to SOA adoption

According to the literature, the sharing of information between healthcare providers is often specifically related to the sharing of patients EHCR (Grimson, 2001; Katehakis, Kostomanolakis, Tsiknakis & Orphanoudakis, 2001; Payton & Ginzberg, 2000). Currently the only allowed method of securely sharing the EHCR in Norway is by asynchronous, electronic messaging or transporting corresponding paper documents between healthcare organizations via the Postal Service or other transportation means. Grimson (2001) points to the trend that healthcare is required to become more integrated where the individuals healthcare requirements are the responsibility of healthcare professionals across multiple healthcare providers.

Three interviewees mentioned that functional specialization of specialist healthcare organizations could imply an increase in the demand for Inter-Organizational Systems (IOS) and therefore the ability to require information sharing across organizational boundaries. One could say that functional specialization has already been the predominant trend for many years in healthcare depending on where you define the starting point for a healthcare process. Usually healthcare processes either start in primary healthcare i.e. with GP's or with a pre-hospital situation e.g. Emergency Rooms. If the patient requires specialist treatment the GP usually refers the patient to the hospital of choice that is best suited for treating the patient's ailment. One could interpret the movement of patients between primary and

specialist healthcare from a holistic point of view as a type of functional specialization. However specialist healthcare will in the future probably become more specialized as the reorganization of hospitals in Oslo seems to indicate. My findings indicate that the sharing of information between specialist healthcare organizations and / or primary healthcare presumably requires supporting both offline and online services that can offer access to information such as the EHCR that is common across organizations. In Norway preliminary work is being done in the area of establishing a patient consent-based EHCR (KITH, 2007).

My findings indicate that the necessary infrastructure for supporting secure online services communicating across organizational and security boundaries is not at the level required by legislation and the organizations that need to share and consume common information at the regional and national level. In summary this seems to indicate that if inter-organizational processes and the online sharing of information between healthcare-organizations are to be supported by adoption of a SOA then securing the transport of information between providers and consumers to enable information sharing is an important potential factor influencing the adoption of a SOA.

6.3.12 Healthcare Vendors

Themes extracted from Organization H1 and H2 interviewees indicated the importance of getting vendors to comply with specialist healthcare requirements to ensure SOA adoption and diffusion. One of the main reasons for this, is that most of the IS in specialist healthcare organizations is not developed in-house, but purchased from Norwegian and international software vendors.

Table 6 A selection of vendors in specialist healthcare (Gausdal, 2008)

Specialist healthcare vendor	System
Acos	ACOS
Agfa Norge	RISPACS
Apertura	Apertura EYE
CAP Gemini	CAPSI
Cardiac AS	Imatis Natus
Clinsoft AS	Partus
Clinsoft AS	Cytodose
Communicate Norge AS	Amtrix
csam international	PASDOC
Databyrån	ProSang
DIPS ASA	DIPS / DIPS Lab
GetMedic	Getmedic
GATsoft	Gatsoft
HK data	Rusdata
Hove Medical Systems AS	System X
Infodoc	Infodoc Journal
Kodak	RIS
LabCraft AS	Bloodcraft
Medilink Software AS	MediLink
Minispinn	Minispinn
Miclis AS	Miclis
Microsoft Norge AS	Biztalk

Nirvaco	AMIS
Nirvaco	NIMES
NAF-data	Pharmapro
PAIS	PAIS
Profdoc	Profdoc Vision GP
Profdoc	WinMed GP
Profdoc	SafirLIS Lab
RisCo	TRIS2003
Sectra	SectraRIS
Sectra	SectraPACS
Siemens AS	DocuLive EPR
Siemens AS	RIS/PACS
Siemens AS	Obsterix
Siemens AS	Doculive Pathology
Steria	Netlab
SWISSLAB	Clinical Chemistry
SWISSLAB	Microbiology
TietoEnator	NSL / NSML
TietoEnator Health Care	Infomedix IMX
TietoEnator Health Care	HIS90 PAS
TietoEnator Health Care	LMX
TietoEnator Health Care	Flexlab
TietoEnator Health Care	SymPathy
Varian Medical Systems	VARIS
Visma Unique	MedAxess
Visma Unique	Habildata
Visma Unique	BUPdata
Well Diagnostics AS	Well Communicator

However interviewees pointed out that one of the main challenges of getting vendors to comply with a requirements standard for specialist healthcare also requires that such a standard exists. In October 2008 N-ICT (The National ICT Board) published a document called the 'Service Oriented Architecture in Specialist Healthcare' which describes the national requirements and guidelines that vendors and healthcare organizations interacting with specialist healthcare are expected to comply with.

Another related aspect to the issues mentioned above has to do with vendor interoperability and standards compliance. There are a number of standards that exist in healthcare that have been established to ensure interoperability between vendors i.e. Health Level 7 and Digital Imaging and Communications in Medicine (DICOM). The Health Level 7 (HL7) Standard is a product that consists of an information model which describes the most common entities used in the healthcare, also including messaging formats for information exchange. DICOM is a standard supporting exchange of digital image information. This standard is developed and published by the DICOM Standards Committee. The point that was expressed by interviewees was that it was critical to have a compliancy mechanism in place which could ensure interoperability of the IS portfolio purchased from national and international healthcare vendors.

As Figure 22 indicates, I was given the impression by organization H1 and H2 that without the willingness of both national and international vendors to collaborate

with specialist healthcare organizations, adoption of a SOA would probably be difficult. A major challenge for healthcare software vendors is that most of their current offerings are built on a traditional client / server architecture. This implies that each vendor potentially needs to acknowledge that collaboration with specialist healthcare is an important factor for future survival within the healthcare marketplace, that the necessary processes have to be put in place to ensure a migration from client / server architecture to a future architecture that takes into account specialist healthcare requirements and that interoperability is ensured by adhering to healthcare standards as they become available.
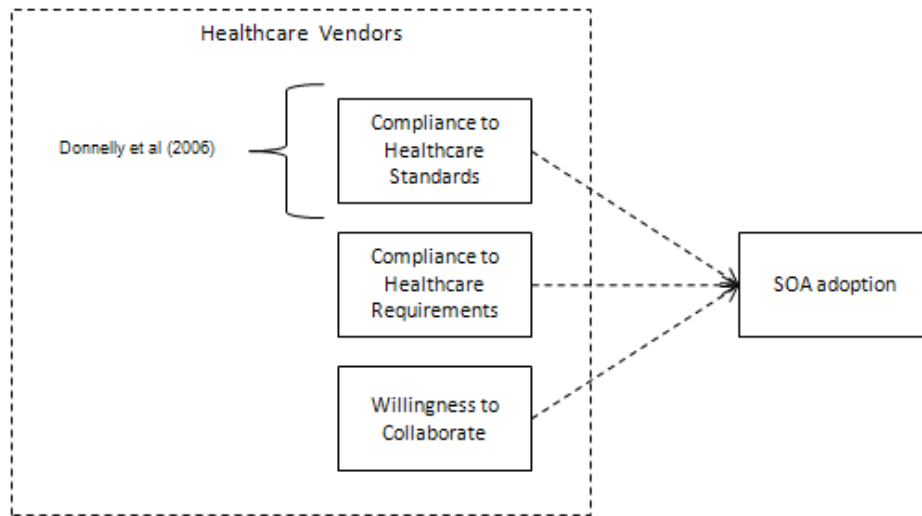
Figure 22 Healthcare Vendor themes related to SOA adoption

Integrating the Healthcare Enterprise (IHE) is a multi-national collaborative of healthcare providers and vendors that are working together to establish an environment for defining and implementing standards-based integration profiles that vendors can implement and certify their solutions against (Donnelly, Mussi, Parisot & Russler, 2006). This imitative and its guidelines are described as a component of the requirements and guidelines established in specialist healthcare's Service Oriented Architecture and should be applied when necessary. Apart from this initiative and literature on interoperability, it has been difficult to find explicit support for the component themes that are visualized in Figure 22.

As far as I have been able to judge there are three alternative interpretations of my findings in this area, either the evidence indicates some 'new' knowledge on how vendors are perceived by specialist healthcare in Norway relating to SOA adoption, or there is an existing body of literature which describes similar findings that I have not been able to find during my review of the literature or that my interpretation of the evidence is 'incorrect'. I have chosen to interpret my evidence as a country specific extension of knowledge presumably existing for this area in the literature.

6.3.13 Stakeholder Benefits

My findings indicate a degree of alignment with the potential benefits described in Chapter 2.5 with some interesting variations most of which I will discuss in further detail in this chapter.

Davis (F.D. Davis, 1989) introduced the Technology Acceptance Model (TAM) to explain and predict user behaviour based on only three theoretical constructs;

intention, perceived usefulness and perceived ease of use. One could possibly argue that Stakeholder Benefits as described in my findings are an aggregated expression of a perception of usefulness of a SOA from the viewpoint of IT. This could therefore be interpreted as similar to the construct of perceived usefulness in the TAM. Venkatesh and Davis (V. Venkatesh & Davis, 2000) later suggested a theoretical extension to the original TAM proposed by Davis (F.D. Davis, 1989) which included job relevance which they found to have a relationship to the construct of perceived usefulness in the original TAM. There seems to be a similarity between job relevance and the theme job functional fit which has been discussed previously. There seems therefore to be some justification for Stakeholder Benefits being suggested as a potential factor influencing adoption of a SOA at the holistic level. However I have also investigated the literature to see if there were any comparable factors found that could give support for the component themes of Stakeholder Benefits.

According to Shah (2005) organizations adopting a SOA should be wary of vague justifications such as improved flexibility. My findings indicate four or more interviewees that listed flexibility and adaptability as a direct benefit of adoption of a SOA. However none of the interviewees gave (or were asked to give) a justification of why they felt that flexibility was an important benefit of the SOA adoption. Shah (2005) recommends that any benefits that are formulated should be measurable either in the context of cost reductions or productivity increases.

According to the literature , information quality as defined by Wand et al (1996) is a pre-requisite for clinicians to make quality decisions which affect patient treatment (Bates, 2000; Kohn et al., 1999; Kubose, Cimino & Patel, 2001; Welzer et al., 2002). My findings seem to be aligned with the literature in this area although it is expressed in two different places; the first being information quality under the theme internal pressures and the second being patient safety under the theme benefits. This could be interpreted as indicating a causal relationship between information quality and patient safety i.e. that low information quality implies a lower degree of patient safety.

Another interesting finding was the absence of benefits of a SOA related to improving the organizations adaptability related to mergers. For example the South Eastern Regional Healthcare Authority is undergoing major transformation at all levels in most of the organizations it consists of. There were no direct indications in my findings that expressed the benefits that adoption of a SOA would give in this area. Indirectly the interviewees may have taken this into account when they related that flexibility and adaptability were important benefits. One possible reason for none of the themes extracted containing a benefit relating to mergers may have been the timing of my interviews and the geographic location of the interviewee. For example organization H1, although being a significant part of the South Eastern Regional Healthcare Authority, was probably not aware of the impact the changes being proposed could have on their organization as the decision to transform Oslo's hospitals to a new organization had not been made at the time of my interviews.

Chaudry et al (2006) investigated the literature to see whether there is evidence that IS has an effect on quality, efficiency, and costs of health care and found that four benchmark institutions had demonstrated the ability of IS in improving quality and efficiency in healthcare which indicates some fundamental support for potential benefits of SOA adoption. Hillestad et al (2005) observe that a homogenous adoption of Electronic Healthcare Record (EHCR) systems in the United States (USA) could potentially transform healthcare in that country and potentially increase cost reductions in the long term. Hillestad et al (2005) also point out that it

is becoming clearer that a lengthy adoption of non-standardized and non-interoperable EHCR systems will delay the transformation of healthcare in the USA. These references indicate support that lowering process cost is an issue that is important to healthcare providers both in Norway and the USA even though healthcare is organized differently in the USA.
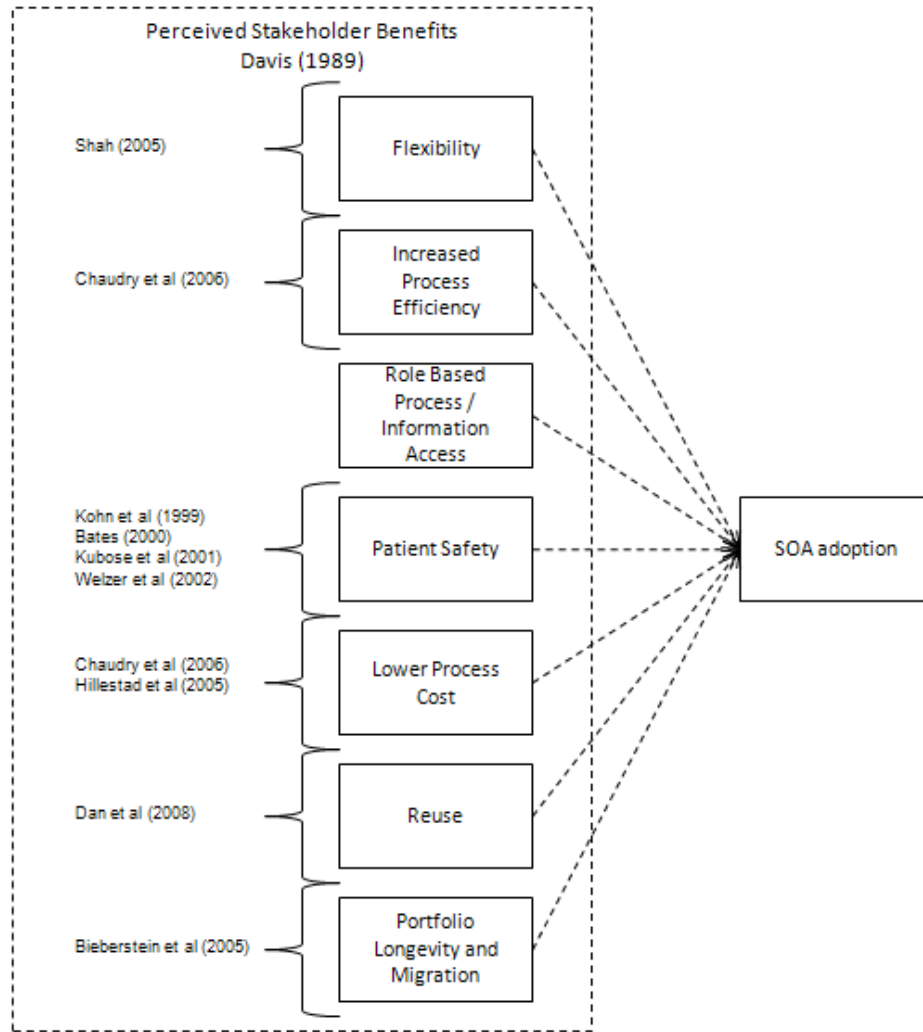
Figure 23 Perceived Stakeholder Benefit themes related to SOA adoption

Another potential benefit which surprisingly was not expressed by interviewees was the ability of a SOA to extend the longevity of the IS portfolio. There were only a few references to this being a benefit in the themes elicited especially in organization H2 which has current challenges in offering clinicians a user-friendly interface that fits the requirements of clinicians. The reason for this being mainly due to the age of it's IS portfolio relating to patient administration.

Another probable benefit which was not described by interviewees was the potential that reuse had for limiting development waste. By development waste I mean the time software developers throw away building the same component over and over again. It seems that each new generation of developers make the same mistakes and build software which has been built before. This could be compared to developing the wheel time and time again. Adoption of a SOA could limit

developer waste by governing the reuse of services built previously. The pre-requisite for achieving such a goal is however the adoption of a SOA and the establishment of SOA governance which is viewed from a holistic and long term perspective. According to Dan et al (2008) service reuse improves agility by allowing the organization to compose new processes more quickly, implies reduction of cost and reduces risks as the services being reused are probably tried and tested through previous usage.

Only two of the interviewees stated functional consolidation as a direct benefit of the adoption of a SOA, but I did not get the impression that they put this in the context of lowering cost. This is surprising when you think of the number of IT systems healthcare organizations have in their IS portfolio and that there is a relatively large probability that there is both data and functionality overlap present in the IS portfolio. Removing such redundancies could potentially imply a large saving for each specialist healthcare organization seen from both an IT and organizational perspective (Bieberstein, Bose, Walker & Lynch, 2005).

In summary the literature seems to indicate support for many of the potential stakeholder benefits observed in my analysis and it seems reasonable to conclude that stakeholder benefits could be a potential factor influencing adoption of a SOA in specialist healthcare in Norway.

6.4 Potential Factors influencing SOA Adoption

During the course of the discussion I have attempted to present arguments from the literature for why I have intepreted each grand theme aggregated from its component themes as a potential factor influencing the adoption of a SOA. However, I have not suggested that the potential factors presented are actual factors affecting SOA adoption as this would require an unprecedented leap of inference which a study of this type cannot support. In addition my area of investigation has only encompassed specific organizations within specialist healthcare in Norway which also implies that any conclusions should be confined to these areas and not be transposed onto any other business sectors that is in the process of adopting a SOA.

I have attempted to visualize in Figure 24, a summary of the potential factors as indicated by my findings and that the literature seems to indicate some support for. The small boxes represent the potential factors suggested by this thesis, while the large box illustrates the phenomenon of SOA adoption. The arrows between the potential factors and the phenomenon indicate a potential influence as indicated by my findings and subsequently discussed in this chapter.

My findings indicate that an organization's SOA expertise could have some sort of influence on the adoption of a SOA. The interviewees have indicated that it is important to have the necessary skills related to SOA governance which includes process modeling and management, information management, IS portfolio management, the Web Service Architecture including security, healthcare standards and integration.

Figure 24 visualizes that the potential factor Organization is indicated as having an influence on the adoption of a SOA. This potential factor includes the business administration model, organizational size, stakeholder support and resource allocation as important elements identified in the interviews.
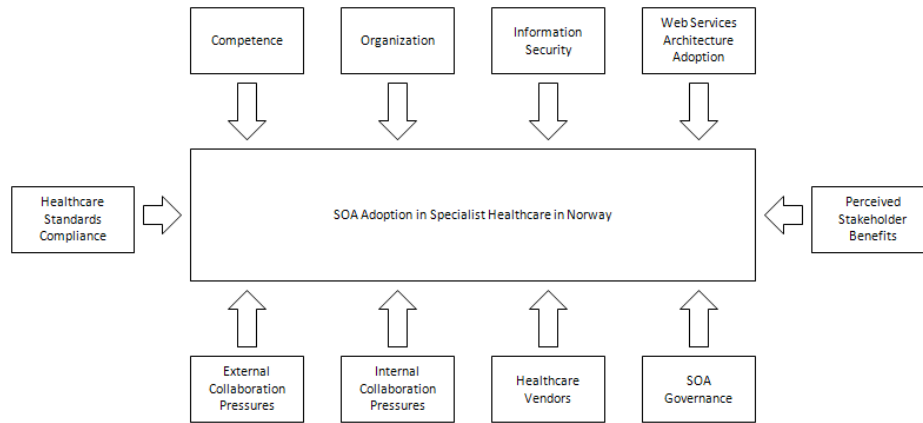
Figure 24 Conceptual framework of potential factors influencing SOA adoption

I have elevated security themes and placed them in a box representing the potential factor of Information Security as my findings have indicated that this issue is perhaps one of the more complex challenges related to the adoption of a SOA and therefore deserves visibility in the illustration. Information Security seems to be more of an issue with a SOA due to the distributed and loosely coupled nature of SOA based collaboration. Information Security seems to consist of multiple layers of security complexity related to relevant healthcare Legislation, Web Services Security, Identity Federation and technical infrastructure security issues.

My findings indicate that the Web Service Architecture is being implicitly adopted by healthcare providers in specialist healthcare in Norway. I have attempted to show a number of elements from my findings that are indicated as being important to the potential factor Web Service Architecture i.e. Identity Federation, Web Service Security and Web Service Management.

Process management, information management and IS portfolio management have been identified as important disciplines relating to the adoption of a SOA. These have then been encapsulated by the concept of SOA governance as a potential factor influencing the adoption of a SOA due to possible implications that SOA governance can have for elements of each of the disciplines mentioned. SOA governance has been implied as very important relating to the adoption of a SOA, but the moving of process management, information management and IS portfolio management should not defer from the importance of these disciplines. Process management has been indicated by the data as being extremely important to consider when adopting a SOA.

There are indications that Healthcare vendors are a potential factor influencing the adoption of a SOA mainly due to the characteristic of the IS portfolio in specialist healthcare providers. As shown most of the IS portfolio of a healthcare provider is dominated by Commercial Off The Shelf (COTS) purchases. The makeup of the IS portfolio therefore seems to imply a dependency on the willingness of healthcare vendors to comply with healthcare requirements and standards also including a willingness to collaborate with healthcare providers even though this could represent a potential competitive disadvantage.

Figure 24 visualizes potential factors Perceived Stakeholder Benefits, External Collaboration and Internal Collaboration pressures as potential factors. The component elements of each of these suggested potential factors all seem to have the characteristic of being drivers for the adoption of a SOA and therefore could possibly influence SOA adoption.

The last potential factor suggested by Figure 24 has been labelled Healthcare Standards Compliance. My findings indicate that this potential factor is in fact two dimensional in that Healthcare Vendors need to be 'nudged' towards standards compliance in addition to any in-house development units operating in specialist healthcare providers. This is one of the main reasons that this potential factor has been visualized directly in Figure 24.

Chapter 7 Conclusion

7.1 Summary

This thesis attempts to answer the research question "What potential factors are influencing the adoption of a Service Oriented Architecture (SOA) in specialist healthcare in Norway?" as a multiple case study using a qualitative, interpretive approach.

My findings indicate that specialist healthcare in Norway is in a very early stage of SOA adoption where provisional guidelines for establishing a SOA have been created at the national level by the N-ICT Board of specialist healthcare. The decision to adopt the SOA described in "A Service Oriented Architecture in Specialist Healthcare" (National-ICT, 2008) has to be endorsed by all specialist healthcare providers due to the nature of the organization and business administration model that has been established by the government for the specialist healthcare sector ("The Healthcare Provider Act," 2001). Also the N-ICT Board is not a judicial entity that has any formal authority over specialist healthcare providers and seems to exercise 'power' by the consensus of the organizations represented on the board. The decision to adopt a SOA has mainly involved IT personnel and not clinicians with the exception of Project P1 which partially involved clinicians in the analysis phase, but not in the actual decision process.

This study is not ground-breaking, but does introduce a conceptual framework of potential factors that could influence SOA adoption. Some of the themes that have been described in this thesis have been aggregated into grand themes, then discussed and labelled as potential factors influencing adoption of a SOA. I have been unable to find any tried and tested factor models pertaining to adoption of a SOA in the literature and have therefore had to 'lean' somewhat on previous research concerned with similar areas in IS such as Enterprise Application Integration, Web Services adoption, Electronic Data Interchange adoption and healthcare informatics when evaluating each grand theme elicited against the literature. I would like to emphasize I have not been in a position of experience to consider the quality of the individual sources where the literature cited was discovered.

I have identified a number of potential SOA adoption factors, but would like to summarize some important conclusions related to a selection of the key findings. This thesis indicates that there are a number of organizational issues that could influence the adoption of a SOA. This has led me to the following conclusions about organization as a potential adoption factor:

1. Specialist healthcare providers are mostly large in size which could imply greater complexity of the IS portfolio where the individual systems need to be interoperable with each other

2. The support of management should be considered if the organization is going to adopt a SOA. This support will probably ensure that the correct competence is built or acquired and that resources have time and money allocated to work on the necessary projects

3. The support of clinicians should be considered if the organization is going to adopt a SOA as they probably have to be able to understand the benefits of allocating their time to the necessary work that has to be done to ultimately achieve the common goals of IT and clinicians

4. The business administration model should be considered and possibly reflect the regime chosen for SOA governance

5. The necessary SOA related expertise and competence should be considered at all levels of specialist healthcare

Of all the grand themes extracted, I would like to emphasize that my findings and subsequent comparison with the literature indicate that SOA governance, including the components of process-, information- and IS portfolio management seems to be extremely important to the adoption and diffusion of a SOA. My findings give some indications for the following conclusions on process management:

1. There are indications that process management is an important discipline to consider if it is required to establish a holistic approach to IS support in specialist healthcare where process ownership is key

2. There seems to be some serious challenges to establishing a process management discipline in healthcare providers due to the difficulties of finding a process ownership model that is well fundamented with clinicians

3. A process management discipline should consider a working method and notational standards that can be used throughout the organization

4. A process management discipline should consider how to ensure that process descriptions are always current and thereby trustworthy

My findings also indicate the following possible conclusions related to IS portfolio management:

1. Specialist healthcare providers seem to have a history of purchasing IT systems on a departmental level without necessarily taking a holistic perspective on support for processes across individual organizational units and external organizations

2. The above has seemingly led to the current situation where the IS portfolio is characterized by many monolithic systems that do not have the necessary level of interoperability to be able to support intra- and inter-organizational processes well

3. Purchasing continues concurrently without a holistic governance regime

4. It is probably necessary for specialist healthcare to continue investing in specialist IS as there is no one solution indicated that fits all healthcare processes in specialist healthcare

5. A monolithic IS portfolio implies redundant data entry which seems to lead to more work for clinicians and a general lengthening of process cycle time

6. All of the circumstances above seem to indicate the importance of a IS portfolio management discipline that ensures management of IT investments, that the investments are planned thoroughly and coordinated in a holistic perspective at the national, regional and healthcare provider level

Based on my findings I have concluded the following for information management:

1. It is important for healthcare providers to have a common management model that controls how information should be

managed, interpreted and used in specialist healthcare. The reasoning behind this is that information quality is important to clincians i.e. that information should be semantically correct and available at the right time

2. A high level of information quality is necessary for clinicians to be able to make the right decisions that could ultimately influence the patient's healthcare experience

The characteristics and goals of SOA governance as indicated by the literature seems to imply that a common governance model for a SOA needs to view process management, IS portfolio management and information management from a holistic perspective to be able to exploit the necessary decision and planning processes that ensure that healthcare providers achieve their goals. This conclusion indicates that SOA governance might be a potential factor that should encompass the disciplines mentioned as separate but inter-dependent elements.

This thesis also includes indications that some specialist healthcare providers have already adopted a few selected SOA enabling technologies such as defined by the Web Service Architecture. There are indications in the literature that the Web Service Architecture currently defines a commonly accepted standard of interoperability that enables support for inter-organizational processes and information sharing across security domains. Based on my findings I have concluded that the Web Service Architecture as a SOA enabling technology is a potential adoption factor due to the following:

1. Functional specialization of specialist healthcare is leading to an increased requirement for inter-organizational collaboration

2. Inter-organizational collaboration requires secure, realtime information sharing between healthcare providers at the process level

The last key finding that I would like to conclude with is related to healthcare vendors. Interviewees in specialist healthcare providers indicated dissatisfaction with their healthcare vendors which has lead me to conclude the following about this potential factor:

1. Much of the IS portfolio of healthcare providers has been purchased from commercial healthcare vendors (COTS)

2. There is an indication that healthcare vendors wish to bond healthcare providers as tightly as possible by 'owning the desktop' and view this as a strategic competitive advantage

3. There are indications that specialist healthcare providers should enforce healthcare vendor compliance by active application of the SOA defined nationally, if they are going to be able to achieve the benefits of a SOA

4. Healthcare vendors should collaborate with specialist healthcare even if it seems initially subversive to their own competitive advantage, and comply with the common SOA defined at the national level to make sure that their customers – specialist healthcare - achieves the benefits promised by the adoption of a SOA

To conclude this summary, this thesis indicates that specialist healthcare providers consider the adoption and diffusion of a SOA as the most significant alternative available for solving some of the current IS challenges they are facing, potentially

delivering benefits to clinicians which may ultimately improve patients' experience of specialist healthcare. However this assessment should be tempered by a deeper understanding of the complex issues indicated, so that a thorough plan of action can be considered.

7.2 Possible Limitations of this Study

There are a number of limitations to this study which firstly includes the circumstance that I did not interview any clinicians or clinicians with an IT background. This could mean that this study has a certain bent towards IT that does not take into account the firsthand worldview of clinicians, but only assumptions made by IT based on their interpretations of the clinicians worldview. It would probably have been of value to interview clinicians to get a better understanding of how adoption of a SOA could help them overcome their daily challenges. However, including clinicians in a study of this type would probably require a different interview approach if the same type of research design was chosen.

There are a number of other healthcare organizations that have been mentioned, but not selected for interviews for example the Norwegian Centre for Informatics in Health and Social Care and Patient interest organizations. These other organizations could have had some valuable bearing on my research question. A similar limitation is that I did not interview any large national or international software vendors such as DIPS AS. A software vendor would probably have shed some light on how they see the world of SOA in specialist healthcare and how they are preparing to address their own offerings in the future for example in the context of IHE, healthcare standards compliance and migration of their existing products to the new architecture.

7.3 Possible Implications for Future Research

This thesis seeks to extend the literature with a further understanding of the potential factors influencing SOA adoption specifically within the healthcare sector in Norway. It may be valuable to consider extending this work by abstracting the potential factors from the specifics of healthcare into a more general framework of potential adoption factors thereby establishing the fundament for a potential theory which can be tested through hypotheses formulation and testing.

This study could also possibly form a starting point for a quantative or a qualitative study where it should be possible for a researcher to evaluate the proposed potential factors influencing adoption of a SOA in specialist healthcare and formulate hypotheses that can be tested.

7.4 Possible Implications for Practitioners

Practitioners in the healthcare sector may find this thesis useful as an advisory tool when their customers and managers need to make decisions on how to approach adoption of a SOA in their organization. The results from this study could possibly also be used to formulate a number of actions that need to be addressed if the organization wants to ensure success in its adoption and diffusion of a SOA in the healthcare organization. However it is important to note that one should be cautious on interpreting the findings presented in this thesis as they are only relevant to one segment of the healthcare sector i.e. specialist healthcare and should not be used in a general way.

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Appendices

A. Interview Guide

Interview structure and questions

" Factors influencing adoption of SOA technologies"

Act II - Spørsmål 2

- Hva er bakgrunnen og formålet for initiativet?

Act I

- Hvem er jeg?
- Hvorfor ønsker jeg intervjuet?
- Hvilken rolle har jeg?

Act II - Spørsmål 3

- Hva består SOA initiativet av?

Act II - Spørsmål 1

- Har virksomheten eller prosjektet noen SOA initiativ?

Act II - Spørsmål 4

- Hva er din involvering og dine perspektiver på SOA initiativet?

1

Act II - Spørsmål 5

- Hvilke interessenter er påvirket av SOA initiativet og hvordan?

Act II - Spørsmål 8

- Hvilke 5 kritiske suksessfaktorer er identifisert for SOA initiativet?

Act II - Spørsmål 6

- Hvilke målsettinger har SOA initiativet og hvordan ser man for seg at man skal nå målsettingene?

Act II - Spørsmål 9

- Hvilke 5 barrierer er identifisert for SOA initiativet?

Act II - Spørsmål 7

- Hva skal man bruke SOA initiativet til?

Act II - Spørsmål 10

- Hvilke 5 gevinster forventer man å få ved gjennomføring av SOA initiativet?

2

Act II - Spørsmål 11

- Hvilke 5 utfordringer forventer man å få ved gjennomføring av SOA initiativet?

Act II - Spørsmål 14

- Hva har man lært av SOA initiativet som gjennomføres / er gjennomført?

Act II - Spørsmål 12

- Hvilke teknologier anser man som kritiske ifb. gjennomføring av SOA initiativet?

Act III - The End

- Summary of the process moving forward

Act II - Spørsmål 13

- Hvilke teknologier har man anskaffet ifb. med SOA initiativet og hvorfor?

3

B. Sample Interview Transcript

Virksomhet   : N/A
Intervjuobjekt : N/A
Rolle   : N/A
Dato   : N/A

Q: Kan du si gi en kort beskrivelse av Helseforetak A og din rolle?

A: Min rolle er å være IT arkitekt på Helseforetak A sykehus dvs. at jeg har ansvaret for – hva skal man kalle det – de systemstrukturmessige vurderingene på sykehuset. Egentlig å utarbeide eller få utarbeidet vurderinger rundt sammenhengene og integrasjonene mellom systemene, teknisk og arkitekturmessig forhold mellom systemene ift. IT strategiaspektet. Det vil si ivareta at informasjonsflyten mellom systemene er så veldefinert som mulig. At det er tydelig hvilke systemer som eier hvilke data, at vi ivaretar den fleksibilitet vi kan i arkitekturen. Det slår meg nå at vi burde ha laget noen teser for arkitekturen på Helseforetak A sykehus. Samt at jeg har for tiden et operativt ansvar for gjennomføring - design og implementasjon av integrasjonene mellom systemer. Det er et ansvar som jeg skal vekk fra. Det skal komme en ny leder som for så vidt vil ligge og rapportere under min rolle en stund, men…et hakk vekk fra det rene operative. Den strategiske utviklingen av hvordan systemene skal samhandle er vel en enkel oppsummering av hva jeg prøver å jobbe med.

Q: Nå er det sånn at jeg i denne fasen har ikke lagt noen føringer i hva man legger i SOA.

A: Så jeg definerer SOA sett fra Helseforetak A. Vi betrakter – vi har en slags forankret ide om at vi skal tenke tjenesteorientert – litt forenklet er den ideen sterkest forankret hos meg. Og så er det hos Ola en aksept for at det er en god ide, men…Det som er godt forankret på sykehuset er ideen om en slags "best of breed" tankegang og med at man skal kunne kjøpe den komponenten som utfører den jobben man trenger best mulig og at de skal kunne samhandle. Det er en sånn best of breed på komponentbasis – utskiftbare komponenter fra komponentbasert systemutvikling er veldig sterkt forankret i hele organisasjonen tror jeg. Da inkluderer jeg ikke akkurat sykehusets ledelse for de forholder seg ikke på det nivået i det hele tatt. Ut fra den er det en påbygning om en ide om en tjenesteorientering. Det ligger nok godt i en diskusjon sånn på konsern IT, men man kan alltids diskutere hvor mye ut fra her en sånn ide er forankret. Man kan også selvfølgelig diskutere hvor viktig det er at det er forankret utenfor en strategisk ledelse av IT også.

Men vårt forhold til tjenesteorientert arkitektur går på å kunne klare å etablere – eller at systemene skal kunne eksponere og konsumere et sett veldefinerte tjenester som samsvarer med prosesser eller aktiviteter innenfor sykehusets arbeidsprosess. At man skal ha best mulig alignment mellom IT og forretning og det går at integrasjonsgrensesnittene våres skal i stor grad kunne reflektere en funksjon som noen gjør. Når vi integrerer på pasientinformasjonsiden, så snakker vi om en innleggelse, en utskriving, en overføring eller et annet veldefinert begrep i sykehuset. Vi legger ikke integrasjonsgrensesnittene på noe annet type nivå. Det er den ideen vi har ift. tjenesteorientert arkitektur. Det er mer teknisk diskuterbart om det er hendelsesdrevet eller request / respons drevet. Vi er ikke veldig interessert i den. Det vil være andre…Hvis man ser på innleggelser da, tjenesten innleggelse

utføres i PAS. I tillegg som konsekvens av at noen er lagt inn, oppstår det en hendelse som er 'pasienten er lagt inn' som masse systemer skal agere på. Å ha den tjenesten og de korresponderende hendelser er en del av vår tjenesteorienterte tankegang uten at man diskutere om den ene er en SOA eller den andre er en EDA (Event Driven Architecture). Vår tjensteorientert arkitektur forholder seg til de to konseptene. Jeg vet ikke om det var en omtrentlig rimelig svar på spørsmålet?

Q: For å klargjøre tankene mine, kan en si det sånn at hvis en skal gå spesifikt på tjenestedefinisjonen at tjenesten er litt avhengig av hvem som ser på det – om du står innenfor tjenesten eller om du står utenfor tjenesten? Jeg fikk inntrykk av at du satt likhetstegn mellom en arbeidsprosess, en tjeneste og en funksjon?

A: Ja, en tjeneste er veldig generisk. En tjeneste kan på laveste nivå sammenfalle med en aktivitet eller en funksjon. På det høyeste nivå kunne den faktisk reflektere en arbeidsprosess. Nå føler jeg at vi er nok mer på definisjons aktivitets, sub-prosess nivået i vår tjenestedefinisjon….tjenester vi forholder oss til hvis vi skal kalle det det enn vi er på arbeidsprosessnivået. Men konseptuelt klarer ikke jeg helt å se - den ene tjenesten er bare en aggregering av andre tjenester. Det bygger opp på hverandre sånn en bygger en prosesshierarki da. Også kan man selvfølgelig diskutere på hvilket nivå disse tjenestene er mest fornuftig modellert. Hvor høyt oppe er det interessant å ha IT støtte for dem. Jeg vet ikke om du kommer tilbake til den type ting etter hvert? Vi er ikke gått veldig langt inn i overgangen fra prosessmodellering til automatisk eksekvering av prosesser i en BPM / BPEL kontekst. Der er vi ikke bare, rett og slett.

Q: Ift Helseforetak A, har dere noen prosjekter i Helseforetak As regi eller involvert i noen prosjekter som vil kunne påvirke Helseforetak A og som kan kalles for SOA initiativ? Nå tenker jeg i vid forstand.

A: I det store bildet så gjør vi Nasjonal IKT sitt Nasjonal systemarkitektur prosjekt som har som en målsetning å utarbeide første rammene av en nasjonal systemarkitektur innenfor informasjonsmodell, prosesser, teknologi og sikkerhet, samt noe rundt arbeidsflate portal. Det prosjektet har en vedtatt grunntanke at det skal være basert på tjenesteorienterte prinsipper. Sånn sett vil Helseforetak A bli påvirket av det. Vi er som deltager og pådriver for at det prosjektet blir gjennomført veldig innstilt på at det som kommer ut der – det skal vi ta i bruk.

Q: Hvordan kom dere fram til at SOA tankegangen skulle ligge i bunnen av leveransen fra arkitekturprosjektet?

A: Av de meningsberettigede…eller… I den arkitekturgruppen som dette er tatt utgangspunkt i kanskje hvis man ser. Av deltagerne i arkitekturgruppen har det vært en konsensus at man skulle basere seg på tjenesteorienterte prinsipper som har kommet med i prosjektet. Det har aldri vært drøftet om det skulle være sånn eller ikke. Det har vært en underliggende implisitt sannhet. Det som er en sak som nå kommer til å komme opp i det prosjektet, er at vi mens jeg har en tanke om hva som er en tjenesteorientert arkitektur som vi snakket om i stad – vi var innom å kanskje ikke skille mellom om det er tjenesteorientert eller om det er hendelsesorientert – så er det andre i det prosjektet som ikke er nødvendigvis helt enig i den måten å tenke på – at det er en forskjell mellom en hendelse og en tjeneste. Og som ønsker å eksplisitt uttrykke det i større grad enn det jeg mener er fornuftig. Det er en diskusjon som en ennå ikke har tatt. Ift det prosjektet er det noen detaljer i bruk av SOA begrepet og må presiseres etter hvert som prosjektet går frem. Nå er vi foreløpig i en så tidlig fase at det ikke er tema å presisere den. Vi

identifiserer prosesser og tjenester i øyeblikket. Vi er ikke på et implementasjonsnivå hvor det er interessant å diskutere akkurat - hvilken siden av denne tjenesten er jeg i øyeblikket.

Q: Ut fra andre som jeg har vært i kontakt med, har jeg forstått at de fleste deltagere i arkitekturprosjektet er teknologer. Du nevner at dere har kommet fram til en konsensus om at SOA er en fornuftig vei å gå. Hvis du skulle prøve å se dette fra klinikerens ståsted, vil du tro at de har en mening om den foreløpige konklusjonen?

A: Et godt spørsmål. Dersom det hadde vært klinisk representasjon i den gruppen…den problemstillingen kommer nå til dels til å komme opp tror jeg. Vi gjør et samarbeid mellom arkitekturgruppen og nasjonal fagforum for elektronisk pasientjournal og i den gruppen er det en vesentlig grad av klinikere samt rådgivere som har jobbet veldig klinisk orientert. Der vil man kanskje ta opp den diskusjonen – hvorfor tjenesteorientering – man har ikke tatt diskusjonen om hvorfor selv om alle som kommer inn der med deres teknologisk bakgrunn mener at det er en fornuftig måte å strukturere systemarkitektur på. Men jeg tror at en tjenesteorientering på mange måter er den enkleste måten for en – nesten det er ikke helt sant – vil være en gjenkjenbar måte for en kliniker å forstå en arkitektur på. Hvis man tenkte seg en klasissk komponentbasert eller hub and spoke modell med bruk av proprietære formater og mappingmodeller, vil det være vanskeligere forståelig. Da vil modellen være mye mer teknisk og lenger unna klinikere. De kan være med lenger inn i systemdesignet i forståelsen av en tjenesteorientert arkitektur enn kanske andre mer…

Q: OK. Hvorfor? Hva er det som er sammenfallende fokus for de to gruppene?
A: Jeg tror at du får en abstraksjonsnivå ift. teknologi og implementasjon ift. teknisk detaljer som er styrende som er lavere da. Hvis man skulle tenke seg en mer tettere koblet, komponentbasert design så ville du få flere diskusjoner av typen transaksjons…

Q: Jeg skal stille spørsmålet på en litt annen måte. Hva er det som kan enklere få til en felles forståelse om den arkitekturen? Hva er felles nevneren mellom klinikerne og teknologene i denne sammenhengen?

A: Fellesnevneren går på at man får en informasjonsmodell og en tjenestemodell som bruker begreper – en ontologi – som er forankret begge steder, mens man i en annen mer sånn teknisk orientert grensesnitt. Et eksempel i denne sammenhengen – i stor grad bruker vi HL7 for en god del integrasjoner. HL7 er en god, gammeldags klassisk meldingsorientert standard der en alikevel har modellert etter prinsipper som er tjenesteorienterte ift en veldefinert innleggelse / utskriving osv. Mens hvis du snakker HL7 med klinikere så går rullegardinen rett ned. Hvis du snakker ADT01, så er det ikke noen hjemme for å diskutere den. Men hvis du klarer å forholde deg til en planlagt aktivitet og dette er en pasient, pasienten har et navn sånn og sånn, så kan vi være med å snakke sammen om dette til et helt annet nivå av... Vi kan sikre at man er omforent om hvordan dette skal henge sammen i mye større detalj enn at man forsvinner inn i standarder.

Q: Er det riktig å si at det er prosesssene, arbeidsprosessene på et eller annet nivå som er den fellesnevneren som dere kan ta utgangspunkt i?

A: Jeg er litt usikker. Ja, på en måte er det da prosessene. Er prosessenes aktiviteter som er fellesnevneren eller er det prosessen i seg selv? Det skille er litt uklart for meg, men ja. Hvis vi kaller det prosessene så er det...

Q: Det kommer vel litt an på hvordan dere definerer prosess? Hva dere legger i prosess?

A: Ja, ja på hvilket nivå definerer du en prosess. Hva er en aktivitet.

Q: Du har nevnt N-IKT prosjektet.

A: Ja så var det Helseforetak A spesifikk aktiviteter. Vi har ingen interne prosjekter som kan på en måte defineres som SOA prosjekter som en del andre typiske bedrifter har – vi skal til SOA verden, la oss ha et SOA prosjekt. Jo men det er mange som har det. Det kan til og med hende at det er en god ide å bruke energi på å tenke hva man mener med SOA. Noe av en SOA tankegang vil jo kreve at man gjør en investering i infrastruktur kanskje. Vi har nok en litt mer pragmatisk holdning til at vi sier – der hvor vi skal ha integrasjoner og vi er i stand til å påvirke hva de skal gjøre – så ønsker vi å… Ska vi ha tjenesteorienterte konsepter i bunnen? Man kan jo si at det er SOA tilnærmingen, samtidig kan man si at parallelt med det ønsker vi å forholde oss til mest mulig grad av standard bruk. En gevinst har vært her er å begynne å bruke HL7 som er modellert den gangen iht. prinsipper som samsvarer med SOA ganske godt, mens jo ikke bruker dagens SOA mekanismer sånn teknisk, men bruker "piped" dokumenter med en egen ASCII basert protokoll på toppen av TCP. Så det er liksom ikke – det er ikke akkurat veldig Web Service kompatibelt per i dag, men det er utrolig stabilt. Det er en veldig veldefinert grensesnitt. Det er lett å mappe mot et system – selv mot et system som ikke har HL7 som utgangspunkt – men som gir hendelser på hva som skjer. Så er det så å si en en til en mapping mot disse HL7 hendelser. Vi måtte balansere mellom dem og det at noen har sagt at HL7 er en del av vår SOA satsning – det er kanskje litt i gråsonen for hva en SOA purist ville akseptere, men vi mener at det skalerer såpass bra og er såpass effektivt. Det bringer oss dit vi vil da. Gjenbrukbart. Vi må se på gevinstene i andre enden og gevinsten er at vi skal bruke disse tjenestene mange ganger.

Q: Hvis vi går litt tilbake. Vi kommer tilbake til gevinster etter hvert. Hva er bakgrunnen og formålet til N-IKT systemarkitekturprosjektet?

A: Bakgrunnen for prosjektet ble etablert før min tid. Det ble startet som en del av – når Nasjonal IKT ble opprettet - det ble satt opp en del tiltak. Da ble det besluttet at det skulle gjøres noe – en utredning – på arkitektur. Arkitektur for et prosjekt som var ganske åpent tror jeg. Jeg må innrømme at jeg ikke har lest mandatet så det er jeg faktisk ikke sikker på. Det forprosjektet konkluderte med at det var fornuftig å utarbeide den nasjonale systemarkitektur og jeg tror allerede der at det ligger noen ideer om at det burde basere seg på en tjenesteorientert tankegang. Så jeg trur det også kommer gjennom det forprosjektet.

Q: Legger en den samme definisjon av systemarkitektur som en legger i SOA?

A: Hvordan man definerer systemarkitektur tenker du?

Q: Altså om man bruker begge begreper om…

A: Når man sier nasjonal systemarkitektur. Hvorfor man bruker akkurat systemarkitektur i stedet for IT arkitektur eller noe annet, det er jeg ikke helt sikker på. Det er nok arv – at man har tenkt nasjonal systemarkitektur…Vi ville vel etter vår ordbruk på Helseforetak A ha kalt det for en nasjonal IT arkitektur. Systemarkitektur er nok litt systemorientert – et system, en systemarkitektur eller et systemområdet, en systemarkitektur kanskje. Mens det vi egentlig snakker om her er en slags IT arkitektur for spesialisthelsetjenesten. Når prosjektet startet har det vært veldig fokusert rundt arkitekturen for interne systemer innenfor et foretak – være som om det er lokalt eller regionalt. I liten grad tenkt på samhandlingsmekanismer selv om det nok kommer til å komme med nå – en kommer til å se definisjon på tjenester, se på protokoller og mekanismer for å kunne få en samhandling mellom foretakene så har formålet vært det interne – vår alle felles utfordringer. Alle har integrasjon mellom PAS, EPJ og RIS/PACS. Alle har integrasjoner mellom…Vi bruker ulike mekanismer og prinsipper eller varianter basert på hva som er tilgjengelig av ressurser i det enkelte foretak, og hva som er prioritert i øyeblikket. Sånn at formålet har egentlig vært å ønske å ha en felles front mot leverandørene når man skal utarbeide ting så gjør man det på den samme måten – man har de samme grensesnittene og de samme tjenestene definert på systemene. Vi har vært veldig introvert tenkende i prosjektet.

Q: Er det noen eksterne faktorer som er drivere for de prosjektene som du har beskrevet?

A: Hva tenker du på?

Q: Det kan for eksempel pålegg, leverandører osv

A: Det er nesten litt omvendt. Ift. eksterne faktorer i og med at vi stort sett kjøper systemer der leverandørene har et ønske om levere komplette pakker – levere sykehuset nærmest – så er min følelse at leverandørene i veldig liten grad og i hvert fall hvis vi snakker om de norske da, tenkt på et arkitekturløp før de har blitt tvunget til det. Det å integrere mot andre systemer er…Man har laget noen integrasjonsgrensesnitt fort og gærnt fordi man har trengt det litt hist og litt her. Litt av det her og litt av det her uten at det har vært noe samsnakk. Jeg er overrasket over hvor lite leverandørene har tenkt gjenbruk av sine integrasjonsgrensesnittene på tvers av alle foretakene. Og hvor lite likt det er på tvers av alle foretakene. Det er mer kommet som et dyd av nødvendighet for å klare å temme trollet internt på de litt store miljøene. Behovet for å integrere spesialistmoduler inn mot sentrale systemer som kanskje har vært driveren som et internt oppstått behov. Det eneste eksterne pålegget som er en slags driver som er en utfordring vi har nå er knyttet til disse kvalitetsregisterne – nasjonale kvalitetsregisterne - som det er kommet en drøss av og som ingen har en ide av hvordan man skal få til å henge sammen inn i sykehuset. For det er ikke noen…Hvordan skal de få dataene sine og hvordan skal de få rapportert dataene nasjonalt og hvordan skal vi unngå at klinikerne sitter og dobbeltregistrerer i alle mulige rare kvalitetssystem. Så der er det en driver fra – det er en ekstern driver for å få etablert en god arkitektur, men arkitekturløpet var i gang før den bølgen – at man tok innover seg hva den bølgen betyr. Man kan vel si at det bare tydeliggjorde at man kanskje bør har startet arkitekturløpet enda tidligere. Den har vel ikke i seg selv iverksatt noe.

Q: Du sier at dere har noen utfordringer ved å hekte dere på pålegget – disse kvalitetsregistrene. Hvilke hindre er det dere ser? Hva er problemet?

A: Problemet er at …Jeg er litt usikker på akkurat hvor mange kvalitetregistre det er. Det er i alle fall et tosifret antall pluss Kreftregisteret og noe hist og her. Og alle de registrene skal i det minste ha pasientens personalia som et absolutt minimumsinformasjon. Det ville si at hvert av de systemene må integreres med de respektive PAS rundt omkring inne på alle foretakene. Og i tillegg er mesteparten av den informasjonen som står i de registrene – det finnes allerede registrert et annet sted. Ganske mye løpende tekst, men overraskende mye strukturert registrert. Og det kan de ikke nyttiggjøre seg, rett og slett…For det første fordi det ikke finnes noe nasjonalt grensesnitt det kan forholde seg til – tjenesteorientert eller ikke tjenesteorientert. Det finnes ikke noe. Den andre problemstillingen er at den muligens må ha noen identiteter som den ikke har f.eks at det må forholde seg til forløp som ikke nødvendigvis er veldefinert andre steder.

Q: Når du sier identitet, er det knyttet til nøkler eller..?

A: Du kan ha noen pasienter som er behandlet for flere ting samtidig og det kan være et behov for at et sånt kvalitetsregister at det er informasjon knyttet til kreftdiagnosen – at det er muligens registrert informasjon på det nivået. Om ikke i dag så i alle fall fremover. Det er ikke sikkert at det er et problem akkurat nå. Det vil kunne få problemstillinger rundt f.eks. å hente maks og min verdier av blodprøveverdier innenfor forløpet og da er man nesten nødt til å vite når forløpet startet og sluttet. Sånn som det skjer i dag så er det en sykepleier når de registrerer det i kvalitetsregisteret så må de slå opp det da. Så må de slå opp når pasienten kom inn, når ble den skrevet ut og hva var maksverdien – se på alle blodprøver for den perioden og maksverdien og føre det over og minverdien og føre det over. Kanskje står pasienten på ulike typer medisinering, ikke sant, så må man slå opp i…for de foretakene som har et medisineringsmodell, de så må man slå opp i medisineringssystemet og se før man fører det opp i kvalitetssystemet. Det er der hovedproblemet med den type kvalitetsregister, vi har ikke noen mulighet til å hente.

Q: Hvis jeg har forstått deg riktig er det to hovedområder som du peker på som mulige hindre og det går på prosess og integrasjon. Er det noen infrastrukturmessige hindre?

A: Ift kvalitetsregistre?

Q: Ja ift. samhandling med kvalitetsregistrene fra helseforetakenes fagsystem.

A: Ja og nei. Det er igjen et problemstilling at man har ikke en – en felles arkitektur for de systemene heller. De blir tildelt de ulike regionene basert på mer sånn …hvis Nord tar de tre, Vest tar de tre så tar Sør-øst tar disse. Så har det vært opp til hver av regionene å lage disse systemene og noen har laget en nettsentrisk løsning og det fører med seg noen arkitekturmessige utfordringer ift. å få de til å henge sammen. Da er det så å si umulig å få de tett integrert, mens andre har laget desentrale løsninger hvor det er problemstillinger knyttet til innrapportering. Så ja det er en utfordring, men akkurat hva som er utfordringene er litt vanskelig å gå inn på og si noe generellt uten å gå inn på hvert enkelt register.

Q: Så det er ikke noe du kan generalisere utfra sikkerhetsutfordringer, lover osv?
A: Nei, det er også tatt et initiativ for å samle de registrene så i stedet for at man skulle fordele at hver mann tar ansvar for sitt register så går det en aktivitet for å etablere en arkitektur for alle registrene og konsolidert sånn at det er ja – en eller to eller tre leverandører av registere som må være konforme til en arkitektur og som

må kanskje – ja si at du har en utviklingsleverandør av registere som står for utvikling av visse deler av det, så har driftsleverandøren som hoster alle registrene sånn at ja…Registrene er mer et eksempel på en ekstern driver for behovet for en felles arkitektur – en SOA. Det kom sånn etterpå at det hele var i gang som en bekreftelse på at det man gjorde var bedre sent enn aldri.

Q: Kommer du på noen andre eksterne drivere?

A: Jo, mens vi er i gang. Vi har en trend på en heving – hva skal man kalle det – flytting av tjenester. Hvis du får en nasjonalisering av et sett med tjenester og det er klart at man kan tenke seg basale infrastrukturtjenester alla Folkeregisteret, ditt rekvirentregister eller HER da, hvor man vil se et arkitekturmessig behov for å først etablere noe som er eller – hvor lokasjon av tjenesten er egentlig burde irrelevant. Man trenger et design som ivaretar det hvor man starter lokalt så kan du si at jeg forholder meg til det lokale , det regionale – det er ikke så innmari viktig. Du vil se det på de registrene – Folkeregisteret, Nødnummertildeling, du vil kanskje se det på – man burde se det når man kommer til kjernejournal aspektet, så vil man se det på kav(?) informasjon bla. der du vil få en lokal nasjonal sak på. Så det er nok noen sånn type drivere også som driver behovet for en nasjonal arkitektur og behovet for en tjenesteorientering. Litt av begge deler. Først arkitektur så vil man se at det løses bedre med en tjenesteorientering dersom de er lokasjonstransparent. Det helt sikkert ikke lokale i betydning av å være en del av samme prosess, de er helt sikkert distribuert et eller annet sted. Om det er her eller der eller nasjonalt – det er ikke så viktig.

Q: Jeg trodde at det var litt av poenget med SOA at man kunne skjule…?

A: Jo du skal kunne skjule men du skal ikke kunne skjule ned til det tekniske – den er remote.

Q: Det skal vel ikke spille noen rolle hvor tjenesten befinner seg for å kunne realisere SOA tankegangen?

A: Nei.

Q: Hva med interne drivere hvis du ser på Helseforetak A isolert sett?

A: Jeg føler at jeg startet med de interne. Problemstillingen på et sykehus, på alle foretakene er det at vi sett ift. våre IT budsjetter i veldig liten grad driver med noe særlig utvikling. Vi driver primært anskaffelser. I varierende grad vil foretak – når jeg snakker om foretak mener jeg enten helseforetak eller regionen – noen driver med litt utvikling, noen driver ikke med utvikling og noen driver med masse utvikling. Men generelt – hovedsystemene kjøpes stort sett. Altså Helseforetak A har utviklet sitt PAS men den ble skilt ut i 2003 som en egen sjappe sånn at man har et kunde / leverandør forhold til. Sånn sett det å integrere større eller mindre grad av standard pakker er både foretakets utfordring og det har nok vært mange som har overlatt det til leverandørene med vekslende hell både ift oppgraderinger og kostnader ved utskiftinger samtidig som at behovet for integrasjon – ønsket om å slippe å taste pasientens navn og adresse hele tiden er stadig økende. Når legen har sittet med sin egen lille Access database med sine ytterst få pasienter så har man måtte akseptere det, men plutselig så har systemet deres vokst seg større enn dem og så har ikke den funksjonaliteten blitt akseptabel. Så har man anskaffet nye systemer som det forventes skal henge sammen med resten. På mange måter kan man si at det er et forståelig minimums krav da de ønsker. Men kostnadene ved

integrasjon har utviklet seg til å bli signifikante ift. prosjektets størrelse og i og med at det er mange små – det kan være prosjekter i størrelse av en halv million kroner så koster det trehundre tusen kroner å få basis sett av data integrert. Det er klart at det er en intern driver.

Q: Du peker på anskaffelser som en mulig faktor som har en rekke konsekvenser som driver behovet for å integrere. Og min tolkning er at du setter en del likhetstegn mellom integrasjon som veldig viktig for foretaket og det at det også en driver for å få etablert en SOA. Er det riktig tolkning?

A: Integrasjon i anskaffelser som…

Q: Du gjør en anskaffelse som medfører integrasjonsarbeid og integrasjonsløsninger. Er det riktig av meg å tolke deg dithen at du setter likhetstegn mellom integrasjon og SOA? For å snu på det, hvis vi etablerer SOA så er en av gevinstene det at vi har etablert en arkitektur som har ivaretatt integrasjonsbehovet og arbeidet vi må gjennom alikevel?

A: Jeg vil ikke si at vi ivaretar integrasjonsarbeidet, men du får en struktur…Gjennom SOA har du etablert en integrasjonsinfrastruktur som forhåpentligvis er mer veldefinert og gjenbrukbar sånn at kostnadene knyttet til en ny oppkobling går ned ift. det du har i dag. Du har etablert den på en måte – dette er det vi forholder oss til ift. informasjonsinnhold og tjenestedefinisjon – i all enkelhet ift format og protokoll. Dette er rammene til den integrasjonen og det er fortrinnsvis definert på vår side og forhåpentligvis kjent på andre siden. En diskusjon i arkitektur sammheng kunne være at man kunne definere sin elegante SOA med veldig fine tjenester men det er klart at hvis man ikke selv styrer andre siden – det er ikke et utviklingsprosjekt som pågår hos oss, men et utviklingsprosjekt hos Siemens i Tyskland og vi er av dens 5312 kunder – hvis den (Siemens) ikke engang har en forståelse av vår arkitektur, så har SOA ingen verdi heller. Hvis ikke jeg kan påvirke konsumenten av tjenesten til å faktsik bruke dem så har det ikke innmari høy verdi. For å referer en tidligere kollega – Anders Føyen – "Et IT system som ingen bruker, er et ganske verdiløst IT system".

Q: Er dette noe som påvirker deres tenkning ift. det å ta i bruk SOA?

A: Ift Nasjonal Systemarkitektur prosjektet, er jeg vel en av forkjemperne for – man skal nå definere en SOA, men samtidig – jeg ønsker at den SOA skal mappes mot en eller annen form for internasjonal standard. Jeg tror ikke at - vi kan godt definere opp f.eks. Web Service basert SOA i Norge, den norske nasjonale systemarkitektur for spesialisthelsetjenesten – men hvis det er et tjenestelag som forvaltes av KITH som er veldig flinke til å forvalte standarder, da mener jeg alikevel at de som forvalter at det er deres ansvar å holde det videre og det ikke har noen forankring utover det nasjonale og med den internasjonalisering man ser av leverandører i Norge, så har ikke det grensesnittet noen verdi. F.eks. hvis Siemens i liten grad vil tilpasse seg og hvis de vil tilpasse seg – vil det koste så mye penger at det ikke er i vår interesse tror jeg. Jeg tror ikke vi selv med hele Norge er store nok til å ha sin egendefinerte tjenesteområdet i hvert fall ikke på tvers av hele spekteret. Kanskje på ting vi holder på med som er sært, kanskje utvidelser av eller spesifisering av. Men det må dessverre ha en map mot noe – eller en roadmap som sier at vi etablerer denne tjenesten i dag men vi ser at det kommer i HL3.7 så får vi dette. Vår strategig er da at vi skal over til det når det – det må være et aspekt av det ellers tror jeg at vi er sjanseløse. Dessverre er det sånn – standarder, standarder,

standarder. Hele SOA tankegangen går jo i at hvis du ikke har orden i informasjonsinnholdet – informasjonsmodellen – så ja.

Q: Hvilke interessenter / aktører er påvirket av det SOA initiativet som vi har snakket om og hvordan?

A: De viktigste interessentene i Norge – jeg synes at det er fornuftig selv om om vi har en arkitektur tanke på foretaksnivå – er det mest interessant å diskutere det på nasjonalt nivå. Da er det nasjonale leverandører fordi norske leverandører har i veldig liten grad leveranser utenfor Norge og de forholder seg veldig slavisk til ting vi gjør i Norge og i veldig liten grad Sverige og Danmark. Det er på en måte Norge som er hovedområdet. Sånn sett er det klart at norske leverandører er viktige aktører i den sammenhengen og nok noen som vil bli tatt med en eller annen gang i arkitekturarbeidet. Ellers er det foretakene som eier av prosjektet da. Det er veldig spennende å se om en evner å implementere.

Q: Ja mener du at det å lage en arkitektur er en utfordring, og det å operasjonalisere er annen utfordring?

A: Ja eller om en kan lage en arkitektur som kan operasjonaliseres da. Det er igjen dette leverandørproblemet. Hvor hardt kan du slå en leverandør i hodet for at han faktisk følger arkitekturen din eller – hvis for å få arkitekturen til å virke du må bygge wrapper klasser rundt leverandøren så er det liksom ikke en ja... Det er ikke veldig vellykket da.

Q: Er det andre hindre som svekker muligheten for å operasjonalisere?

A: Egne utviklingsløp – alle mulige aktiviteter som foregår som burde foreholde seg til arkitekturen får en avveining hvorvidt de skal – skal på en måte det lille utviklingsprosjekt X da som to utviklere sitter et eller annet sted – i hvilken grad skal de ta på seg kostnaden ved å tilpasse seg arkitekturen. Hva skal være konsernbidraget for at de skal tilpasse seg arkitekturen? Eller skal man la noen omgå den fordi de lage en liten, lett og elegant løsning? Jeg vet ikke. Dette er den klassiske problemstillingen du har i alle…

Q: Finnes det noen prinsipper for å håndtere de situasjonene i Helseforetak A?

A: Nei. De har ikke oppstått enda, men vi får anskaffelser her også som er veldig små og som ønsker ganske begrensede integrasjoner. Men modenheten på integrasjonsteknologi eller modenheten vår – altså hele maskineriet for å få den integrasjonen på plass er såpass stort og tungt - at det blir en signifikant kost for totalprosjektet. Det er jo greit at det er en kostnad du ser, men når det blir 40 eller 30 prosent av hele prosjektet så er det kanskje større enn det man tenker seg. Det er jo et hinder, men vi skal jo klare å integrere og gjøre kostnadene lavere selvfølgelig. Det er en loop der - hvordan unngår du hackene? Hvordan klarer du å få småting til å betale det det koster for å unngå hackene? Og$å er det en annen sak – det der med forståelse - som vi nok skal få slite med i dialog med krefter som vil ha databasetilgang fordi det er det eneste som gir det dem det de egentlig trenger. Det er et – den følelsen av at jeg ikke får det – bare gi meg databaseskjema så skal jeg fikse det.

Q: Det du påpeker som et mulig hinder er da modenheten ift SOA, ift de tekniske ressursene og kompetansen som du har internt eller er det fordi det er raskere å gjøre det på den gamledagse måten?

A: Ja, er det ikke det. Jeg er ikke sikker på hvor stort problemet er, men jeg ser stadig dette når det kommer nye anskaffelser i Helse Sør-øst så dukker det opp et eller annet teknisk krav om at man må ha tilgang til databasen og databaseskjemaet skal være sånn og sånn. Så det sitter jo noen mennesker rundt omkring som har en sånn rett på jernet holdning. Ja, det bare indikerer at modenheten gjennom hele organisasjonen ikke er kanskje på plass. Den er kanskje på plass på de store primære delene, men sitter litt hist og her. Spørsmålet er om det er en trussel eller et problem. Jeg er ikke redd for det, jeg bare registrerer det.

Q: Du kan jo kanskje kategorisere dette under hvor klar organisasjonen er til å klare å ta i bruk SOA?

A: Det er mange som programmerer vet du rundt omkring – økonomer og leger og…

Q: Er det noen andre konkrete målsettinger som Helseforetak A har i forbindelse med SOA?

A: Hvis vi skal være litt strukturert på det så er den enkle greie målsettingen – hvordan skal vi greie å redusere kostnadene på standard integrasjonene. Det er den lavhengende frukten da. Men det er klart at den egentlige motivasjonen er med tanke på fleksibilitet – endringsdyktighet ift. nye systemer og endringer i systemer. For det er for trådt i dag. Vi ser hvor lang tid det tar å anskaffe et nytt eller endre systemet signifikant – så tar det lang tid. I øyeblikket er det heldigvis slik at organisasjonen på sykehuset er tregere enn IT. Den organisatoriske tilpasningen, den organisatoriske øvelsen er større enn IT, men samtidig heller vi jo mer og mer sement i IT hvis vi ikke får gjort noe med å få ting til å henge sammen på en mer standardisert og veldefinert måte. Det å få til en fleksibel arkitektur er mantraen og primær gevinsten. Igjen av det følgerdet et kostnadsaspekt.

Q: Er det andre gevinster som du kan peke på som vi ikke har vært innom?

A: Dersom det samtidig gir oss lettere mulighet for å bygge tilpassede arbeidsflater knyttet til yrkesgruppe.

Q: Hva legger du i det begrepet?

A: Per i dag så er det slik at man jobber systemorientert – du jobber i ditt system - og det skal man nok fortsette å gjøre tror jeg, på veldig mange spesialistoppgaver i alle fall. Samtidig er det ulike portalinitiativ f.eks. på Rikshospitalet, HEMIT har gjort en pilot. Jeg lurer på RIS / PACS kommer med en legeportal for radiologene. Sånn at det er klart at det er noe med å sammenstille informasjonen. Per i dag så sitter klinikere og sykepleierne og ser i de samme systemene men med litt ulike tilganger og bruker nok ulike skjermbilder primært. Men det er alikevel de samme skjermbildene de vipper imellom. Det er klart hvis en tjenesteorientering i kombinasjon med en portal tankegang i en veldig høynivå diskusjon – jeg snakker ikke om web eller Web 2.0. Det er noe greier som gjør at vi kan gjøre noe med arbeidsflaten deres så er det et ønske fremover. Det er et behov vi ser at vi er nødt til å løse. Vi har et problem at arbeidsflaten er for generell. Hvert skjermbildet er primært drevet av den som er hovedbrukeren av det skjermbildet. Det blir veldig effektivt for den ene hovedgruppen og veldig komplisert for den andre. Vi har noen problemstillinger knyttet til det. Noe av det ivaretas av leverandøren vår men alikevel er det en underliggende følelse av at det er noe arbeidsflate problematikk som vi ikke har helt på plass. Og som vi også for så vidt diskuterer i vårt nasjonale

prosjekt. Men jeg føler fremdeles at det er litt sånn vagt at det kommer inn noe prosessstøtte ift journalsystem og prosessen ift. behandlingslinjer og noe tilpasning ift bruker. Noe som er litt vagt og vanskelig å få tak i. Men det er en ide om at en tjenesteorientert arkitektur vil hjelpe oss med å sette i sammen noe sånt. Men akkurat hva noe sånt er er litt for tidlig for meg å ja..

Q: Du har nevnt to hovedbrukergrupper. Hvilke gevinster vil det gi dem?

A: Det vil jo gjøre det mulig for brukeren å bruke skjermbildet. Per i dag er det overraskende mange ting som – legen dikterer på bånd og får det skrevet for seg. Så kommer jo talegjenkjenning skal jo løse den problemstillingen. Han fyller ut sykemeldingen på papir fordi det går raskere. Det er vanskelig å definere skjermbilder som er tilfredsstillende effektive for at man får adopsjon av systemet i. Det er ikke nødvendigvis en gevinst for klinikeren å bruke maskin i stedet for papir hvis tidsfølelsen er akkurat den samme. For sykehuset er det en enorm gevinst hvis vi blir kvitt – hvis vi kan digitalisere hele prosessen både kvalitetsmessig. Da vet vi at papir blir borte.

Q: Er SOA en premiss for å få det til?

A: For at man skal kunne ta det i sin fulle bredde så ja det tror jeg. Men igjen under forutsetning at man skal kunne ta det i sin fulle bredde til en akseptabel pris og kunne ha endringsdyktighet så ja. Hvis man skal bare lage den og man ikke får spart pengene og man ikke forventer store endringer etterpå så nei.Du får det selvfølgelig til med alle skitne triks i boka og du har uhemmet mye ressurser, så selvfølgelig er det helt uproblematisk men på et eller annet punkt kommer sementen og tar deg.

Q: Er det noen andre gevinster du vil peke på ved SOA?

A: Den siste tingen – jeg tror at det ligger noe i den eksterne samhandlingen mellom foretakene som er også avhengig av SOA tankegangen hvor du har juridisk autonomitet der man trenger SOA for å løse det på en god måte – ihvert fall hvis man skal tenke nasjonalt. Hvis man tenker innenfor en region så kan man sikkert bruke alle skitne triks i boka hvis man har nok ressurser, men i en nasjonal sammenheng og regionalt der man ser på enhetene som grader av uavhengige så trenger man en type SOA tankegang. Og mens vi er inne på det er det en annen problemstilling. Nå har du fått meg i gang. Jeg håper du har tid. Man ser jo endringer i spesialisthelsetjenesten ift. funksjonsfordelingen og ift. hele Helse Sør-østs hovedstadsprosess med – hvor man skal man funksjonsfordele og sentralisere krevende særlig kirurgiske inngrep. Det har vært akkurat i helgen eller på fredag en diskusjon om disse fødestuene rundt omkring skulle … - hele tilbudet får en sentralisering av enkelt tjenester knyttet til enkelte sykehus. Vi har for lengst forlatt det at et av sykehusene er komplett. Det finnes ikke komplette sykehus det behandles på tvers av foretakene. Jeg tror at SOA er viktig i den pasientflyten for å få den sammenhengen til å fungere. Men den er også viktig ift. det vil være sånn at når sykehusene blir spesialisert så blir de også forskjellige. Det er de nødt til å bli forskjellige og selv om det er utrolig liten forståelse for den diskusjonen i dag knyttet til. Jeg synes det er veldig rart. Det er mulig jeg tar feil, noe jeg er helt åpen for men det er et paradoks at du sentraliserer anskaffelser av systemer samtidig som du desentraliserer arbeidsprosessene - hvis man kan si det sånn. Man lager standardiserte behandlingsforløp men hvert foretak får ulik rolle. På et eller annet nivå på et eller annet sted i stakken av systemer som skal få disse prosessene til å gå, så vil det være store forskjeller på foretakene. Den enkle måten å se det på er

primærlegen som har enkle systemer f.eks. ressursplanleggingen kan foregå i Excel hos legesekretæren så skal lokal sykehusene som alikevel er av betydelige størrelse – skal inn og jobbe tettere mot pimærlegene og vil få systemer som ligger nærmere primærlegene. Vi ser også ift. skadelegevakten og systemutviklingen der at de trenger en helt annet type system enn man gjør på resten av Helseforetak A. Man klarer å ivareta det ift resten av systemet så det kan hende at det ikke er et problem, men alikevel er det noe at sykehusene spesialiseres dermed må man forvente at de blir forskjellige, det blir ulike prosesser som de skal optimaliseres ift. Teoretisk da så kan det hende at det vil være ulike systemer som er optimalt for dem da å anskaffe som er fokusert på ulike ting. Ulike type ressursplanleggingssystemer er av ulik kompleksitet og sånn sett for å få det til å henge sammen i en felles arkitektur så er man nødt til å tenke en grad av tjenesteorientering. Det er et aspekt av dette da. Det skal gå noen år før det er bevist om den tankegangen er helt feil.

Q: Hvis jeg har skjønt deg riktig så kan du på en måte bruke en allegori mellom tjenesteorientering der du prosessintegrerer systemene og det andre bildet er hvis du løfter deg et hakk opp og fjerner deg fra systemene der sykehusene er systemene der du tjenesteorienterer mellom sykehusene. Der sykehusene er helt forskjellige og der systemene innenfor sykehusene kan være forskjellige.

A: Det kan være noe likt og. For eksempel på den administrative siden så er det ikke sikkert at vi skal ha et økonomisystem som er forskjellige fra de andre foretakene. Og lønn og personal er samme greie. Men det kan hende at man på Rikshospitalet har noen transplantasjonsgreier som ikke mange andre holder på med i Norge iallefal. Det krever systemstøtte eller vil i fremtiden kreve systemstøtte. Det er noen aspekter på et eller annet - jeg liker å tenke lagvis – vi har Intel servere eller i 90% av tilfellene. På et eller annet nivå opp i stakken så får vi et avvik og i det grensesnittet forskjellene blir da, der er det viktig å få på plass en god tjenesteorientering.

Q: Er det noen innlysende kritiske suksessfaktorer som du har sett på denne ferden mot en SOA?

A: Det må være basert på en modell som medfører adopsjon. Altså hvis du ikke – selv om jeg har min hentpasient tjeneste og har en grad av suksess hvis klarer å få den gjenbrukt, men det er en mye større suksess når vi kommer med et nytt hjerteinnfarkt register så er den ferdig integrert fordi det er den samme tjenestedefinisjon vi bruker. Ulike implementasjonene på baksiden bruker den samme WSDL i praksis.

Q: Når du sier at arkitekturen må være gjenbrukbar sier du det med utgangspunkt i hvilken aktør vi snakker om? Nasjonalt så holder dere på å lage en tjenesteorientert arkitektur, den arkitekturmodellen må kunne brukes av alle interessenter som er involvert i de prosessene som dere prøver å få integrert. Det i seg selv, hvis du får det til er en suksessfaktor?

A: Ja er det ikke det. Jeg tror det. Intuitivt føles det sånn

Q: Hvilke tiltak har dere implementert for å ivareta det?

A: Foreløpig er vi ikke der. Det kan godt hende at vi ikke har diskutert den problemstillingen nok. Vi har vært litt innom den. Jeg er usikker på om – vi har tiltak som går på å mappe arkitekturen mot nasjonale og internasjonale intiativ og det er klart det er..Det er når vi begynner å se resultatet av det når vi ser hvordan

samsvarer vår nasjonale arkitekturtankegang mot hva som er gjort internasjonalt er da vi vil se. Da kommer avveiningene om det passer eller ikke. Er vi nødt til å gå inn på enkelte områder og definere noe selv og si ja vi vet at vi må definere noe selv – det er ikke internasjonalt gangbart men det er alikevel vår vurdering at det er det beste som er. Det er lovlige å si det, men det er et mer kostbart løp. Og igjen det er ikke sikkert at det er – det er sannsynligvis midlertidig.

Q: Er det andre kritiske suksessfaktorer dere har definert i systemarkitektur prosjektet eller internt?

A: Nei ikke som jeg har klart i pannen?

Q: Du var inne på operasjonalisering ift leverandører og foretakene? Er det andre kritiske suksessfaktorer ift. operasjonalisering?

A: Det er en kritisk suksessfaktor ift. forvaltning. Det er noe med versjonshåndtering og sånn. Det er en kontinuerlig prosess. Så må man klarer å balansere endringstakt hos..

Q: Hos hvem?

A: Å klare å balansere– hva skal man si – nye behov mot behovet å faktisk realisere på – realisere med kjente begrensninger mot... Ja det er ikke perfekt men det er det beste vi har. Man må på en måte ha en plan på hvordan den versjoneringen skal foregå, hvordan utviklingen skal foregå og hvilket takt man kan akseptere for å ikke få store sprik i versjonen som er implementert på de ulike foretak. Vi kommer sikkert til å kjøre oss fast der og.

Q: Ift. det arbeidet som dere gjør, hvilke teknologier og / eller løsninger anser dere som kritiske ift. gjennomføringen av SOA initiativene?

A: I det nasjonale prosjektet så har vi ikke diskutert teknologi ennå. Det går et del- prosjekt på det, og vi ha vært veldig lite teknologi orientert. Det er sånn at man har en forventning om hva som dukker opp der ut fra en ide om hva folk snakker om fortiden. Men det gjenstår litt å se – jeg har ikke vært på de møtene. Jeg er litt nysgjerrig om hvor den ballen går. Samtidig er det et initiativ som heter IHE som er en profilering av internasjonale standarder for helseintegrasjon – Integrating the Healthcare Enterprise, som jeg tror er viktig. Dersom vi ikke endrer opp med en variant av IHE, så tror jeg personlig at vi mislykkes. Det er mitt utgangspunkt. Jeg skal la meg overbevise. Jeg skal ikke sette meg ned og gå i protest for jeg er ikke så sikker. Jeg ser ikke noe annet veldig godt alternativ etter det første personlig markedsundersøkelsen. Forventningsmessig er min forventning er at det er noe i IHE retningen som vil være naturlig å gå. Hvis man ser internt så er det to teknologier – hva skal man kalle det – som er grunnleggende. Det ene er at vi bruker Web Services til noe, og det andre er at vi bruker HL7.

Q: HL7 er det en teknologi og en standard?

A: Det er både et format og en protokoll. I tillegg er det noe rundt DICOM fordi det er så veldefinert innenfor sitt fag. Vi kan ikke ha en arkitektur uten å ha et forhold til DICOM. Så er det et spørsmål om vi får et tjenesteområdet som sier at innenfor tjenesteområdet så er det DICOM som gjelder. Vi bruker DICOM mekanismer for de er ikke er helt nødvendigvis overførbare til en tjenesteorientert

tankegang. De er på et litt lavere nivå. Det er 3 hovedtjenester "list", "store" og "retrieve".

Q: Er det andre teknologier som er grunnleggende for å få realisert SOA?

A: I det nasjonale prosjektet er vi kommet for kort, men hvis jeg tenker internt så er det klart at det er noe vi trenger internt for å komme et hakk videre. Vi trenger en type katalogtjenester etter hvert – å ha en tanke om en tjenestekatalog i det.

Q: Når du sier katalogtjeneste mener du ift brukerprofil eller tjeneste?

A: Nei ift. tjeneste i betydningen vi trenger å vite, å abstrahere seg fra tjenestens lokasjon. I dag så er ikke tjenestelokasjon fjernet fra klient og tilbyder. Det er et aspekt som må tas vekk. Så er det overvåkning av tjenesten – en type teknologi vi mangler.

Q: Ift samhandling mellom – inter-organisatorisk samhandling?

A: Det går for så vidt tilbake til det interne også at vi mangler noe på sikkerhetsteknologier – graden av…Det er gjennomløpende hele autentiseringsmekanismer ift. bruken av tjenester. Hvis man ser på de funksjonelle kravene f.eks se på kliniske tjenester så krever det personlig autentisering for å ivareta autorisasjonsmodellen i de respektive systemer. Det er per i dag – har vi ikke noe teknisk løsning som gir oss en god autentiseringsflyt. Vi bruker Kerberos selv om vi egentlig har sagt at vi skal bruke personlig autentisering og at det skulle være personlig autentisering gjennom systemene. Altså når du henter informasjon fra PAS så skulle det være basert på en brukers rettigheter. Så er vi ikke der i dag. Det er en teknologi modenhets problem. Selv om teknologi – at man kan argumentere at det har vært ute et par år – i hvertfall ift en slags pilot og finnes nå etter hvert i mer og mer modne teknologier så er det systemutviklerne både hos leverandørene og internt er ikke ferdig modne, kokt og kompetente med fullforståelse ift det hvordan det skal virke. Og det er kanskje ikke i andre heller. Man har en ide men er ikke klokkeklar på hvordan det skal virke og hvordan det skal henge sammen. Vi er ikke i stand til å gjøre det i øyeblikket.

Q: Ift. hvis jeg har forstått deg riktig så har du nevnt sikkerhetsproblematikk relatert til autentisering og autorisasjonsnivå?

A: Sorry jeg svarte ikke på det andre ift inter-organisatorisk samhandling. Det mangler en federeringsmekanisme også. Det skal bli en interessant debatt da ift. regionalisering og i hvert fall i Helse Sør-øst om hvordan man skal autentisere ift. sentrale tjenester og bruk av federeringsteknologi kontra en felles, sentral katalog.

Q: Hvis vi går tilbake til den innledende definisjon om hva en tjeneste var og hvis en ser på samhandling på tvers av organisasjoner der du har en prosess som begynner i den ene organisasjonen og konsumerer en tjeneste i en annen organisasjon, hvordan skal du håndtere det?

A: En type federeringsteknologi. Jeg føler at veldig ofte når vi prøver å se det totale bildet så ser vi masse mekanismer som skal være på plass. Jeg tror ikke det kommer i år eller neste år heller, dessverre. Vi har enda noen runder å gå på modenhet før vi fullt ut forstår hvordan vi skal løse problemet. Og jeg tror at vi har litt igjen på å forstå hva problemet er.

Q: I tillegg hvis vi går tilbake til arkitekturprosjektetsleveranser. Er det noen sammenhenger mellom det du har sagt nå og leveransen?

A: Jeg tror ikke at arkitekturprosjektet på sikkerhet og teknologi vil jobbe med den inter-organisatoriske samhandlingen på et nivå at vi kommer bort i sikkerhet. Men det er jeg ikke helt sikker på. Man har mer enn nok med å snakke om det interne på et foretak rundt disse mekanismer. Men det skal bli interessant å se. Mandatet er litt åpent og tillater å se på slike ting.

Q: Grunnen til at jeg spør er ifb med henvisningsprosessen som er inter-organisatorisk utgangspunktet. Når du ser tjenesteorientering ift de prosjektene som..

A: Det er nok mer…La oss si at vi fikk en endring av fortolkning på lovverket knyttet til journalinformasjon alternativt at man fikk en endring av lovverket som gjorde det mulig å hente journalinformasjon fra et foretak til et annet dersom den informasjonen var eksplisitt aktivt utlevert. At jeg har min journal merket at Jon Gupta ved Sykehuset Innlandet har lov til å lese dette dokumentet. Så har jeg en Web Service som heter hentDokument som ditt journalsystem implementerer. Der trenger vi en type sikkerhetsarkitektur basert på noen federation mekanismer som sier Sykehuset Innlandet bekrefter at det er Dr. Jon Gupta som rekvirerer dette dokument, som henter all journalinformasjon på denne pasienten som aktiv utlevert sånn og sånn. Der trenger du en sånn type mekanisme. Det er i den type tjeneste at vi faktisk trenger det. De tjenester som vi driver og spesifiserer i øyeblikket så er jeg litt usikker - selv om de har en grad av sensitivitet i seg så er de veldig sånn vi sender, vi krypterer og sender. Du sender en forespørsel ja liksom, men…den er nærmest gyldig i et tillitsforhold. Du sender en rekvisisjon som er stemplet med navn og HPR nummer. Da er tillitsforhold… man agerer på bakgrunnen av rekvisisjonen. Men når du skal gi fra deg informasjon som er sensitiv om en pasient så tror jeg at den garden…du kan liksom ikke tillittsbasere deg på at han sier at han er lege. Da skal vi faktisk vite gjennom sykehusets sertifikat og personlig sertifikat. Hvertfall en form for federation som garanterer at denne brukeren er hvem man utgir seg for å være. Du har også tilfeller at pasienten har lov til å si at du kan levere ut men ikke til han.

Q: Jeg har to spørsmål til. Har dere tenkt å anskaffe noen konkrete teknologier ift. SOA initiativ?

A: Ja det er to ting. Vi kommer til å gjøre noe på Web Service / katalogtjeneste. Der tror jeg at det kommer til å skje et eller annet på. Og så tror jeg at det kommer til å skje noe rundt Web Service Management. Selv om vi ikke har et ekstrem bruk av Web Services i dag så tror jeg at vi må gjøre noe der. Jeg har tenkt hele tiden at vi skal ikke se på det inneværende kvartal men skal se på det neste kvartal. Behovet er der men det er hele tiden ikke brennende nok til at vi må ha det da. Jeg tenker det er som sånn Q4 08 aktivitet eller en 2009 aktivitet å tenke på litt avhengig av hvilke prosjekter som kommer opp i løpet av kort tid. Det er den SOA orienterte delen av det. Integrasjonsinfrastrukturen vår er også en del av en slags SOA infrastruktur, men den hadde blitt anskaffet uansett så jeg føler ikke at den liksom er…

Q: Kan du peke på noen læring som er viktig relatert til SOA initiativene?

A: Jo en viktig og interessant observasjon er det at det er tydeligere og tydeligere at SOA som konsept skiller seg fra de tilhørende SOA teknologiene og produktene.

Bruken av Web Services og tanken om ESB og dette med prosessstøtte gjennom BPEL og bruken av BPMN modellering. Det er veldig interessant og kjempe spennende men samtidig det å klare å fokusere på informasjonsmodellen og tjenesten, og klare å implementere den med den teknologien du har er mye viktigere. Disse internasjonale standarder som er til syvende og sist skalerer bedre enn – integrasjonsmessig, fleksibilitetsmessig - enn det å begynne å jobbe seg mot… Det tar lengre tid å komme opp på modenheten - til å ta i bruk -hypekurven på en del aspekter rundt SOA er kanskje høyere enn det jeg trodde. Jeg har mindre bruk for ESB enn det jeg trodde. Det er mer uklart hva jeg skal med den ESB enn hva jeg trodde. Veldig mange sånne ting. Nå har jeg aldri vært en veldig ESB entusiast så det er kanskje noe som ligger der og. Det står stadig klarere for meg å holde orden på informasjonsmodellen og formatet og hva som er gjenbrukbart inennfor sektoren . Det er liksom viktigere og ta det og mappingen mot tjenesteorienteringen enn bruken av teknologiene som følger etter SOA bølgen. Jeg har aldri vært imponert over mennesker som sier at ja men jeg har holdt på med SOA i 20 år, men samtidig så skjønner jeg tankegangen at det kan du godt ha gjort. Så SOA forståelsen og SOA konseptet i organisasjonen sammen med systemene og bruken av det du har på riktig måte. Jeg følte ikke at jeg fikk det helt riktig artikulert men…

Q: Ja har du noe annet å tillegge ift lærdom?

A: Nei, men modenhet og forståelse ift teknologi tar tid. Vi snakker om mange år før vi agerer.

Q: Da takker jeg for tiden.

Table 7 Grand Themes and Themes compared across Interviews

	Sites													
	Organization H1			Organization H2				Organization H3	Organization H4	Organization H5	Project 1		Project 2	Project 3
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
Organization														
Business Administration Model														
Size														
Innovative Culture														
Competence														
Stakeholder Support														
Management Support														
Clinician Support														
Resource Prioritization														
Time														
Budget														
Process Management														
Process Ownership														
Process Analysis														
Process Analysis tools														
Process Standardization														
Information Management														
IS Management														
IS Porfolio Management														
Change Management														
IT and Healthcare Standards Compliance														
Web Service Architecture														
Identity Federation														
Web Services														
Web Services Security														
Web Services Management														
Service Location Transparency														
Internal Collaboration Pressures														
Monolithic Systems Portfolio														
Data Redundancy														
Non-integrated Systems														
Poor Adaptability														
Poor Flexibility														
Poor Information Timeliness														
Poor Application Fit														
Poorly Integrated Systems														
Poor Information Quality														
Poor Information Flow														
External Collaboration Pressures														
Security Legislative Pressure														
Inter-Organizational Process Support														
Information Sharing														
Functional Specialization														
Synchronized Stakeholder Change														
Trends														
Healthcare Vendors														
Requirements standardization														
Willingness to collaborate														
Willingness to Integrate														
Willingness to comply with Architecture														
Willingness to comply with Standards														
Peceived Stakeholder Benefits														
Flexibility														
Adaptability														
Increased Process Efficiency														
Timely information availability														
Role Based Process and Information Access														
Patient Safety														
Easier Integration														
Lower Process Cost														
Functional consolidation														
Portfolio Longevity														
Portfolio Migration														
Reuse														
Improved Process Oversight and Optimization														
Healthcare Standards Compliance														
HL7														
DICOM														

The table introduced in this appendix makes use of two different colour codes to represent whether a site / interviewee brought up a theme during the interview.

- A cell filled in black indicates that the theme occurs explicitly in the context of a SOA adoption

- A blank indicates that the theme did not come up during the interview

The table contains the results from the all of the interviews, interview by interview. Results that do not have corroboration across more than one site have been removed with one exception that is related to organizational size. Only one interviewee stated explicitly that the organizations size would probably have some sort of influence on the adoption of a SOA adoption.

D. Comparison of Grand Themes and Themes with the Literature

Table 8 Comparison of Grand Themes with the Literature

Identified Grand Themes and Themes	Data Quality Wand and Wang (1996)	EDI adoption - Chwelos et al (2001)	Web Services adoption - Ciganek et al (2006)	SOA Adoption - Legner et al (2006)	EAI adoption - Khoumbati et al (2006)	Technology adoption and diffusion - Higa (1997)	EAI adoption - Mantzana & Themistocleous (2004)	Organizational adoptin - Chen et al (2006)	EDI adoption - Premkumar et al (1997)	SOA Adoption - Mahajan (2006)
Organization										
Business Administration Model						■				
Size								■		
Innovative Culture								■		
Competence			■		■					
Stakeholder Support										
Management Support			■					■		
Clinician Support					■					
Resource Prioritization								■		
Time										
Budget		■			■			■		
Process Management										
Process Ownership										
Process Analysis										
Process Analysis tools										
Process Standardization										
Information Management					■					
IT Management								■		
IS Porfolio Management										■
Change Management										
IT and Healthcare Standards Compliance			■							
Web Services Architecture										
Identity Federation										
Web Services			■					■		
Web Services Security			■		■					
Web Services Management										
Service Location Transparency								■		■
Internal Collaboration Pressures										
Monolithic Systems Portfolio										■
Data Redundancy										
Non-integrated Systems										
Poor Adaptability										
Poor Flexibility										
Poor Information Timeliness	■									

Identified Grand Themes and Themes	Data Quality Wand and Wang (1996)	EDI adoption – Chwelos et al (2001)	Web Services adoption – Ciganek et al (2006)	SOA adoption – Legner et al (2006)	EAI adoption – Khoumbati et al (2006)	Technology adoption and diffusion – Higa (1997)	EAI adoption – Mantzana & Themistocleous (2004)	Organizational adoptin – Chen et al (2006)	EDI Adoption – Premkumar et al (1997)	SOA Adoption – Mahajan (2006)
Poor Application Fit										
Poorly Integrated Systems										■
Poor Information Quality	■						■			
Poor Information Flow										
External Collaboration Pressures										
Security Legislative Pressure										
Inter-Organizational Process Support										
Information Sharing										■
Functional Specialization										
Synchronized Stakeholder Change		■								
Trends										
Healthcare Vendors										
Requirements standardization			■							
Willingness to collaborate										
Willingness to Integrate										
Willingness to comply with Architecture			■							
Willingness to comply with Standards			■							
Stakeholder Benefits		■								
Flexibility					■			■		
Adaptability				■						■
Increased Process Efficiency				■			■			■
Timely information availability	■						■			
Role Based Process and Information Access				■			■			
Patient Safety					■		■			
Easier Integration				■			■			■
Lower Process Cost				■			■			
Functional consolidation					■					
Portfolio Longevity										
Portfolio Migration										
Reuse				■			■			■
Improved Process Oversight and Optimization									■	■
Healthcare Standards Compliance										
HL7									■	
DICOM										