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Master's thesis in Telemedicine and E-health

Simplifying Technology – Complex Work Practice

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June, 2006

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Department of Clinical Medicine
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Abstract

Information Technology (IT) has for several decades been seen to be a key enabler to achieve improved efficiency and quality in work processes, and so also within health care. Thus, even though many parts within the health care sector have high expectations, the desired benefits are not seen to large extent in practice, at least not until present. A lot of the work flows within health care are still paper based. Several authors claim that the mismatch between the goals and the real situations as today might be caused by the fact that social aspects are not included in design to large extent. Implementation processes has had a tendency to be far more technology oriented than social and communication oriented, thus indicating that technological processes rely on technological deterministic views.

This thesis applies an implementation process of a new technology called Well Interactor, a system which is developed to let general practitioners choose laboratory services electronically and additionally enables interactive possibilities. The thesis is aimed to show to which extent existing work practices influence on the outcome of the technology. The findings documented are based upon an interpretive case study, including field observations and interviews. A study of 21 interviewed subjects has been carried out.

The thesis concludes that existing work practices and existing infrastructures are quite complex. Such complexity makes it difficult to plan the outcome of the technology. It should therefore be seen implicit to map complex work practices before vision of drastic improvements caused by the use of Information Technology is created. The goals must be realistic based on the current situation. Then, both, social and technological aspects should play a role in how technology will and can be used.

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Preface

This master thesis is a part of the educational program, Master of Science in Telemedicine and E-health performed at the University of Tromsø. It is written during a time period from spring 2006 to summer of 2007.

The work with the thesis has been interesting but also very challenging. I could not have made it without the help from all of the contributors. Thank you very much all of you!

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I would also thank my friends, class mates and my family for great support during some hard working days.

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Tromsø, June 2007

Kristoffer Røed

1 INTRODUCTION

Information Technology (IT) has been argued for several decades to have an enormous potential to reduce costs and improve efficiency and quality. Despite this potential a lot of the work flows within health care are still manually performed and paper work is still seen to large extents. Often are expectations of information systems much higher than what can be achieved in practice. In addition many of the IT related projects within health care is not finished in time causing delays and decreased satisfaction. The potential of Information Technology is high while the final product has a tendency to be far lower than the outlined potential.

One of the reasons for such causes can partially be related to the lower focus on social practices and work flows (Giuse and Kuhn, 2003). In addition a lot of IT projects have a tendency to be far more technological oriented than social and communication oriented (Giuse and Kuhn, 2003). This might cause situations where the ideal potential of the Information Technology is taken for granted, assuming that the technology will be used as planned.

The Norwegian Health Care Sector is characterised by being very heterogeneous. A lot of various professions are working together creating a huge team of different workers trying to serve the patients and give them the best treatment as possible. This heterogeneity makes the health care situations very complex. The complexity makes it difficult to generalise work processes. The work processes change from one situation to another.

This master thesis has followed a project called GiLab from the starting point, December 2005 until its scheduled end, in May 2007. The GiLab project was made upon the University Hospital Northern Norway's (UNN) desire to receive laboratory requisitions from general practitioners (GP) electronically. The existing procedures were not efficient enough and caused among others a lot of double registration work. The double registration is partly caused by the fact that the different laboratories are isolated from each other. By implementing a new electronic information system, UNN expect to save lots of human resources. The new system is called Well Interactor and is made by the software developer Well Diagnostics AS located in Tromsø and Oslo. The aim of the project is to increase security and quality related to laboratory requisitions, improve the general practitioners' user interface as the practitioners can select their services directly from their computer by the use of Service Provider Profiles.

In addition to the GiLab project, another project was also established at UNN to enable a more seamless process flow, the Pre-Analytic Service Unit (PAS). This project was established to improve the distribution of samples and requisitions, no matter if they are requested internally, externally, electronic or with the use of papers. The goal of the PAS project is to create an information flow where it is “one way in and one way out”. The two projects are related to each other. They are both contributing to large scale changes. The GiLab project was also created as a positive contributor to the new Pre-Analytic Service Unit, and a lot of the new equipments at PAS, thereby a new distribution machine, was bought with Well Interactors benefits in mind.

1.1 Research objectives

The master thesis has an ambition to seek for answers related to the following research questions:

- To what extent are existing work practices influencing the implementation and outcome of new technology?
- How can Well Interactor be integrated with the existing IT portfolio of information systems in hospitals?
- Can Well Interactor contribute to an overall improved information flow between Primary Health Care and Specialised Health Care through its interactive services?

1.2 The Structure of the thesis

On the basis of the research questions, the scope of the thesis will focus on the relationship between new technology and existing work processes in addition put focus on the connection between all involved actors. The aim is to find out in which extent work practice will influence the outcome of new technology.

Introduction

The first part of this thesis looks briefly into the characteristics of the Norwegian Health Care System, in addition to describing the government's vision of using Information Technology in health care. The characteristics are that IT is seen as a very good tool to improve health care. The new strategy, outlined in Teamwork 2007 constitutes that it is necessary that all actors communicate on appropriate levels. In contrast to previously related IT projects, the focus in teamwork 2007 has been more concerned about evaluating existing work practices when new systems are implemented.

The second section of the thesis, the theory chapter, pays attention to three different angels of looking into the field of Information Technology. The first of this section is looking into ideal situations, how IT ideally can contribute to fast shifting improvements and establishments of seamless information flows. The second part puts focus on an alternative approach of how to look at information systems, partly criticising the traditional way of seeing information systems as isolated parts, and argues that it is necessary to create a more holistic view of all systems as long as they are connected. The last part of the second section concerns about the connection of human beings and technology.

The third chapter of the thesis outlines the interpretive study method. The method chapter illustrates the design of the research and how the research materials have been collected. It is written in a very personal language because this seems naturally. The interpretive study method argues that the researcher is seen as a research instrument himself.

The last chapters illustrate the case and discuss and outline the work flows complexity regarding the developmental aspects and the possibility to achieve a seamless information flow.

2 THE NORWEGIAN HEALTH CARE SYSTEM

2.1 Organization

The Norwegian Health Care System is predominately public. On an overall level it is divided into two parts: Primary Health Care Services and Specialised Health Care Services. It is aimed to give the population in Norway their needed health care.

The Primary Health Care Service is most often the first part of the health care services patients get contact with when they become ill. It is for instance responsible to refer patients to medical specialists, nursing care or hospitals when needed. The Primary Health Care Service has several underlying services being the general practitioners, emergency wards, physiotherapy, nursing homes, midwife services, public health nurse services and home nursing care (www.norge.no).

The Primary Health Care Service is organised under each municipality's responsibility, and its services are performed by health care personnel hired by the municipality or private companies with a municipality co-operation. Examples of services performed are giving health care to people with cancer and heart diseases when they are at their homes and to give elderly people their needed help.

The Specialised Health Care System is organised as a part of the health authorities, and consists of the public hospitals, both local and regional, the psychiatric institutions, the ambulance services, and the emergency call services (SOS), the hospital pharmacy stores, the different laboratories and some of the intoxication institutions (www.norge.no). The Specialised Health Care System takes for example care of patients when they are hospitalised, and treat cancer patients with radiation therapy or performs various kinds of surgery.

From a historical point of view, the Specialised Health Care Services were organised as part of the counties' responsibility. This changed as a consequence of the new hospital reform in January 2002, which reorganised the responsibility structure. As a result a 30-year old tradition where hospitals were run by the counties ended. Every public hospital was undertaken the ownership of the central government (Norsk Forskningsråd, 2007).

One of the reasons for the change was to reach a better use of the health resources (Ot.prp.nr 66, 2001).

The reform resulted in the establishment of five new regional health care authorities, each with their own management, administration and board. The new authorities, which replaced the five former health regions, were named Helse Nord RHF, Helse Midt Norge RHF, Helse Vest RHF, Helse Sør RHF and Helse Øst RHF (see Figure 1). These authorities are today responsible to run and operate all public hospitals and other health care institutions within their own region. The regional health enterprises are also divided into sub authorities, meaning that the different health care enterprises also are responsible for underlying independent enterprises. Helse Nord RHF for instance covers five underlying independent enterprises which also have their own management (www.helse-nord.no).

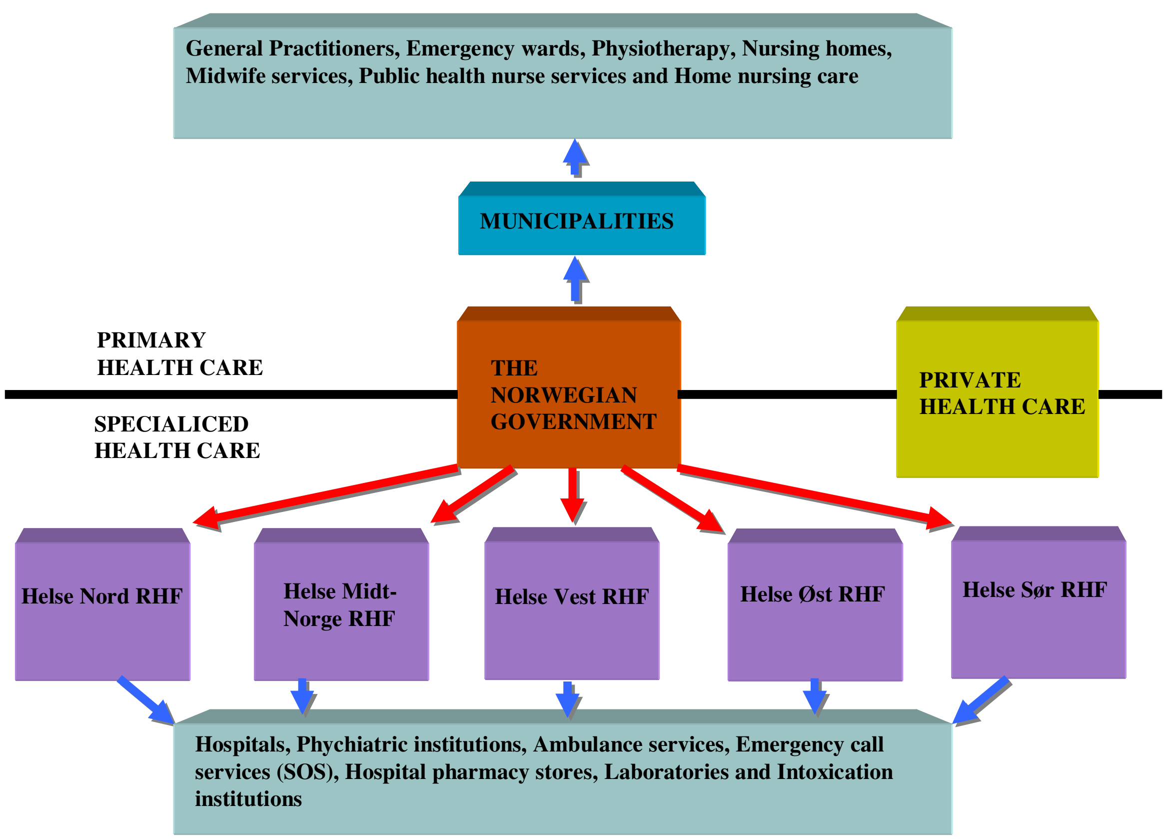

Figure 1: ***Illustrates how the Norwegian Health Care System is organised.***

The Norwegian Health Care System has also established other organisational changes within the last years. For example the Norwegian government introduced the "fastlege" system by June 2001 (Vigerust, 2007a). The vision was to improve the communication between the patients and the general practitioners. The "fastlege" system allows each inhabitant to choose his or her own primary general practitioner from a list of available practitioners. Research has concluded that the "fastlege" system has led to improvements, especially for patients (Gripsrud, 2002). A study performed by the University of Bergen showed that a majority of the involved general practitioners said that they were more considerate about their relations to their patients because they were afraid to loose them from their list. This indicates that patients have become more empowered as a consequence of the "fastlege" system.

Another recently change in the Norwegian Health Care System is the ability to let each patient choose which hospital he or she wants to be treated by (www.lovdata.no, patient right law, § 2-4**).** This service contributes to let each patient choose specialised health care independently on regions and health care enterprises.

2.2 Visions of using IT in health care

A common goal from the authorities is to build a health care service which serves each patient's needs, no matter where the services are generated, whether it is the health enterprises, the municipalities or the country authorities. To achieve this goal, the Norwegian government has realised that it is necessary that all actors involved communicate on an appropriate level. To be able to achieve a more seamless integration of different health care services, appropriate use of Information Technology has become highly prioritised.

> *"Appropriate use of information and computing technology is essential for high quality and effectiveness" (Teamwork 2007, p3).*

The use of Information and Communication Technology (ICT) within health has also gained strong political emphasis internationally. The following quote illustrates the emphasis given to this area.

"eHealth is the single most important revolution in health care since the advent of modern medicines, vaccines, or even public health measures like sanitation and clean water" (Teamwork 2007, p 4)

The Norwegian Health Care System is expensive. The country used approximately 10 % of its gross national product on health and social services in 2002 (Brændvang and Kjelvik, 2005). Based on this, The Norwegian Health Care System is one of the most expensive in the world in relation to the population (Feiring, 2005). Comparably, Norway used 7.6 % of its gross national product in 1993 (Sæter and Heimly, 1996). Regarding the fact that the costs are increasing, long waiting lists and lack of efficiency are still seen in many different health care areas. The trouble of increased costs and inefficient management has resulted in many reorganisation attempts where ICT is intended to make the health care system more effective.

"Cooperation, the share of functions and network solutions between hospitals within and across borders of counties and between hospitals and primary health care are important policy instruments to secure the quality and to meet the challenge within the health care sector" (Innst.S.nr.165 1994-1995)

The vision to create an improved and more efficient health care system is also seen to be beneficial to the patients. They will achieve more power, get faster treatments, reduce waiting times and hopefully many patients will feel that the health care system is made for them. Additionally, the use of IT is also expected to free some time for the health care workers.

"Experience show that the employment of IT has considerable potential in freeing time for the health care workers (Vigerust 2007b)

According to the authorities it is believed that the cost benefit will not be fully realised before changes in routines, organisational development, standardisation and the management of processes for both the national and local levels. The final result is expected to be a more secure and reliable exchange of information between the cooperating partners in the sector (Teamwork 2007).

2.2.1 Building a national strategy

Some of the existing trouble in today's health care system's work practices is characterised by parallel paper based and ICT based systems. Duplicate work and ambiguity in dealing with information prevents the full potential of ICT. In addition different technological applications and lack of standards prohibits appropriate interaction between the involved actors. To face these challenges the government has made the national strategy Teamwork 2007, with a goal to make sure that all contributions are coordinated and pulled in the same direction. The strategy is important as it points out important constructional factors. According to the national strategy several steps must be taken into account before the great benefits of ICT can be achieved. Some of these steps are seen below.

- *Paper must be removed when electronic applications are implemented.*
- *Electronic interaction must be extended to all the cooperating partners in the sector and to other cooperating areas.*
- *ICT development must follow organisational development, changes in work processes and new forms of interaction and division of labour.* (Teamwork 2007 p 4-5).

The strategy prioritises improvements related to information flow and vitality for the common applications. Working with infrastructures, information structure, information security, electronic patient records, exchange of electronic messages and access to professional support are some of the prioritised aspects. The concept "continuity of patient care" has been seen important as it emphases coordination and continuity in provision of services and preventive care. The strategy outlined in Teamwork 2007 argues that patients and clients shall experience continuity of care when they use health care related services.

2.2.2 Facing the challenges

On a national level it is still a long way to go before the full potential of ICT is realised. The plan called "more health for each biT" outlined by the Norwegian government in 1997, focused on how Information Technology could contribute positively on a large scale, from telemedicine to hospital administration and from patient cards to standardising attempts (Vigerust, 2007b). A goal was to build bridges between ICT based systems, and so saying make the information flows more seamless. The Norwegian government did also start a plan called "Si@!" in 2001. This plan was made to improve ICT based interaction on a broad basis, not just in pilot projects. Many different ICT projects were included, but they lacked coordination. The ability to implement them into the everyday running services was poor. On the other side the contributions of "Si@" were said to give positive results.

> *"Si@!" has succeeded creating a satisfied result regarding the goal of stimulating electronic interaction (PLS Ramboll Management 2004, p 2).*

Teamwork 2007 points out a clear focus:

> *"Attaining electronic interaction is not only a question of technology. Limitations and possibilities do not lie primarily in the actual technology, but in how it is applied. Choice of technological applications, organisations of activities and work processes, skills, legislation, culture and economy are all important aspects in terms of attaining electronic interaction"(Teamwork 2007, p 7).*

The national strategy does also put attention to implemental aspects.

- *National priority areas, just as local ICT priority areas, must be followed up until they have gained adequate acceptance, and have demonstrated that they are sustainable in daily operations (Teamwork 2007, p 5-6).*

- *New priority areas should not be too broad, but measures should be implemented thoroughly in a few selected areas. Ideally these areas should be closely linked to areas that have been given priority previously, in order to take advantage of the experience gained by interactive partners (Teamwork 2007, p 6).*

- *The actors who shall benefit from areas that are given priority must be made accountable, both financially and as owner of the project. This helps to ensure that priority is given to the areas of the greatest needs (Teamwork 2007, p 6).*

3 THEORY

3.1 Changing Processes using Information Technology

Information Technology has for decades been considered to have an enormous potential to make improvements related to efficiency, documentation, organisational management and security. The rapid pace of technological innovation has enhanced company's ability to produce, distribute, and marked goods and services and communicate effectively with customers (Kudyba and Diwan, 2002). The accessibility of information has also become a vital condition for participating in economic, cultural, and societal processes, both for individuals and for organisations. Information has become the most important production factor and is increasingly determining the functioning of individuals and the structure of organisations (Oostendorp et al., 2005).

The use of Information Technology to enable improvements is widely seen within health care. The idea to use Information Technology as a convincing tool to achieve improved health care was already relevant from the beginning of the computing era (Giuse and Kuhn, 2003). Electronic patient records have for many years replaced papers, and computers are used frequently in treatment and surgery.

In medicine, clinical processes are widely used and characterised by a high degree of communication and cooperation among physicians, nurses, and other groups of personnel. According to Lenz et al., (2002), an information system should support these processes by enabling a seamless information flow between the different participants and different locations. The use of information system as to achieve radical benefits has also on an overall level been considered as a powerful change tools for changing business (Davenport, 1993; Hammer, 1990), and also within health (Lenz et al., 2002).

> *"..information technology, has been hailed by many as the most powerful tool for changing business to emerge in the twentieth century" (Davenport 1993, p 13)*

Michael Hammer (1990), a professor of computer science, argues that Information Technology is a key enabler of Business Process Reengineering (BPR) or "radical change". By this he means that Information Technology is a very beneficial tool to achieve drastic benefits. Thomas Davenport (1993), also a key person in Business Process Reengineering, agrees, and argues that the advantage of BPR is to have an enormous potential for helping organisations to achieve major reductions in process cost or time. In addition BPR helps improving quality, flexibility, service levels, or other business objectives. The basic of Business Process Reengineering, which also is known as Business Process Redesign or Process Innovation, is to recognize and break away from the outdated rules and fundamental assumptions that underlie operations (Davenport, 1993). This is achieved by enabling discrete initiatives that are intended to achieve radically redesigned and improved work processes in a bounded time frame. Davenport (1993) argues for example that implementation of process management is one of the reasons to Japans economical success.

> *"That Japanese Firms discovered (or at least implemented) process management long before the West helps explain their world wide economic success" (Davenport 1993, p 2)*

Japanese companies have a tendency to have efficient processes related to key areas as product development, logistics, sales and marketing. Many of them are logical, balanced and streamlined. These qualities have in fact influenced the western counterparts to large extent. During the 1990's the process innovation approach was highly adopted by a huge number of companies which strived for renewed competitiveness. Many positive results were seen. An example is how General Motors for instance, succeeded after financial drawbacks due to competition (Breshbuhl and Margulius, 2005).

Hammer (1990) argues that the use of Technology has not reached its full potential because companies tent to use technology to mechanise old ways of doing business. This means that their existing processes are kept intact and that technology is only used to speed the existing processes. If a process for instance has deficient fundamental performance, the full potential of the technology will not be achieved, because it still is based upon the existing process. Hammer (1990) also argues that companies should rather reconsider their processes in order to maximize customer value. This idea is also supported by Davenport (1993), who argues that quality initiatives and continuous, incremental process improvements is still essential but no longer sufficient.

> *"Objectives of 5% to 10% improvements in all business processes each year must give way to efforts to achieve 50%, 100%, or even higher improvement levels in a few key processes" (Davenport 1993, p 1)*

By performing reengineering attempts, both Hammer (1990) and Davenport (1993) argues that efficiency can radically be improved. New processes can be created by breaking loose from outmoded business processes and the design principles underlying them (Hammer, 1990). Exchanging the existing processes with totally new ones is argued by the authors to have radical positive effects.

> *"We cannot achieve breakthrough in performance by cutting fat or automating existing processes" "Unless we change these rules we are merely rearranging the deck chairs on the Titanic" (Hammer 1990, p 107)*

The above quotes might seem a bit dramatic, but it was not only General Motors that achieved benefits trough reengineering work. Ford Motor Company, for instance, achieved competitive leadership by reengineering their accounts payable processes. In the early 1980's their accounts payable in North America employed more than 500 employees. This was one hundred times more than the smaller Japanese car producer Mazda which comparably only had 5 employees within their accounts payable processes (Hammer, 1990). Before hearing about Mazda's payable process, Ford thought that by rationalising their processes and install new computer systems, they could reduce the staff by 20%. After hearing about Mazda, Ford became enthusiastic. In an attempt to make improvements Ford Motor Company decided to do radically changes, resulting in dramatic improvements. They did not only achieve 20% but rather 75% reduction in head counts. What Ford did was to eliminate ineffective work and pay more attention to the work which made results (Hammer, 1990).

Benefits within Process Innovations are to reduce financial costs (Davenport, 1993). It is very helpful for companies that have assumed heavy dept loads as a result of leveraged buyouts or fending off corporate raiders. Often such companies need to cut expenses substantially to improve profitability. Another point is that executives in organisations have a tendency to spend a lot of money and time on less structured and less ambitious approaches to business change with little results (Davenport, 1993; Hammer, 1990). By performing Business Process Reengineering the results are argued to be the opposite. According to the benefits of Davenport (1993) and Hammer's (1990) theories, there should be reason to believe that BPR could improve processes related health care as well.

The idea to use information systems within health care is not new. More then 25 years ago the idea to improve the quality of care by providing direct support for care providers and emphasizing the clinical aspects of information processing were considered the chief challenges facing the field. A group at the working conference on Hospital Information System (HIS) held in Cape Town in South Africa in 1979 felt that technology, if properly applied, could enable improved clinical outcomes (Giuse and Kuhn, 2003). In 1988, in Netherland, a conference indicated a need for a centralised data base with global distribution. Some years later another conference, in Durham, NC, in 1994, saw it important to develop regional-scale computer based patient records to support clinically oriented and patient centred systems. Such systems would support seamless linkage of all members of the health care team (Giuse and Kuhn, 2003). Regarding the many years of seeing Information Technology as a positive contributor to improved health care, the same issues are unfortunately also relevant today (Teamwork 2007). The effort to use Information Technology to increase efficiency is still high, without reaching the major benefits. This means that, regarded the nearly 30 years of expecting benefits of using Information Technology to improve health care, we still have to admit that the current health care information systems are still far behind the expectations (Lenz et al., 2002). For instance a large percentage of health care organisations are still largely dependent on manual information processes. In addition lack of integration has been the root of the causes of many failed HIS implementations (Giuse and Kuhn, 2003). The failures are costly and the problems cause trouble and unproved returns for health care administrators. Within health care IT investments are far behind other business sectors (Giuse and Kuhn, 2003).

Other troublesome issues is that a lot of nformation systems within health is isolated with only small scopes and little possibility to interface with other systems. This means that interconnecting technical components together is challenging. The information needed is either not widely available causing discontinuities in care (Giuse and Kuhn, 2003). Such consequences are kind of a paradox and have not been the goals. It is not one of the goals illustrated by national strategy, teamwork 2007. The goals are off course directed in the opposite way. The result of incomplete information systems on larger scales is often redundant work and clinical decisions based on incomplete data (Ellingsen and Monteio, 2006; Giuse and Kuhn, 2003). Such results are also far away from the intended visions of the use of information systems. To a large extent, information systems are still ad hoc based and handcrafted and still far away from the plug and play systems that was a vision long time ago (Giuse and Kuhn, 2003). Many of the problems are related to integration where it seems like there is a lack within some of the more fundamental terms. For instance, standardisation efforts have not yet resulted in a complete application framework generally accepted and used for health care information systems (Lenz et al., 2002). System evolution by adding plug and play components in a “best of breed” strategy is argued by the previously written author to still be difficult.

Considering all the amazing powers we hear computers can do, it seems strange that computers still have problems supporting health care on larger scales. Despite the potential of process innovations as well, it seem also strange that this does not contribute very well. Between 50 and 70 % of reengineering efforts are unsuccessful in achieving the organisation visions (Dreilinger, 1994). King (1994) argues that the primary reason of BPR failures is overemphasis on tactical aspects and that the strategic dimension is being compromised.

Giuse and Kuhn (2003) argue on the basis of Coiera (2000) that one of the reasons why the original goals (nearly 30 years ago) are not achieved is that the focus has been technological oriented rather than social and communication oriented. Giuse and Kuhn (2003) argues that it is important to include the currently information flows, and make systems able to naturally fit into the clinical workflow. The benefits are that the systems will see clinical communications among the different health care workers as it’s fundamentally activity. A reflection of this might be that it is necessary that the different people involved in design of information system, both end-users, managers, decision makers and developers see their roles as equally important. It will also be important that the many technological parts involved in large complex organisation are more viewed as a whole. As long as many systems are involved there are reasons to believe that they are connected as well. To look at different information systems as infrastructures rather then a lot of isolated parts will enable possibilities to discover the fundamental relationship between them. This is the basis for the next part in this theory chapter.

3.2 Information Infrastructure

Infrastructures in general are often used to describe different networks, such as airports, roads, harbours and so on (Aschehoug and Gyldendal, 1997). Such infrastructures make it implicit to think that each airport must have a runway so the planes can safely land and take off. If you fly a Boeing 747 from Frankfurt to Manila the Boeing will suffer huge trouble if the runway there is too short. We see that there is an implicit connection between the runway and the 747. Infrastructures can also be related to the connection between different information systems. As long as they are related to each other in some way, they are connected in the same infrastructure.

Some decades ago, connection between different information systems was not very common. One reason was their isolated use. Traditional information systems are characterized by being isolated, local and unique (Coiera, 2003; Hanseth, 2002; Hanseth and Monteiro, 1998). They are stand-alone based and used to solve specific problems and work tasks, often with a special function or purpose in mind (Coiera, 2003). Such separation makes them very restricted to the work task they are supposed to handle. For example, if the needed work task differs from the intended meaning of the system, the system might not able to support the needed work tasks, which in second turn might cause the system to be useless.

Information Infrastructure is different. It concerns about the connection of various information systems rather then seeing them as stand alone systems. The relevancy of thinking in infrastructures is gained as more systems are connected to each other. Regarded the multiplicity of mobile phones, mobile television and internet, it becomes naturally to think that the daily based information systems are not that isolated anymore. The clear typical borderline between the different systems is erasing, because it is harder to separate them and see them as stand alone based systems. The integration of the Information Infrastructure grows as the number of systems grows (Hanseth, 2002). The interests of the connections between different systems are the fundamental basis of Information Infrastructures. Information Infrastructures is also an increasingly used term and refers to the ongoing fusion between information systems and Communication Technologies (Hanseth and Monteiro, 1998).

Despite the fact that the technological evolution has made it difficult to distinguish information systems from each other, the traditional way of describing information systems is still common. Coiera (2003) for instance argues that information systems can be seen as a routine or regular way of working in that sense that they repeat the same work tasks over and over again. If we consider traditionally information systems in that sense that they handles specific problems, they can be seen as technical tools and isolated facilities doing some work (Coiera, 2003; Hanseth, 2002).

Since traditional information systems have special intentions in mind they can be split into separate parts, like closed boxes. This might affect the systems possibility to be shared, especially if the other surrounding “boxes” do not cover the same compatibility. The metaphor describing stabile information systems is often called “Black boxes” Traditional information systems might be very stabile in limited use, but as bigger they grow as more difficult will it be to keep them isolated. The challenge of keeping the “Black box” stabile increase as the size of the system increase, because as it increases more surrounding elements will influence.

Coiera (2003) argues that developers design information systems on the basis of using models or templates as an abstraction of the world. Seeing the world in templates might be good in small systems, but as it is an interpretation, the outcome might be different as templates might differ from one system builder to another. For instance, if you are supposed to create huge systems, you also have to have huge templates. Otherwise you might be able to loose some important information. The bigger the systems are, the more difficult will it be to keep on looking at information systems as isolated parts.

Traditional designs of information systems are characterised by following a strictly made plan, carefully controlled by project managers (Hanseth, 2002). The design project is assumed to have well defined start and ending time. The design is an event, not an ongoing process (Orlikowski 1996). The aim is to develop closed systems, made for a specific purpose by a closed project organization, within a closed time frame. Traditional information systems designs contributes to special users needs, and often are the technical solutions derived from these users needs (Hanseth, 2002). Listen to users should of course be seen as beneficial, but satisfying users are still difficult (Hanseth, 2002). The reason is the complexity of users' work practices the systems are intended to improve.

Information Infrastructures are much more opened compared to the traditional way of looking at information systems. They consider connectivity, integration and standards, and put their attention to the connection between different systems. Infrastructures are in fact considering standards as crucial elements. Standards become very relevant in the fundamentality of integration (Lenz et al., 2002). Thinking in terms of infrastructures will contribute to better collaboration between different parts or systems within their same network. It has no limitation. It includes human beings as well as machines (Hanseth and Monteiro, 1998; Hanseth, 2002). According to the just mentioned authors, Information Infrastructure includes several key aspects. These key aspects play an important role to understand the infrastructures potential and are mentioned below.

3.2.1 Enabling

Information Infrastructures have a supporting or an enabling function. This means that Information Infrastructures are well suitable to include new inventions, for example new systems, technical issues or organisational changes. Infrastructure evolves as a consequence of technological change.

3.2.2 Shared

Infrastructures are also shared among its involved actors. It can be seen as one irreducible unit shared by a larger community, for example a collection of users and user groups. It is in contrast to traditional systems not limited to special use. It can't neither according to Hanseth and Monteiro (1998) be split into separate parts. It is irreducible as a consequence of being used by all its users. Each part of the Information Infrastructure is linked together using standards. The standards are a shared resource or a foundation for a community (Hanseth, 2002). When one application is integrated with others, trough information exchange, these other applications are becoming dependent on what already exists.

3.2.3 Socio-technical network

Information Infrastructure can not work without supporting people and people using it properly (Hanseth and Monteiro, 1998). This means that the users are very important in the sense of Information Infrastructures. The users and the information systems are all connected together.

3.2.4 Open

Infrastructures are open, because of no limits in the numbers of users using it. Another characteristic is that they have no beginning and end because its developing time is opened (Hanseth, 2002). You can not distinguish Information Infrastructures with borderlines like you can in the traditional way of looking at systems (Hanseth and Monteiro, 1998). Users can be both human and non-human actors, which support the relevancy of Actor Network Theory (See chapter 3.3). The amount of users, involved vendors, nodes in the network, application areas, network operators and other technical and social factors are not limited according to Hanseth and Monteiro (1998), and since Information Infrastructures are not limited they are very open to new technology and additional organisational changes.

3.2.5 Heterogeneous

Information Infrastructures include components of different kinds, both technological and non-technological (Hanseth, 2002). Non-technological components could for instance be human beings and organisations. Information Infrastructures are therefore heterogeneous. Information Infrastructures are built of different layers which can be illustrated by internet for instance (Hanseth and Monteiro, 1998). What is important is that all these layers are a part of the infrastructure. Something else which clearly illustrates the contrast to the traditional way of looking at information systems is that Information Infrastructures includes standards covering the same area in terms of functionality. This means that both Windows and Linux, for instance, could be seen as parts of the same infrastructure (Hanseth, 2002). Traditional information system thinking would clearly distinguish these operating systems apart.

3.2.6 Installed Base

The state of the current Information Infrastructure is called an Installed Base. Examples of an Installed Base can be all information systems at a hospital. The way the Information Infrastructure evolves is a consequence of cultivating the shared, opened, socio-technical heterogeneous Installed Base (Hanseth and Monteiro, 1998; Hanseth, 2002). Since all elements are connected, it is crucial to remember the importance of standards which are the elements that connect the different parts together. The Installed Base exists, but standards make the different parts able to communicate.

As time passes, new requirements might have to be adapted by larger organisations. Such requirements must fit into the existing Installed Base. This is simply because the whole Information Infrastructure can not be instantly changed, since this would be like starting out of nowhere where nothing exists, and then rebuild the infrastructure. Information Infrastructures are not designed from scratch. You can not throw it away and start from scratch again, which might be a common Process Innovation idea. New technology has to be connected to the existing Installed Base (Hanseth and Monteiro, 1998), and since Information Infrastructures include heterogeneous elements, all elements must be considered when the goal is to do changes. Actor Network Theory for instance concerns about the connection between these heterogeneous elements.

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3.3 Actor network theory

Actor Network Theory (ANT) was developed by Michael Callon, Bruno Latour and John Law in the early 1980's. It is a distinctive approach to social theory. The theory argues that all kinds of things, human (subject) as well as objects can be viewed as actors or actants. The words actants and actors are often used interchangeable. To give non-human elements a role as actors might for someone seem a bit controversial, but according to Law (1992) it should be considered as an analytical stance, not an ethical position.

Use of Actor Network Theory is very suitable to understand the connection between human and technology. It is characterised by linking technical and non-technical elements together by placing them in the same network (Monteiro, 2000). Such relationship between technology and people has not been highly focused on in information system Research (ISR) before. The lack of such connection might, according to Giuse and Kuhn (2003), be the reason for many information system failures within healthcare. To make it even more clearly, only 12.5 % of the articles in Information System Research have had a perspective on the interplay between people and technology (Orlikowski and Icano, 2001). Actor Network Theory focuses on how the human and non-human actors are connected and influenced by its surrounding environment (Monteiro, 2000; Aanestad, 2003). It might be suitable to understand and maybe improve the connection between the different parts of the health care organisation. The Health Care System is complex, built very much on heterogeneity. It sounds natural that the social factors should be considered at the same extent as technological factors, an argument also supported by Giuse and Kuhn (2003).

To get a better understanding of Actor Network Theory, we can take a look into the aspects of Technological Determinism and Social Construction. These aspects are fundamentally different and can be used to illustrate two directions or ways of look at technology. The Technological Determinism is kind of a top-down approach and argues that technical forces determine cultural and social changes; a relevant example would state that an effect of a technological implementation does not dependent on the type of organisations. The technology will determine its use (Monteiro, 2000). Social Construction argues that social and cultural forces determine technical change which is a kind the opposite way of thinking, illustrating that the technology itself does not play an important role, because it is always social constructed (Monteiro, 2000). To understand it even more clearly we can look into an example, taken from Pandoras hope (Latour, 1999), about the way people kill with the use of guns. A deterministic way of thinking is that guns kill people. Social Construction will argue that people are the killer. Both of these arguments are important, but it should also be very sensible that a gun can not kill by itself and that people cannot shoot without guns. The killer is shaped as he holds the gun in his hand and pulls the trigger.

Thomas Hughes (1994) argues that both concepts, the Technological Determinism and Social Construction, will influence the outcome of the society, and argues that the society both shapes and is shaped by the society itself. Akrich (1992) agrees and claims that neither Technological Determinism nor Social Construction can be stated as a correct view, as they are opposite ways of thinking and do not explain how the structure of links between actors are built, maintained and stabilized. Technological Determinism pays no attention to what is brought together and ultimately replaced by the structural effects of a network. Social Constructions deny the obduracy of objects and assume that only people can have the status as an actor. In the sense of Actor Network Theory all actors are connected and will influence the totality. If you change one actor in an infrastructure, this will influence the other actors as well (Aanestad, 2003; Hughes, 1987). According to Information Infrastructures you can not isolate the included parts. The correct view of the Actor Network Theory is then to put it somewhere in between these two extremes (Hughes, 1994; 1987). In other words, the result of the technological and organisational configurations is depended on how well the interaction between Technological Determinism and Social Construction is shaped. Actor Network Theory is positioned within the broader landscape of conceptualisation of technology and society (Monteiro, 2000).

Latour (1987) argues in his book "Science in Action" that new technology might be very dependent on other actors in relation to how it will be used.

"The fate of a statement depends on other's behaviour" (Latour 1987, p 104)

Latour (1987) argues that other people are necessary to make something decisive. For instance, if you are lucky to invent something really useful, the idea is still dependent on how well other people are willing to use the invention. Latour (1987) uses a metaphor and argues that if no player takes it up, it simply sits on the grass (Latour, 1987). Latour (1987) do also pays attention to the creation of the Diesel engine, and ask: Was it really Diesel that invented the engine? Diesel invented the patent, but the engine itself needed a lot of modifications performed by other people or companies (MAN for instance) to make the engine run smoothly all over the world (Latour, 1987). Diesel claimed that it was his original engine which had been made by others. However, several of Diesels colleagues argued that the credit should go to the hundreds of engineers who had been able to transform an unworkable idea into a marked product.

“The object is modified as it goes along from hand to hand. It is not only collectively transmitted from one actor to the next; it is collectively composed by actors” (Latour 1987, p 104)

This means that the use of new technology is not only dependent on the technology itself, but also on the organisation and users who will use it. The implementation and development of the new technology then depend on all involved actors. The different actors are aligned in a network where they shape and reshape each others dependent on their relationship. This means that the characteristics of the involved actors will play a major role about how the new technology will be developed and used.

“An actor network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of” Callon, 1987, p 93)

The overall idea about Actor Network Theory is that whatever you do, you will be influenced by the surrounding elements in less or larger degrees. When you are driving your car for instance, you will be influenced by traffic regulations, prior driving experiences and your cars manoeuvring abilities (Monteiro, 2000). The point is that all factors are related or connected to how you act (Monteiro, 2000).

“You do not go about doing your business in a total vacuum, but rather under the influence of a wide range of surrounding factors” (Monteiro 2000)

3.3.1 Translation

One of the main concepts in Actor Network Theory is translation. This is a process of generating ordering effects such as devices, agents, institutions or organizations (Law 1992). Told in another way it is a process where negotiation takes place and different interests are aligned (Hanseth and Monteiro, 1997; Monteiro 2000). Such negotiations and alignment of interests are usually performed in social processes, where actors have a diverse set of interests. The stability of the outcome is dependent on the ability to translate, which is, re-interpret, re-present or appropriate others interests in to one own (Monteiro, 2000). Since different actors have a diverse set of interests, which can influence the outcome, more actors involved will enable a broader support to the outcome (Monteiro, 2000; Hanseth and Monteiro, 1997). "Interests" are according to Latour (1987) what is laying between the actors and their goals. The different interests creates a tension that will make actors only select alternatives, which in their own eyes, helps them reach these goals amongst many possibilities. Callon (1991) describe translation this way.

> *"A translation presuppose a medium or a material into which it is inscribed, that is, translations are embodied in texts, machines, bodily skills, which comes their support, their more or less faithful executive" (Callon 1991, p 143)*

In relation to Actor Network Theory translation can be seen as design (Monteiro, 2000). The users and others interests, might according to typical ideal models, be translated into specific needs. The specific needs are further translated into more general and unified needs so that these needs might be translated into one and the same solution. When the solution is running it will be adopted by the users (Monteiro, 2000). In such a design process, the designer works out a scenario for how the solution, a system for instance, will be used. This scenario is then inscribed into the system.

3.3.2 Inscription

Inscription includes programs of action for the users. It refers to the way technical artefacts embody patterns of use (Monteiro, 2000). It includes programs of action for the users, and defines roles to be played by the users and the system. The designer is able to make implicit or explicit assumptions about what competences that are required by the users as well as the system (Monteiro, 2000).

> *"By imposing programs of actions into a piece of technology, the technology becomes an actor imposing its inscribed program of action on its users" (Monteiro 2000)*

Due to Akrich (1992) technical objects embody and measure a set of relations between heterogeneous elements. Technical objects are participating in building heterogeneous networks that bring together actors of all types and sizes, no matter if they are human or non-human (Akrich, 1992). Akrich (1992) also states that designers define actors with specific tastes, competencies, motives and political prejudices. They assume that morality, technology, science and economy will evolve in particular ways and maybe most important as stated by Akrich, (1992):

> *"A large part of the work of innovators is that of "inscribing" this vision of (or prediction about) the world in the technical content of the new object"* (Akrich 1992, p 208)

This means that the innovators visions are much based upon their possibility to create templates of the world like illustrated by Coiera (2003). The technical realization of the innovators beliefs about the relationship between an object and its surrounding actors is therefore an attempt to predetermine the settings that users are asked to imagine (Akrich, 1992).

According to Aanestad (2003) designers should consider design as design of configurations. This will enable a more holistic view or approach. Doing so will also recognize the materially heterogeneous elements as equally important in achieving the goal. As a result she argues that we should see things more in a holistic way. Akrich (1992) argues that it is important to shift back and fourth between the designer's projected user and the real user in order to describe this dynamic negotiation process of design when technical artefacts are studied. This means that it is always important to try to connect the development of new technology with its real use, not only the predicted use.

One important thing is that the inscribed patterns of use may not succeed because the actual use deviates from it. The users might use the system differently than expected, by following anti-programs (Latour, 1991). An example illustrated by Latour (1991) is a case where a manager at a hotel wanted to make sure that the guests left their keys, when they walked out. The manager inscribed many solutions in how to make sure the guest left their keys. He tried to inscribe his desired pattern into the existing actor network, but found it very difficult to succeed. By doing a lot of translations he finally succeeded. This example shows the difficulties of realising success by doing top-down approaches. It also illustrates that the choices which is taken must fit into the existing environment and into the already existing context. If it does not fit, the inscription part will be difficult to perform. The original ideas made in the translation phase must therefore consider and fit into the existing socio-technical network.

> *"Inscriptions invite us to talk about how the various kinds of materials — artefacts, work routines, legal documents, prevailing norms and habits, written manuals, institutional and organisational arrangements and procedures — attempt to inscribe patterns of use (which may or may not succeed). Inscribing patterns of use is a way to confine the flexibility of use of an information infrastructure (Monteiro 2000)*

Based one the above mentioned theory, there is a broad consensus that social expertise must be considered to the same extent as the technical expertise, and that it is important that different actors communicate on an appropriate level. The outcome is simply a result of all involved parts.

4 METHOD

The method chapter describes the research design, how the research materials have been collected and reflections on the method. The chapter put focus on the interpretive research approach. This research approach argues that the researcher should be seen as a research instrument itself. Parts of the method chapter are therefore written in a personal way.

4.1 Research design

Interpretive Research has emerged in the last decades and has become an important strand in Information System Research (Walsham, 1995). Considering the social aspects, Interpretive Research has the potential to produce deep insight into the information system phenomena, where both, management and developing of such systems are included (Klein and Myers, 1999). Interpretive Research is an underlying philosophical assumption of Qualitative Research (Myers, 1997; Orlikowski and Baroudi, 1991).

Qualitative Research methodology is an alternative research method to the Quantitative Research methodology. Robson (2002) uses the terms “flexible” and “fixed” design to illustrate those two research approaches. Both, the Quantity Research methodology and the Qualitative Research methodology are based fundamentally on the same logic of inference (King et al., 1995).

Within information system Research, the Quantitative Research methodology has usually been seen as the method of choice related to the evaluation of information systems (Stoop and Berg, 2003). It is characterised by being very suitable for establishing the size, extent or duration of certain phenomena. Quantitative Research is theory driven and are often started by making a hypothesis which either is falsified or validated. In many cases the research is planned from the beginning (Robson, 2002). Such methodology is well suited in establishing a causal relationship between different variables (Robson, 2002). For instance Randomised Control Trials, a quantitative study approach, is often viewed as the “Gold Standard” within research, and have been widely used if decisions makers want to establish evidence that something works (Robson, 2002). The disadvantages of doing quantitative approaches in information system Research might be related to the fact that you have to make a plan before you start the study. Such planning can also be related to positivism which states that the only authentic knowledge is scientific knowledge, and that such knowledge only can come from positive affirmation of theories trough strict scientific methods. Positivism is often referred to as a scientist ideology. The result of the evaluation might be unsuccessful because it might fail to answer the asked question. Whether it is the asked question that is wrong or the reality that doesn't fit is hard to tell.

Interpretive Research is very different in most aspects. It assumes that knowledge of reality is gained only trough social constructions such as language, consciousness, shared meanings, documents, tools, and other artefacts (Klein and Myers, 1999; Guba and Lincoln, 1994). This means that it is, in contrast to quantitative study, very difficult to plan what to seek for. The point is to study what is "out there", in the field you are participating in. To be able to do this, the interpretive researcher involves the use of qualitative data to understand and explain social phenomena's. Research materials like interviews, observations and document analysis are common in Interpretive Research (Stoop and Berg, 2003; Robson, 2002). Interpretive Research focuses on the complexity of human sense making as the situation emerges (Kaplan and Maxwell, 1994). Because of this it might be difficult to see what is coming next. The research material is multidirectional relationships where events shape each other (Maykut and Morehouse, 1994). The researcher is a part of the study field, which makes him act like an instrument (Walsham, 1995).

Klein and Myers (1999) argue that the fundamental principle of the hermeneutic circle is relevant in all interpretive work. They suggest the idea that:

> *"We come to understand a complex whole from preconceptions about the meaning of its parts and their relationship" (Klein and Myers 1999 p 71)*

All human understanding is achieved by iterating between considering the independent meaning of parts and the whole that they form. This is also one explanation of why it is very difficult to make a recipe according the data you need to study in Interpretive Research.

When researchers carry out Interpretive Research they are attempting the difficult task of accessing other people's interpretations by the researchers own conceptual apparatus

(Walsham, 1995). This means that the independent role of the researcher participating in complex processes where humans are involved are actually influencing the field of study himself. According to Klein and Myers (1999), the concept of reality (if there is one) is interpreted differently by different people. This should make it clear that one reality seen by one participant is not necessary the same as another participant's reality. Critical reflection is therefore important regarded the researchers own assumptions and his research material collection (Klein and Myers, 1999).

According to Walsham (1995) the researchers do also have the ability to be an outsider observer or an insider observer, dependent on the participation. The outsider observer preserves a more distanced role than the insider observer, but in both cases the researchers will be subjective and influence the interpretations of those people who are being researched (Walsham, 1995). Walsham (1995) argues that if the researcher performs an outsider view, the researcher is seen as not having a direct personal stake in various interpretations and outcome. An effect of this is that the participants might be relatively open in expressing their views. If the researcher on the other hand has a possibility to become a member of the field group or organizations involved in the research within some time, and thus be an insider, he or she will have higher personal influence and greater possibilities to look into confidential and sensitive issues. The result could then be that the involved personnel will become more guarded in their expressed interpretation. Being an insider will give the researcher more possibilities to be involved in day to day happenings, than what an outsider view will do (Walsham, 1995), and increase the chance of collecting more research material and observations. But on the other hand it is also more difficult to hide research motives as an insider because of higher influence and because of the unethical position of doing such (Walsham, 1995).

According to Klein and Myers (1999) there are two types of studies related to interpretive field studies: being the in depth case study and ethnographies. Both are related, but are principally distinguished by the time spent in the field. Ethnography produces in-depth understanding of real-world social processes (Forsythe, 1999), and is therefore very suitable in design and evaluation (Forsythe, 1999; Harper, 2000). Ethnographies seek to capture, interpret and explain how a group, organization or community live, experience and make sense of their lives and their world. Ethnographies rely substantially or partly on participants observations (Atkinson and Hammersley, 1998). Case studies are characterized by development of detailed intensive knowledge about a single case or of a small number of related cases (Robson, 2002). Robert Yin (1981; 1994), written in Robson (2002), defines case studies as follows:

> *"Case studies are a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" (Robson 2002, p 178)*

Interpretive case studies, as well as other interpretive studies, are attempting to understand phenomena through the meaning that people assign to them (Orlikowski and Baroudi, 1991; Klein and Myers, 1999). It tries to make a reality picture of how people work in organisations and social contexts (Harper, 2000; Klein and Myers, 1999). Instead of generalizing one single reality performed in one study to be the reality of everyone, which is typical in Quantitative Research, the Interpretive Research related to information systems is according to Walsham (1993) to be more concerned about the relationship between the technology and its context. By doing so it is natural that the researcher must be a place between the information system development itself and the context.

> *"…aimed at producing an understanding of the context of the information system, and the process whereby the information systems influences and is influenced by the context" (Walsham 1993, p 4-5)*

It might be hard to generalise findings based on Interpretive Research, which off course should be viewed as a limitations and disadvantage. For example it has been criticized for lack of control and lack of rigor (Galliers, 1992). Generalizing based on case studies is different from statistical generalizations that are common in Quantitative Research. Walsham (1995) argues that the findings in interpretive studies should be viewed as "tendencies" which are valuable in explanations of past data, but not as wholly predictive for future situations. This means that the findings are related to the specific case. For example are case studies useful for developing new concepts. Interpretive Information System Research can for example give added value in the form of new information, and therefore how information systems can have implications for different work practices. And since the researcher is a part of his own study field it is important that he have rich insight in what he is studying (Walsham (1995).

4.2 Research material collection

The research material collected in this study is based on qualitative material such as documents, interviews and observations. The study is based on interpretive case study. Case study is chosen because I have followed a project called GiLab. My research material (data) collection can be distinguished into three main parts.

- Observations done from January 2006 until the summer of 2006.
- Summer work at Well Diagnostics AS.
- Observations and interviews during the autumn of 2006 and spring 2007.

In total I have performed more than 400 hours with field observations. In addition I have also collected relevant documents, both technical and empirical, participated in 12 meetings and performed 14 longer interviews (30 – 60 minutes), in addition to a lot of small talk interviews. The interviewed subjects have various professional background, being bioengineers, physicians, IT – employees, product developers, general practitioners, project leaders, managers, medical secretaries and registration personnel. I have interviewed and performed small talks with more people than used in the thesis. The reason to not include all is because various people have had a tendency to argue on the same issues. In total 21 various interviewed subjects are included. (Some of the research materials gathered from meetings are also included as interviews). The interviews where performed from November 2006 – June 2007. The interviewed subjects are seen in Table 1 on the next page.

The rest of the text in this section describes the research material collection.

Table 1: Interviewed subjects used in the thesis. The workplace of some of the subjects is not mentioned in detail because doing so will recognise the subjects.

NR	Profession	Work Place
1	Bioengineer 1	Medical Biochemistry laboratory
2	Bioengineer 2	Medical Biochemistry laboratory
3	Bioengineer 3	Medical Biochemistry laboratory
4	Bioengineer 1	Pathological – Anatomic laboratory
5	Bioengineer 2	Pathological – Anatomic laboratory
6	Bioengineer 3	Pathological – Anatomic laboratory
7	General Practitioner	GP Pilot office 1
8	General Practitioner	GP Pilot office 2
9	IT – Laboratory Personnel 1	UNN
10	IT – Laboratory Personnel 2	UNN
11	IT – Laboratory Personnel 3	UNN
12	Leader of PAS	PAS
13	Manager of PAS	PAS
14	Medical Secretary	GP Pilot office 1
15	Project Leader	Well Diagnostics AS
16	Project Leader	UNN
17	Physician 1	UNN
18	Physician 2	UNN
19	Registration Personnel	Pathological – Anatomic laboratory
20	System Developer	Well Diagnostics AS
21	Technical Consultant	UNN

The research project started at the end of 2005. I was introduced to a new project called "GiLab" and my supervisor asked me if I was interested in doing my master thesis on this project. I felt that digitalizing laboratory work was kind an interesting subject, so I said yes. I joined the first meeting in the end of 2005 and was introduced to both, Well Diagnostics AS and the University hospital Northern Norway (UNN). In this meeting I met physicians, information system developers and project leaders. I listened carefully and used my computer as a notebook. Everything was at this moment very unclear.

At the beginning of 2006 I started becoming a research member of the development of the project. I participated in as many meetings I could where members from the different institutions where participating. I also collected reports from meetings that I could not participate in, because of either not knowing they existed or because I did not have time. At this time the work on my master thesis was in addition to the other courses within the master study program, so I had a lot to do. The meetings where different professions were participating were called reference meetings. It consisted of project leaders, chief physicians from UNN, four general practitioners and one medical secretary. In all meetings I listened to what they said and wrote down thoughts and meanings the best way I could. I tried to reflect according to the theory we had learned. I even asked some questions, but I realised very fast that I was not much heard, so I stopped asking questions and tried to listen as much as I could instead.

In addition to the reference meetings I also got the opportunity to join Well Diagnostics AS, when they went to the hospital due to an observation in February 2006. I used the time to observe and tried to think what the company reflected as important information. During the day I was introduced to all laboratories at UNN, the laboratory leaders and the employees. I had many conversations with the employees and sketched down a map of the workflow as good as I could.

In March the project leader at UNN recommended me to hospitalize in the laboratory which used DIPS Lab. I spent three days at Medical Biochemistry laboratory, trying to figure out how the different analyses were implemented into DIPS Lab and how the analysing machines worked. I also collected a one hundred page documentation of the information system DIPS Lab. DIPS Lab is a highly used information system at UNN (See later). During the hospitalize period I was under assistance of one of the IT-member of the group called IT-lab.

Since it was difficult for me to become an insider and participate in all meetings, I got many emails about communication between the actors from UNN's project leader.

In part two of the research material collection period, the summer of 2006, I was an employee at Well Diagnostics AS. I was hired to make a documentation protocol and a training presentation for Well Interactor, the new information system in the GiLab project. I worked in an open landscape and observed the daily work of IT developers. I spent 8 weeks working for them. I got access to a lot of technical documentation, and had the opportunity to ask questions, which gave me unique possibilities to dig into the technical parts of the research field. I also got the chance to join different internal meetings, which I don't think I could have done if I was not working for the vendor. One of these meetings was a presentation for the IT department of UNN.

The last part of the data collection started after the summer holiday. The project was at this time focused on the implantation of the Service Provider Profiles, a profile showing different analyses. I noticed that more participants were included in this meeting so I got the chance to collect information from other participants than those who usually joined the reference meetings.

Later in the autumn I started visiting the different laboratories more frequently. In September 2006 the project went into a pilot phase and because of this I felt the need to document the old work flow. I took pictures, talked to people, cleared out fuzzy things and sketched down drawing about how people used to work before the system began to become digital. I showed my findings to my classmates and supervisor and got some feedback from them as well. In addition to this I also spent some hours at one of the pilot GP office talking to the medical secretary.

At this moment our course about Interpretive Research had started, so I really understood why it is important to document my observations. I bought a voice recorder and started to perform interviews. I felt I was a bit late doing interviews and thus performed my first 3 interviews in one and half week. The rest of the interviews were regularly done afterwards until I finished my thesis. I put my focus on interviewing workers at the hospital as I had no problems in making appointments with them. Talking to general practitioners was much more difficult as they were not very interested in appointments. I still managed to get some information from them though.

In the last semester as a student I felt very independent and was frequently visiting the hospital, doing small talks and interviewing a lot of people. I used the voice recorder everywhere I was permitted to do so, but I felt it sometimes uncomfortable to use it in all situations, especially when I talked to bioengineers working because I felt that it would be too formal. In these cases I used my note book. The result was a lot of written and recorded research materials and quotes.

4.3 Reflections on method

As already mentioned it was not clear to me what I was about to study when I was introduced to the GiLab project. It was like a lot of unlearned elements floating around in the sky. It was like a melting pot observation. My previous education as a radiographer and radiation therapist in addition to my previous summer work as a medical secretary helped me, but still a lot were unanswered when I started my work. This reflection can be pointed to the Klein and Myers (1999) fundamental principle of the hermeneutic circle as human understanding is achieved by iterating between considering the independent meaning of parts and the whole that they form. In my case I was a part of the whole, with a lot of details I had to dig more into. I had to listen to what people said in the meetings, be reflected about their different meanings, discover which participants which was more heard and look into the interaction of the workers and their daily work. According to Benbasat et al. (1987), researchers should be more explicit about their research goals and methods. In my case I felt this was very difficult. First of all, how could I make up a research goal in something I did not know much about? Secondly, how could I choose an adequate focus, when I was not near to have a holistic view of the “whole” I was participating in? According to Klein and Myers (1999) the whole consists of the shared meanings that emerge from the interactions between the actors. Doing positivism research could consequently be a challenge since my preconceptions could and maybe would lead me into a track only absorbing what I wanted to see. Walsham (1995) argues that thick descriptions are necessary to understand the complexity of an information system and its involved human beings. He also illustrates that an information system researcher can only observe the changes of interpretations trough thick descriptions. In my observation I felt this as really an important reflection. During my time in the field I had a lot of preconceptions. I was very critical in the beginning, partly because of what we had learned during the telemedicine course, and partly because of my overestimation of my own knowledge. I figured out that my preconceptions and reality changed as I my knowledge increased. I felt the need to perform further discoveries as more I learned. As a matter of fact I really wished I had understood this fact when I started my work so I could use more time in the field.

But staying too long in the field can also be challenging. The time spent in the field is what distinguishes ethnographies from in-depth case studies (Klein and Myers, 1999). In my case I could not stay in the field each day as I also had other things to do. In addition the research project involved many actors working in parallel settings which could put me into the dilemma needing to be at two places at the same time. I therefore had to frequently alternate and visit different actors. Since it is the time which distinguishes ethnographies and interpretive case studies apart, there are still possibilities to use ethnographic skills in interpretive case studies. Additionally, according to Van Maanen (1979), the researcher have no guarantee for collecting valuable data no matter how long he or she stays in the field. This is because the concept of finding the valuable data relies on good theory and insightful analysis which may not be provided by the research material collection itself. The researcher needs to reflect upon his or her own assumptions, which is illustrated in Klein and Myers (1999) third principle for interpretive field research.

> *"Requires critical reflections on how the research materials ("or data") were socially constructed trough the interactions between the researcher and the participants" (Klein and Myers 1999, p 72)*

I figured out that this principle is important the more I looked into the research field. The more I discovered the more did I see. I became critical to my own interpretation of the reality, and felt the need to do more discoveries. The result was higher knowledge, but also higher degrees of complexity. The research field had become an open field with no ends. I started thinking that reality was not as I assumed it to be. I became more critical about my own assumptions. When I realised this I became much more opened, something which also has influenced on my own personality.

According to Walsham (1995) there are alternative stances on reality and knowledge based on the terms epistemology (theory of knowledge) and ontology (conceptions of reality).

Taking ontology as an example, the reality can both be external and internal. The external view interprets the reality as existing independently of our construction of it. The internal view interprets the reality as an individual cognitive assumption (Walsham, 1995). Saying that the reality both can be internal and external make no sense to what is the real truth or real reality. On the other hand it clearly shows the importance of Klein and Myers (1999) third principle.

One important point is that people's assumptions might only be parts of the whole, like the internal reality is a part of the external reality. In addition the researcher might influence what people actually are saying. When I realised this I clearly understood that the "fact" one person told me, could be very different from what another person was telling. To document everything you do is therefore very crucial, something which is clearly described by Eisenhardt (1989).

> *"one key to useful field notes is to write down whatever impressions occur" (Eisenhardt, 1989 p 539)*

When I was working for Well Diagnostics AS during the summer of 2006 I got the chance to become what Walsham (1995) illustrates as an insider. I had the chance to look into the daily work of the vendor itself. This was an extremely exiting experience. Unfortunately I did not know much about research methods at that time, so I could not make reflections to the theoretical aspects of the Interpretive Research methods. I tried to be as open as I could, but my preconceptions were too influential, which could restrict the view of the external reality as well as loosing insight. Klein and Myers (1999) illustrates in their fifth principle the importance of being sensitive to possible contradictions between the theoretical preconceptions guiding the research design, and actual findings with subsequent cycles of revision. This principle illustrates the needs to always compare your preconceptions with the actual findings.

Being an insider was also special. I noticed during the summer work that I asked much more questions in the beginning than in the end. As a consequence of working at Well Diagnostics AS my preconception changed from being critical to become more honoured. I was guided into become more narrowed in my views, forcing me to change my comprehensions about the work field. I was loosing my conceptions of the whole because I spent a lot of time in one element of the whole. The result was that I became less reflective and took more for granted. According to Forsythe (1999) competence as an insider does not make one to become an accurate observer. Ethnography works best when conducted by an outsider with considerable inside experience. This is because the researcher can then analyze it trough systematic comparison between inside and outside views of particular events and processes. I felt that I was loosing my critical view as longer I worked there. During my work I was able to talk with Well Diagnostics AS, listen to their meanings and was able to look into their thoughts and visions. I agree with Walsham (1995) when he argues that being an insider gives possibilities of having a personal stake in various situations. I was able to influence the product I was studying. I really liked the way they listened and gave me chances to influence.

According to Harper (2000) a description should be rich enough and detailed enough to make some observed behaviour understandable. Getting thick descriptions might be challenging as it require a lot of insight to what people actually do. You can not only listen to what people say as what they say might be different from what people actually do (Forsythe, 1999). To meet this fact it might be natural to think that more time in the field is necessary, but it is also important to ask many informants since they might have different opinions. According to Walsham (1995), interviews are the primary data sources performed by an outside observer. Robson (2002) argues that a key issue for all interviewers is the balance between excessive passivity and over-direction. Robson (2002) mentions that interviews can be fully structured, semi structured or unstructured covering the same intension as Walsham (1995). The point is that if the interviewer directs the interview too closely and refuses to allow the interviewees to express their own views except in response to questions that are tightly controlled by the researcher, then the data obtained will lose much of the richness of interpretation which is the raw material of sensitive interpretive studies (Walsham, 1995). This is because the researcher can trough the interview best access the interpretations that participants have regarding the action and events which have or are taking place, and the views and aspirations of themselves and other participants (Walsham, 1995).

My first interview was based upon a lot of questions that I would like to ask. But when I was in the middle of the interview I sensed that it is not an easy task to ask questions on a row. First of all I discovered that the more as I talked the more I guided the interview subject towards my own presumptions. I even managed to interrupt subjects in such a way that I completely missed what they was about to say. I realised this most when I transcribed or listened to the interviews. I therefore decided in my next interviews to be very opened and let the subjects speak as much as they could.

Since I frequently used the voice recorder I have to admit that I did not transcribe all interviews. The time which is needed to transcribe interviews are enormous. I have collected approximately between 15 and 20 hours with quotes and since I felt it was hard to ask questions on the row, my interviews was mostly open ended and much more like a conversation than interviews. I frequently listen and reflected upon my interviews which in my opinion became very important. To listen to the interviews in different time periods are important because I felt that my interpretations changed as time went by.

During my observations I also realised that the best way of studying is being in the field. It is not smart to be too much driven by theory. I agree with Walsham (1995) that theory is a good way to be motivated to create an initial theoretical framework. But, my reflections also makes me agree with Walsham (1995) when he claims that the researcher might only see what the theory suggests, and thus using the theory in a rigid way that which stifles potential new issues and avenues of exploration. I was not aware of this fact when I started my research material collection.

One of the most important things I have discovered by doing Interpretive Research is as told that I must be very good at documenting my work done in the field. The issue of reporting field work is also according to Walsham (1995) very critical in interpretive field study as it is more difficult than positivism to report facts. Interpretive studies do report interpretation of other people's interpretation. It is therefore important to be opened to the research materials as Walsham (1995) argues:

> *"There is a need to preserve a considerable degree of openness to the field data, and a willingness to modify initials assumptions and theories" (Walsham 1995 p76)*

5 THE STUDY

The Study describes the main actors involved in the case, Well Diagnostics AS, University Hospital Northern Norway (UNN) and the general practitioners.

5.1 Well Diagnostics AS

Well Diagnostics AS is a Norwegian computer software developer located in Tromsø and Oslo. The Company was established as a spin-off from the Norwegian Centre of Telemedicine in 2000 and has a wide background of making health related computer software products. Their goal is to facilitate cooperation and secure exchange of information within the health care sector. This means that they are focusing on communications among health care actors, especially between the primary health care and the specialised health care services. Their product Well Communicator has become a major success and widespread software used to exchange health care messages like electronic discharge letters and laboratory results. Other products are Well Arena, Well Multimedia, Well Integrator and Well Sykehusbooking (www.well.no).

Well Diagnostics AS has by date 12 employees. They work relatively closely with other vendors in the health care market, most notably Profdoc AS and DIPS ASA. Profdoc AS provides systems for primary health care, for example general practitioners (www.profdoc.no) and DIPS ASA for hospitals (www.dips.no).

Well Diagnostics AS has in the later years become a fast growing company. From 2000 to 2004 they expanded in growth by 480 %. This increase ranged them to become number 117 among the growth of 500 technological companies within Europe, the Middle East and Africa. They have also been ranged as number 24 among Norwegian companies. In the beginning of 2006 they acquired GetMedics AS, a company specialised in booking systems for health care services, resulting in higher influence in the Southern Norway (www.well.no).

5.2 The University Hospital Northern Norway (UNN)

The University Hospital Northern Norway (UNN) is the biggest health care institution in Northern Norway. The hospital is driven and owned by the Health Authority Northern Norway (Helse Nord), and is a part of the Norwegian Specialised Health Care System. From January 2007 the hospitals in Narvik and Harstad did also become a part of UNN (www.unn.no).

The hospital has approximately 4500 employees, contains 461 somatic beds and 158 psychiatric beds. It has a running expense of NOK 3.3 billion and a budget of NOK 3.5 billion, (European billion). UNN is also involved in research and educates health care personnel (www.unn.no).

5.2.1 The different laboratories at UNN

UNN has six laboratories. Each laboratory's role is to analyse samples coming from general practitioners and internal departments, but also to deliver the diagnostic epicrises back to the sender. These six laboratories had an ability to analyse 1159 different types of analyses in 2003, and within the Health Authority Northern Norway, UNN is the only hospital analysing 718 of these types (UNN Document 1). Additionally the quantity of analyses performed for external requisitioners was more than 1 million in 2002 (UNN Document 3). The quantity of analysis distributed by each laboratory varies and can be seen in Table 2 on the next page.

The majority of the staffs in the laboratories are bioengineers, but the laboratories do also involve physicians, secretaries and other employees. The workflow is different among the laboratories, and the laboratories are divided into several premises in the hospital as well. The laboratories are also using different information systems (See Table 2).

All laboratories both analyse samples coming from general practitioners and from internal requisitioners. Internal requisitioners are able to use the information system DIPS Lab when they order analyses to Medical Biochemistry laboratory, Clinical Pharmacy laboratory and the Immunology and Transfusion laboratory, while they must use papers when they order services from the Pathological - Anatomic laboratory for instance.

Table 2: Illustrates the laboratories at UNN, number of analysed analyses in 2002, both in total and external (GP's), connected general practitioners, implemented information systems and the status of the ability to receive internal/external electronic requisition until September 2006.

LABORATORY 1421 282	**QUANTITY OF ANALYSED ANALYSES (2002) External ( )**	**CONNECTED REQUISITIONERS**	**INTERNAL ELECTRONIC REQUISITION/ EXTERNAL ELECTRONIC REQUISITIONS**	**IMPLENTED INFORMATION SYSTEM (Vendor)**
Medical Biochemistry	1601236 (85476)	1342	YES/NO	DIPS LAB (DIPS ASA)
Clinical Pharmacy	25170 (7670)	861	YES/NO	DIPS LAB (DIPS ASA)
Immunology and Transfusion	241050 (23244)	1106	YES/NO	DIPS LAB/ LabCraft (LabCraft AS)
Pathological - Anatomic	57726 (45797)	1315	NO/NO	Sympathy (Tieto Enator)
Microbiology	407874 (-)	1421	NO/NO	NSML (Tieto Enator)
Medical Genetic	2727 (936)	282	NO/NO	-

Partially source: UNN Document 1 and 3.

5.3 General Practitioners

When patients become sick general practitioners are usually the first part of the health care service they are contacting. In many cases the general practitioners depends upon the Specialised Health Care System to achieve the demand of treatments according to the patient right law § 2-1. The general practitioners can be viewed as gatekeepers for the Specialised Health Care Service. For instance there are many services they are not able to carry out themselves. This means that the Specialised Health Care Service can be viewed as a service provider to the Primary Health Care Service.

Many general practitioners are familiar of using electronic patient records (EPR). The use of such records has increased in the later years. There exists several different EPR's (See section 6.4). Each is aimed to include patient information, previously illnesses, epicrisis and discharge letters. The use of electronic patient records has become an important part of the general practitioners daily work. More than 4000 requisitioners were connected to UNN in 2002 (UNN Document 1). The four different general practitioner offices included in GiLab is seen in section 6.5.

6 THE CASE

6.1 Background

The Hospital of Northern Norway (UNN) is very concerned about delivering and providing their customers values and quality. They want to give patients the "best" treatment, act like a competitive service provider and be innovative (www.unn.no). Besides this wish of being innovative their possibility to receive laboratory requisitions from general practitioners are still paper based. The general practitioner must fill out special made paper sheets when they order laboratory services. This procedure is considered as ineffective and difficult solutions, and it lacks efficiency and adequate quality. In addition each laboratory does also use different types of paper requisition sheets, dependent on the analysis requested. In total seven such different paper requisition sheets exists.

Because the laboratories are isolated from each other, double registration of the same patient information occurs, if one patient needs analysis's at two or more laboratories. When the general practitioners order services they must distinguish between different paper requisition sheets according to the analyses they are ordering.

Additionally, only one copy of each paper requisition exists. Each patient must therefore bring the filled paper requisition to the medical secretary which usually performs the samples collection when the patient visits his general practitioner. The requested analysis's is not documented. This might cause some trouble if the general practitioners want to retrace the requested analysis.

> *"We did not have any documentation between we sent the requisitions and sample tubes until we got the answers back" "When we got the answer we had this documentation" "If for example one patient had seriously pain in his stomach, and we wanted to do some hepatic tests, blood present and so on, and the patient came back the next day on a acute condition, it could be very helpful to know which tests that had already been taken as we do not get answer back so fast" (Medical Secretary, GP Pilot Office 1)*

Using paper sheets has also been considered to have some other disadvantages. These are seen below (GiLab Project plan 2006, p 7).

- *Low integrity as data can be changed during transportation.*
- *Patient sensitive data might be accessed by a third person.*
- *High error rate exists related to marking, transmission, reading and registration.*
- *Physical samples which disappear are not discovered.*
- *There are no user help filling out the requisitions.*

After sample collections by the general practitioners, the tubes containing the samples and the requisition sheets are packed together in a package and delivered by the Post Service to the service provider (UNN) (See Figure 2).

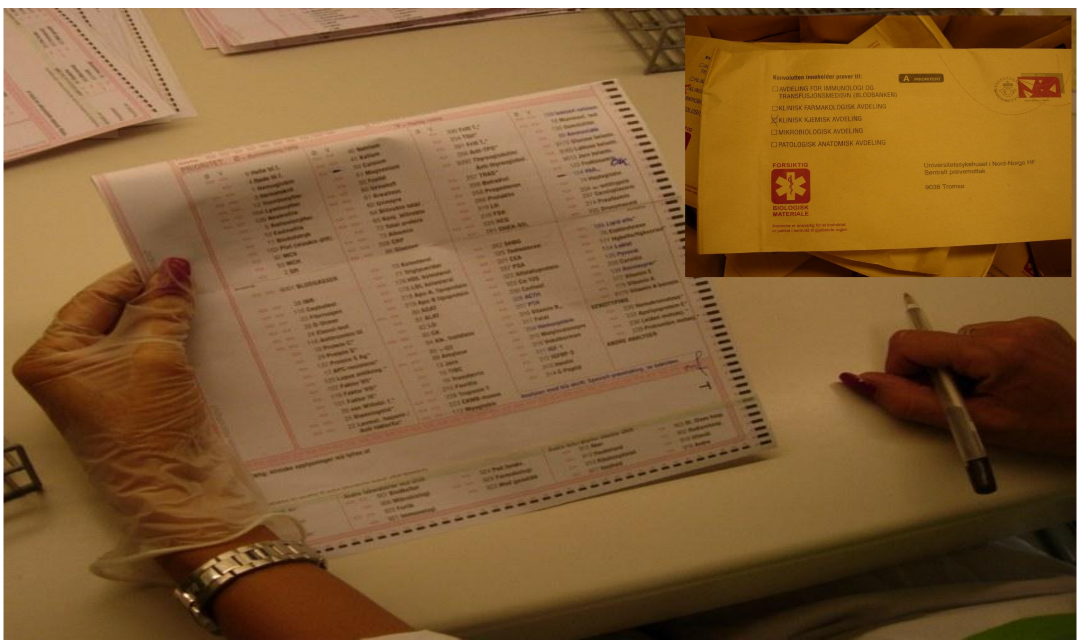

Figure 2: A Medical Biochemistry requisition and its package used to send the paper requisition and the sample tubes.

A lot of the requested analyses, analysed at UNN, have been collected by external requisitioners. This means that a lot of UNN's information flow and organisational work is based upon receiving paper based requisitions. The complexity of work flows between the different laboratories varies and influences the way the different laboratories use the paper requisitions in their daily work (See chapter 7).

All laboratories at UNN have electronic information systems implemented and use these systems more or less in their daily work. The different information systems contain patient information, data of earlier analysis and historical clinical information. But even though the laboratories use information systems, a lot of their work flows are still very dependent on administrating paper requisitions. This means that even if electronic information systems are well implemented, there is still a long way to go before the laboratories are totally free of papers. The case at UNN is a good example of the duplicate use of information systems and papers.

The problems of using paper based requisitions are that it demands a lot of registration work. Human resources are needed to register the paper requisitions into the different information systems. And since the laboratories are not located at the same area, they have a reduced possibility to communicate with each others. The paper based solution do not only requires additional work for general practitioners, but also for UNN themselves. The substantial manual work is very time consuming, and to find solutions to reduce this manual work is one of UNN strong wishes.

6.2 The GiLab project- ambitions and goals

The management at UNN hope that they will save human resources and create a more seamless information flow if they can be able to establish a possibility to receive requisitions from general practitioners electronically. To meet the challenges described in section 6.1, Well Diagnostics AS and UNN started a project called GiLab at the turn of the year 2005 - 2006. Well Diagnostic is the developer, UNN is the customer, and the general practitioners will be the main intended users.

The new system is called Well Interactor and is expected to create a tighter integration between primary and specialised health care. It will for example contribute to improved communication possibilities, higher reliability, and higher security and give general practitioners access to information stored at UNN (GiLab Project Plan, 2006). The GiLab project is partly substituted by “Innovasjonsløft Nord”, a public project group established in 2004 intended to support innovative projects (www.aksjonsprogrammet.no).

The project's main goal is to realise and introduce the new system which will enable secure and real-time access and ordering of medical services. The system will be introduced at UNN in relation to the establishment of the new Pre-Analytic Service Unit (PAS) in 2006.

Well Interactor let general practitioners choose medical services directly from their computer. Such solutions have just recently started in Europe and Scandinavia, and is characterised by having low circulation and low user-friendliness (UNN Document 4). An example from Denmark found in the document shows that only 5% of the general practitioners use such systems. The reason is said to be caused by lack of health care expertise among the system developers and lack of users involved in the decision making process. In contrast the GiLab project will be developed in close collaboration with the users (UNN Document 4).

The GiLab Project is considered as a short and a long run project.

> *"This can at a point of departure be considered relatively as a short project where the delivery can be a part of the marked within approximately one year" (UNN Document 2 p 1)*

> *"Another way of looking into the project is to look at it as a part of the development within a huge field where the whole health care sector are challenging huge modernisations to increase efficiency and quality" (UNN Document 2 p 1)*

The project is assumed to be beneficial for UNN and will contribute to the hospital's vision of increasing its role as a service provider.

> *"To make UNN succeed in relation to deliver appropriate services at correct time, new communication solutions between the primary and specialised health care system are needed. This implies both, the development of new technological solutions and the accommodation of known solutions in new relations demanding expansion regarded persons, systems and organisations" (GiLab Project Plan 2006, p 6)*

In addition, the vendor and system developer, Well Diagnostics AS, will benefit. The product will give Well Diagnostics AS a possibility to create a future oriented product, most probably increase their marked share, and let the vendor take parts in higher tendering possibilities.

> *"Our ambitions in this project are to be able to sell it to as many customers as possible" (Project leader, Well Diagnostics AS)*

An additional driving force can be related to the success of other areas outside the health care sector.

> *"It is a paradox that it has been developed solutions for bank services, commodity trades and auctioneering, while the health care sector has kept unpractical and heavy information exchange to its users" (GiLab Project Plan 2006, p 6)*

The intention of Well Interactor is to decrease costs, improve quality and increase efficiency related to information flows between requestioners and service providers. It will also employ new communication possibilities beyond the traditionally message based systems used to exchange discharge letters and epicrisis's. It will among others create new interactive possibilities.

> *"Considering all new possibilities enabled by the modern health care network it is natural to believe that some medical services can be improved and/or simplified by letting some or all parts of the information exchange becomes interactive. Well Interactor is a product which in a much larger extent utilizes the possibilities a modern health care network offer and is an important supplement to the daily used message based messages exchange within the health care sector". (Well Interactor Product description 2006 p 3)*

The possibilities of interactivity let each general practitioner be more informed about the services UNN offers. The general practitioner can for example access the service provider's laboratory procedure book from his own computer. Other possibilities among others are *dialogue, inspection, booking, and status* (Well Interactor Product Description

2006 p 7).

Dialogue enables possibilities to perform real time conversations between the primary and specialised health care. *Inspection* gives requisitioners opportunities to access previously given answers made by the service provider. Online *booking* possibilities of medical resources delivered by the service provider is handled by booking functions and *Status* enables possibilities to collect status about previously ordered services. The interactive services are one of the functions in Well Interactor which gives this product high credit regarded other compared system.

UNN's ambitions to save manual human resources are seen below.

> *"A quantitative goal is to reduce manual paper registrations, insufficient filled paper requisitions and double registration equally to 10, 5 man labour years" (GiLab Project Plan 2006, p 7)*

By reducing the amount of manual work more resources can be scheduled to the professional health care work. Other goals found in the GiLab project plan are seen below (GiLab Project Plan 2006, p 7-8).

- *Develop an electronic requisition client [smart client] which is implemented to the Medical Biochemistry laboratory, Clinical Pharmacy laboratory and the Immunology and Transfusion laboratory..*
- *Integrating the requisition client with Profdoc Journal system.*
- *Develop functionality solutions (Site Server) which handle requisitions queues and receipts.*
- *Run a pilot period of electronic requests towards DIPS-laboratories after creating the Pre-Analytic Service Unit at UNN.*
- *Develop the Smart Client to also cover the Microbiology Department and the Pathological - Anatomic Department.*
- *Run a pilot of electronic requisitions towards the rest of the laboratories at UNN.*
- *Make it possible to add services without the need for a new sample.*
- *Seek samples which are missing or lost under transportation*

- *Contribute to increased quality and reduce diagnostically errors.*
- *Contribute to shorter treatment time and lower degrees of treatment errors.*
- *Reduce repetitive work processes.*
- *Reduce the frequency of errors related to the management of requisitions and tests.*
- *Increase logical control related to the analyse activity. "*

The project is planned to finish in May 2007 (GiLab Project Plan 2006, p 7). When the product is finished it will be implemented to general practitioners within the Norwegian Health Network. The goal is to fill a marked requirement.

The technical construction and the technical descriptions of the GiLab project are illustrated on the next two pages.

6.3 The GiLab project - Technical construction

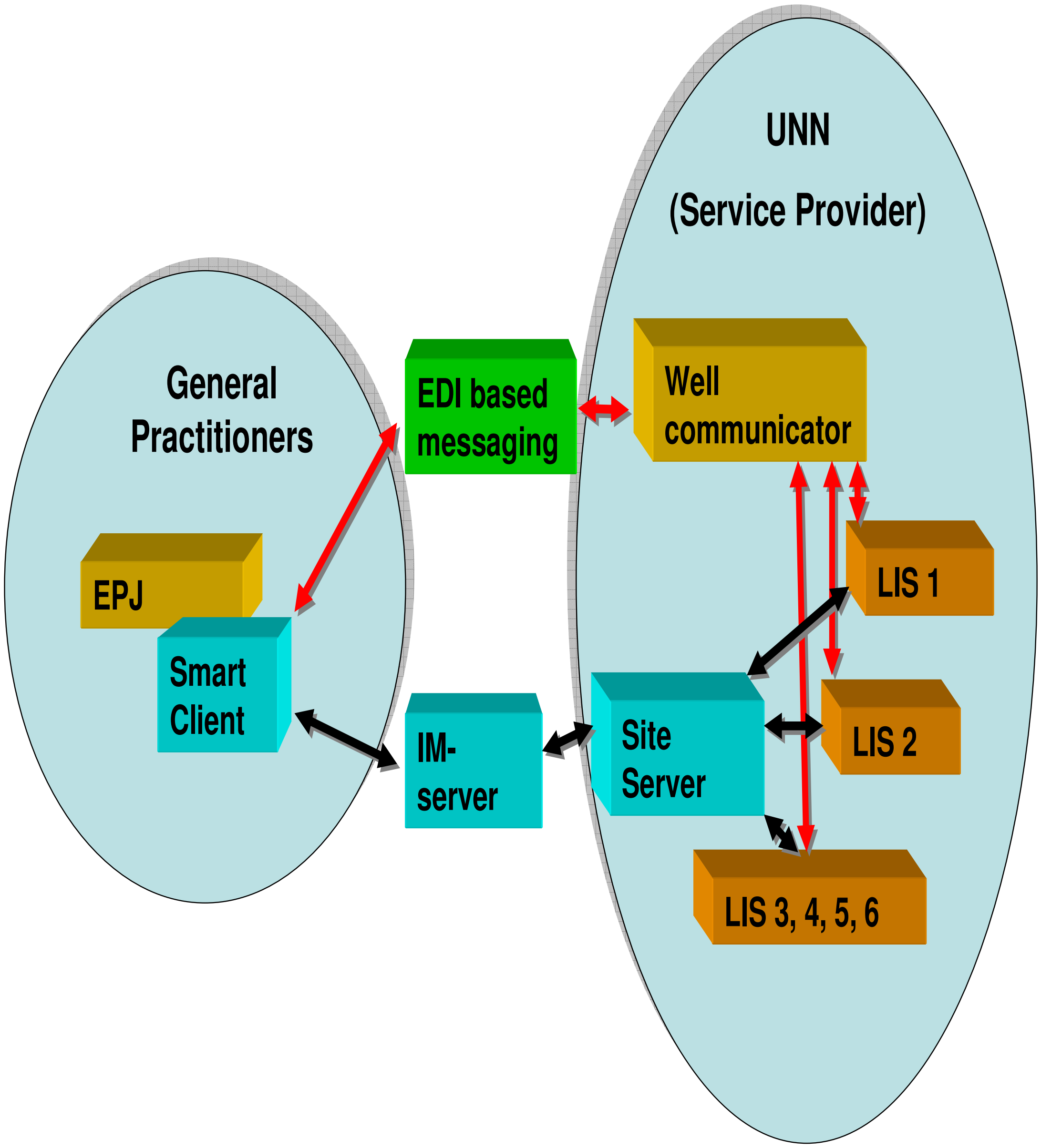

Figure 3: The GiLab project's technical construction. Illustrates Well interactors influence on the GP's and UNN's installed base. The requisitions can both be transmitted trough the black and red channels (arrows). The interactive services can only be transmitted trough the black channel.

6.4 The GiLab Project - Technical description

EPJ :	Electronic Patient Journal. Examples: Profdoc Vision, Infodoc and System X. Each user must have EPJ installed to be able to use the new system.
SMART CLIENT:	Well Interactor's graphical user interface.
EDI BASED MESSAGING:	A common used technical solution to exchange electronic based messages.
WELL COMMUNICATOR:	Complete and modern EDI based software which qualifies to deliver patient sensitive information on a secure and effective way.
IM SERVER:	Instant Messenger Server, a part of Well Interactor. Contributes to enable and establish interactive possibilities.
SITE SERVER:	Well Interactor Site Server, a part of Well Interactor. Contains an electronically description of all services the service provider (UNN) distributes, and an ability to store received electronic requisitions in a queue.
LIS:	Laboratory Information System. Examples: Sympathy, Dips Lab, Labcraft and Safir.
SERVICE PROVIDER:	A health care provider delivering health care services, for instance UNN.

6.5 Development and implementation

The developing processes have been based upon teamwork. Many actors with different professional backgrounds have regularly met each others in reference meetings. In addition to the reference meetings there have been a lot of separate meetings where specific topics have been discussed, for example topics regarding technical details.

The members in the reference meetings consisted of participations from UNN, Well Diagnostics AS and four general practitioners, which are Sentrum legekontor, Sørbyen legekontor, the general practitioner in Bardu and Kvaløysletta legekontor. These four general practitioners have been included in a pilot period of the GiLab project which was planned to start in June 2006 but actually started in September 2006. The intention of the pilot period was to get feedback to be able to make improvements.

> *"…it's a pilot, and it is within this time frame we shall make changes to the use, the way we organise it and find the best practices about how to make electronic laboratory requisitions possible" (Project leader, Well Diagnostics AS)*

The intention of the reference meetings were also to provide and make sure medical requirements, quality assurance and logistics was attended.

> *"The design and development of the requisition system is extremely central. Medical specialists will design the system in cooperation with Well Diagnostics system developers. This is critical to make the requisition module flexible, so single analysis can be accessible the same way as more complex analysis" (GiLab Project Plan 2006, p 14)*

The GiLab project is also divided in two main deliveries. The first delivery is made for The Medical Biochemistry laboratory, Clinical Pharmacy laboratory and the Immunology and Transfusion laboratory. These laboratories share the same information system, DIPS Lab. The other laboratories are involved in a second delivery phase. The resources used in development among these two phases can be seen in Figure 4.

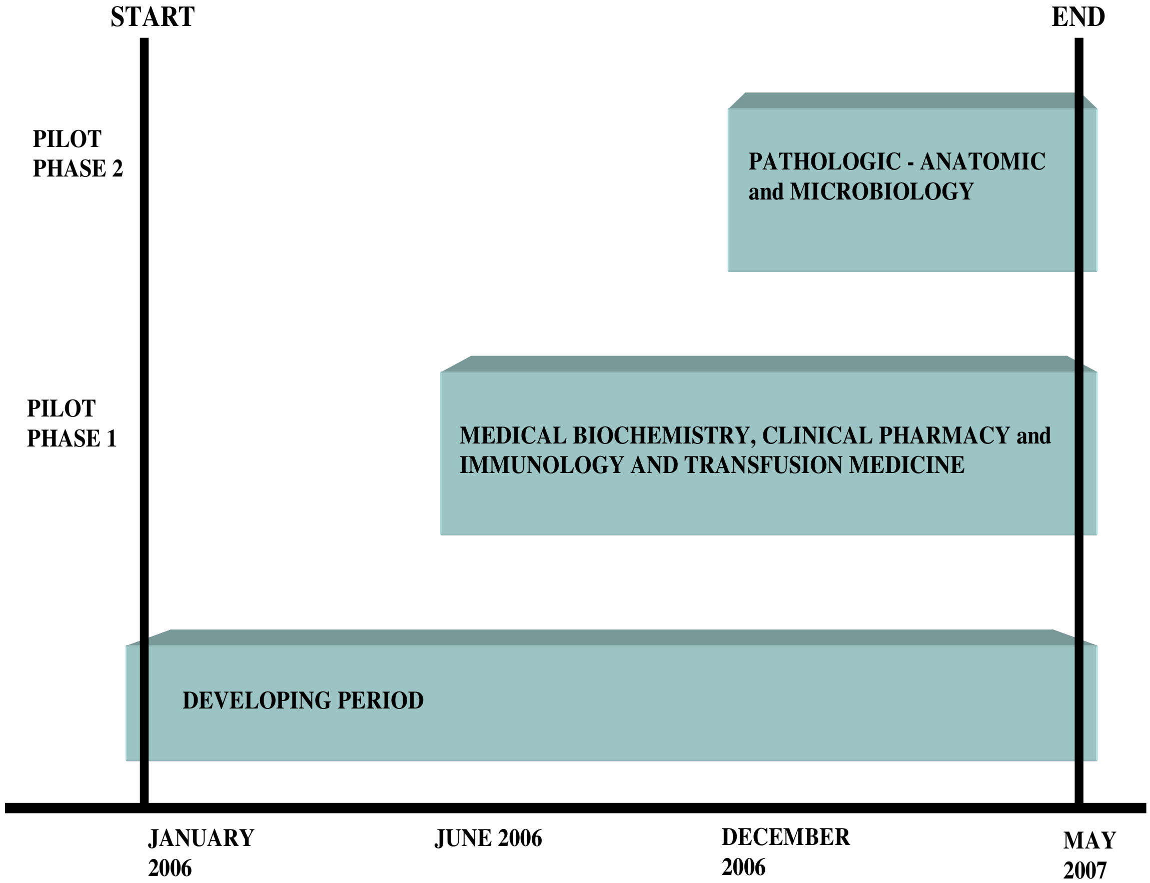

Figure 4: The planned developing time differences between phase 1 and phase 2 (Project Plan 2006, p 8-9).

The process Rational Unified Process has been used as a creation model, meaning that in contrast to traditional methods where one thing is done at a time, the Rational Unified Process enable possibilities to do a little bit of all at the time. Well Diagnostics has a lot of experience in this process. The Rational Unified Process includes four stages. These are *inspection, elaboration, construction, transition and production.*

Because the process is parallel based, the customers (general practitioners in the pilot) have been able to achieve different versions of the product so they can evaluate, verify and test it to be sure it meets its intended goals.

The reference meetings have been characterised of high enthusiasm and different meanings. Most of the meetings have been related to the development of Well Interactor. For instance there have been fewer concerns about integration and how UNN will be able to receive the electronic requisitions. One physician said for instance during one of the first reference meetings:

> *"I do not think there will be any problems regarding receiving the electronic requisitions at UNN. I am more worried about how the medical secretaries are labelling the sample tubes" (Physician 1)*

6.6 Well Interactor Smart Client

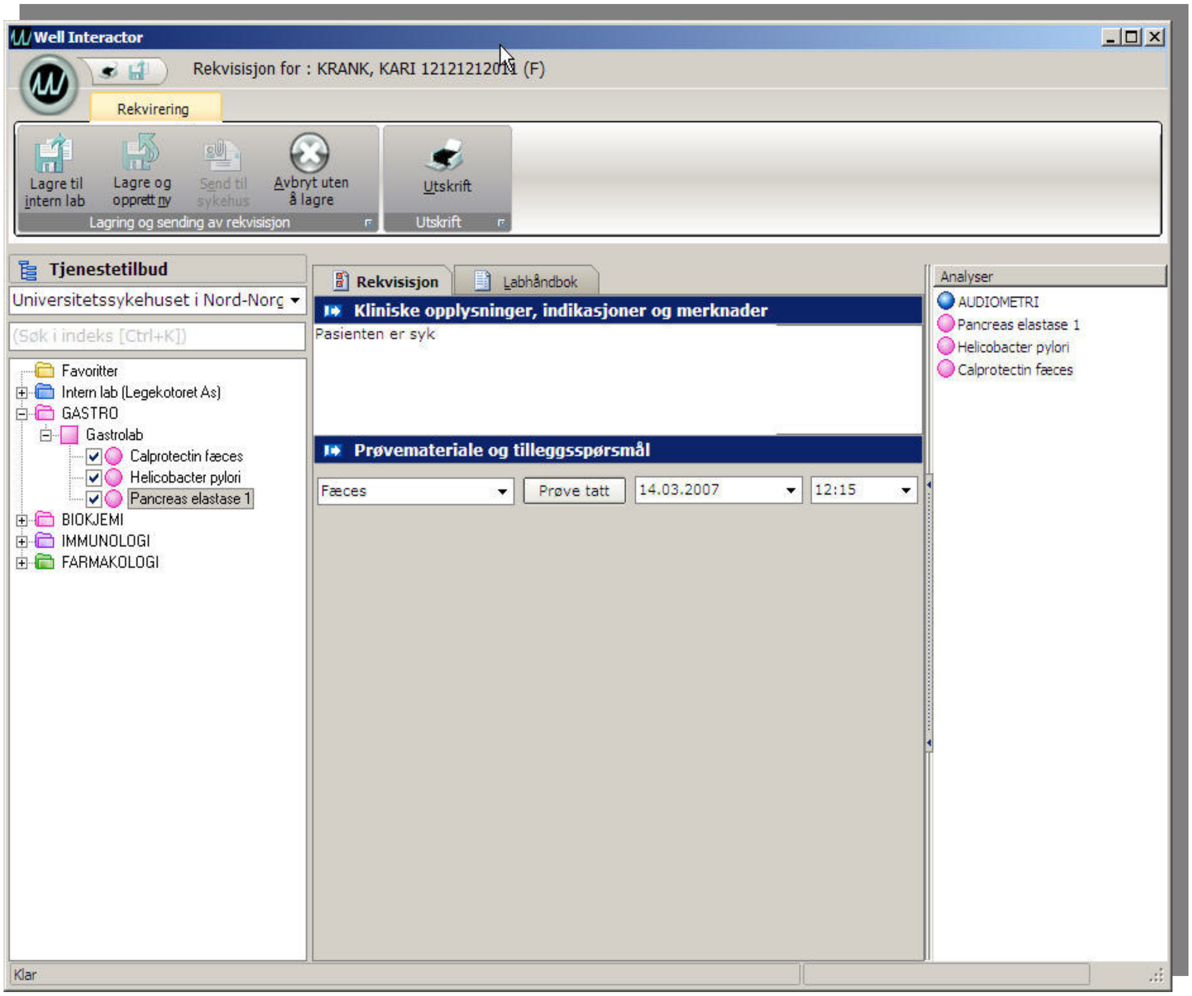

Figure 5: Well Interactor Smart Client, the systems graphical user interface. (Kari Krank is not a real person).

Well Interactor Smart Client is the graphical user interface of the new system. It will be implemented to the general practitioners (end-users). The Smart Client will have a tight integration with the most central electronic patient records, and will contain a chart of all analyses and services which can be chosen. In addition it will also have an ability to create and print bar code labels, so the sample tubes can be marked with a barcode. The Smart Client is accessed trough the electronic patient record and replaces the old paper requisition with an on screen function that gives the general practitioners an ability to choose and pick their needed services directly from their computer (See Figure 5).

Each general practitioner will also be able to choose different service providers, search for their needed services and be able to mark their most used services as favourites. The last point makes it possible to put the most used services in groups, which in second turn makes it easier to choose the most relevant and most used services. General practitioners can then chose among 10 such groups which is intended to reduce the time used to select the different analyses.

It is assumed that medical secretaries will see benefits by improved access to relevant information. They will for example see how much of a sample material each service provider requires, in addition to being informed about the amount and types of sample tubes they need to use. The first point is very important as it might happen that the service provider needs more sample material then what has been sent. The Smart Client will also ensure that the correct time of the taken tests is documented.

6.7 Service provider profiles

All services offered by each service provider are stored in [1]XML based profiles called *Service Provider Profiles* (See Figure 6). When the general practitioners choose services using the Smart Client they mark the services they want to use seen in the service profiles. When this job is done they close the Smart Client and then all chosen analyses are stored in the electronic patient record.

The Service provider profiles are crucial elements of Well Interactor, and must be installed to be able to use the system. The Service Profiles is made by each service provider (UNN) and will totally replace the old paper based requisition sheets.

> *"A service provider profile is technically a version made and signed XML document that gives a service provider an opportunity to describe important aspects regarding ordering and use of medical services" (Well Interactor Product description 2006 p 6)*

The service provider profile is specially made to fit each laboratory services, and is created

[1] Extensible Markup Language. A markup language with a purpose to facilitate the sharing of data accross different information systems.

with their existing services as basis. The system gives each service provider abilities to update their services when needed, something which gives general practitioner enhanced flexibility. The up to date versions are stored in the Well Interactor Site Server.

> *"To enable an effective use of the service provider profile, requisitioners are able to save the service provider profile locally and thereafter define how often the service provider protocols will be updated" (Well Interactor Product description 2006 p 6)*

The general practitioners achieve opportunities to always be up to date considering changes that occur at each service provider they are connected to.

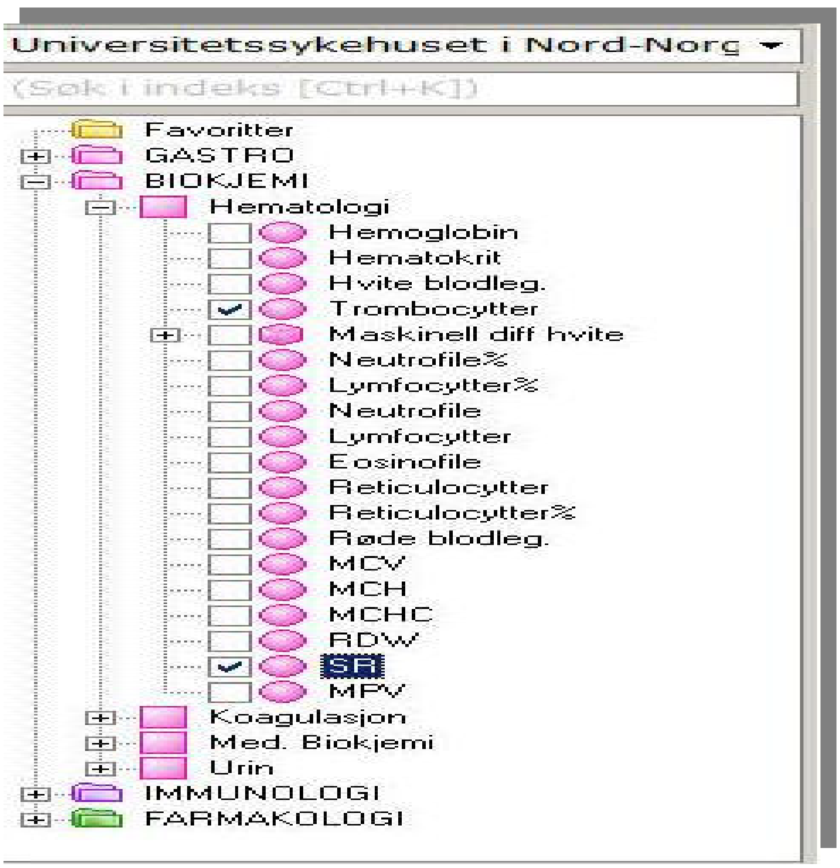

Figure 6: Parts of the Service Provider Profile used at Medical Biochemistry laboratory.

Because each service profile consists of electronically described available services, Well Interactor can also be used in other health care fields beyond this case, like radiology for instance. Then it is required that the radiological department makes such a profile.

During the pilot period there were lots of concerns regarding the fact that it was not possible to add services to an already made requisition.

"It happens that we take some tests and then goes back to the journal. If we then have to add some analyses we must open a new requisition. This was supposed to be changed but I have not seen any changes. This is mucky. Then we have to call" (General Practitioner GP Pilot office 1)

6.8 Use of barcode based labels

Since the samples can not be transmitted electronically, all sample tubes must still be transported by the post service. The labelling process by the general practitioners must consequently proceed as before. The old labels did usually only contain names and person number only. The new labels will in addition contain a bar code and information of the requested analysis. The barcode is used to trace the electronic requisition at each service provider. They scan the label to access the information (See Figure 8). The project had from the beginning planned to only use a barcode, not names and personal numbers in these labels. This was changed in later processes because it was not possible according to the existing work flow (It is easier to distinguish and read names, then only numbers).

All sample tubes belonging to one electronic requisition will contain the same barcode number. A specially made printer is used to print out the new barcode labels. The printer must be implemented by each general practitioner who decides to implement the new system (See Figure 7).

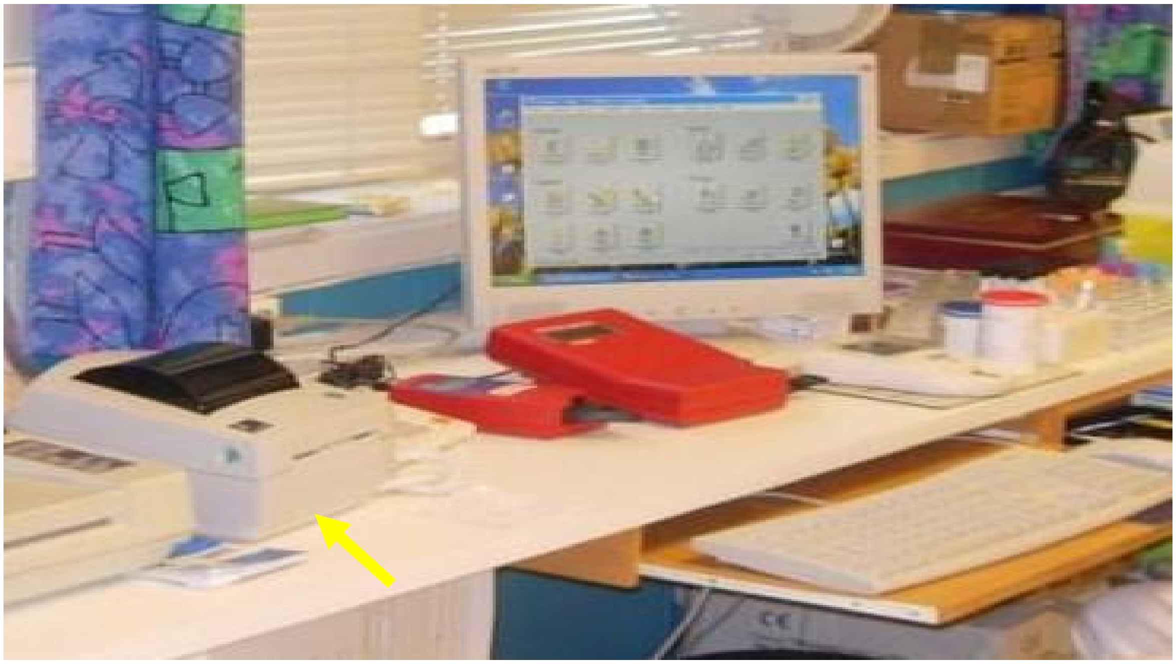

Figure 7: The new GiLab solution. The bar code printer is seen down to the left..

Figure 8: Illustrates how the bar code based sample tubes are scanned at the service provider (UNN).

6.9 The electronic based requisition

The electronic based requisition is built upon the XML standard defined by [2]KITH. Each requisition contains a unique XML - message. The requisitions can both be transmitted to the service provider using existing EDI - based technology or using the Well Interactor Site Server. Since Well Interactor does contribute to increased use of already implemented and existing technology, their already made Well Communicator can be used. This software is mostly used to transform data like medical epicrisis and discharge letters from service providers to general practitioners, but by using Well Communicator to exchange laboratory services, information can be delivered from general practitioners to service providers as well.

> *"When the taking of samples is performed the electronic requisition is sent to the service provider, either by using Well Interactor Site Server or by using traditionally EDI based transmission. (The decision is made by each service provider and is published in the service provider profile)…" (Well Interactor Product Description 2006 p 8)*

The XML, especially ebXML standard has increased its momentum within the health care sector the last years. The standard has become a framework related to exchange of electronically sent messages (www.kith.no). It is supposed to replace the EDIFACT standard which has been widely used to transmit electronically messages. The fact that Well Interactor uses the XML standard should be seen beneficial because it probably will make Well Interactor more able to fit into future Information Technology configurations.

> *"We choose to use the XML standard because this is a national standard" (System developer Well Diagnostics AS)*

The possibility to integrate Well Interactor with the existing information systems at UNN and the general practitioners will be created upon a service based structure.

[2] KITH: A company aimed to contribute to coordinated IT-development within the health and social sector. KITH is located in Trondheim and Oslo.

"The integration of both, the service providers and the GP's information systems, are supposed to be massage based and based upon service oriented principles with a loose connection between autonomous systems exchanging standardized messages trough well defined interfaces and interaction patterns" (Well Interactor, Product description 2006 p 8)

An illustration of an electronic XML based requisition can be seen in Figure 9.


```
<?xml version="1.0" encoding="ISO-8859-1" ?>
- <Message xmlns="http://www.kith.no/xmlstds/rekvisisjon/2005-05-20"
    xmlns:kith="http://www.kith.no/xmlstds"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema.xsd"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.kith.no/xmlstds/rekvisisjon/2005-05-20
    Rekvisisjon-v14.xsd">
  <Type V="R" DN="Rekvisisjon" />
  <MsgVersion>v1.4 2005-05-20</MsgVersion>
  <MIGversion>v1.4 2005-05-20</MIGversion>
  <GenDate V="2006-09-19T11:45:51" />
  <MsgId>1WG0P5WDU-0000000125</MsgId>
- <ServReq>
  <ServType V="N" DN="Ny" />
  <IssueDate V="2006-09-19" />
  <Ack V="J" DN="Ja" />
  <MsgDescr V="CLIN" DN="Klinisk kjemi" />
  <Id>1WG0P5WDU-0000000125</Id>
- <Patient>
  <Sex V="2" DN="kvinne" />
  <DateOfBirth V="1912-12-12" />
  <Name>KRANK, SIRI</Name>
```


Figure 9: An XML - based electronic requisition. (Siri Krank is not a real person).

6.10 Positive feedback

The pilot versions of the Smart Client have resulted in positive feedback. There is for instance no longer a need print patient information on paper sheets anymore.

> *"It took some time to put the paper requisition in the printer. We do not need to do this anymore. Now we can just press send. This part is much faster" (General Practitioner, Pilot office 1).*

The new system does also contribute to improved documentation of requested and sent analyses. In the old way the chosen services were not documented at the GP's at all. A consequence was that it was difficult to cross check the received answer with the ordered service. According to one general practitioner the improved documentation was considered as one of the biggest benefits.

> *"Now we can get an exact log of all we are sending" "we can get it electronically checked without seeing it, that we get an answer to what we have asked to get answer to. This is the biggest benefit" (General Practitioner, Pilot office 1)*

The same general practitioner did also say that if there was a choice to go back to the old paper based system he thought that most people would choose the electronically based system. This view was also supported by information collected from medical secretaries transcribed by UNN's project leader. Even though one of the general practitioners still continued using papers, which caused more work for the medical secretaries, they still gave positive feedback.

> *"I talked to three of these Personnel and even if he [the GP] uses papers they felt that the routines had been improved" (Project leader, UNN)*

The general practitioner was the only general practitioner which did not use the system at that office.

Another general practitioner said that the changes in work flows had been regarded as positive.

> *"Our medical secretaries think it works very well and that it is fun to use" (General Practitioner, Pilot office 2)*

Positive feedback can also be related to the number of received electronic requisitions. In November 2006 the number of received electronic requisitions was about 1000 from the four general practitioners included in the pilot. In February 2007, the result was more than 3000 electronic requisitions. This has been considered as very positive.

6.11 The situation at UNN

Before the GiLab project started, all laboratories at UNN had to manually register the paper based requisitions to transfer the information into their information systems. The new system makes it possible to bypass this registration process, because the information is already stored in the XML requisition message. The work flow process which happens afterwards is very different from one laboratory to another. Two laboratories which have completely different procedures are the Medical Biochemistry laboratory and the Pathological - Anatomic laboratory. The Medical Biochemistry laboratory is based upon DIPS Lab and uses this system in their daily work. This means that they do not use paper very much.

> *"We let go the use of papers in most cases" "But it is not totally paperless yet" (Bioengineer 1, Medical Biochemistry laboratory)*

DIPS Lab is an information system used at all laboratories in Phase 1. It is also the information system which is connected to the most frequently analysed analysis. This means that the quantity of analysis is related to those laboratories using DIPS Lab. When I asked another bioengineer about what they uses DIPS Lab for he said:

> *"We use DIPS to make requisitions, transfer answers, access information about what to do, store the analysing results electronically. We use DIPS for the most part, actually". "It's our computer system". (Bioengineer 2, Medical Biochemistry laboratory)*

A picture of DIPS Lab is seen in Figure 10.

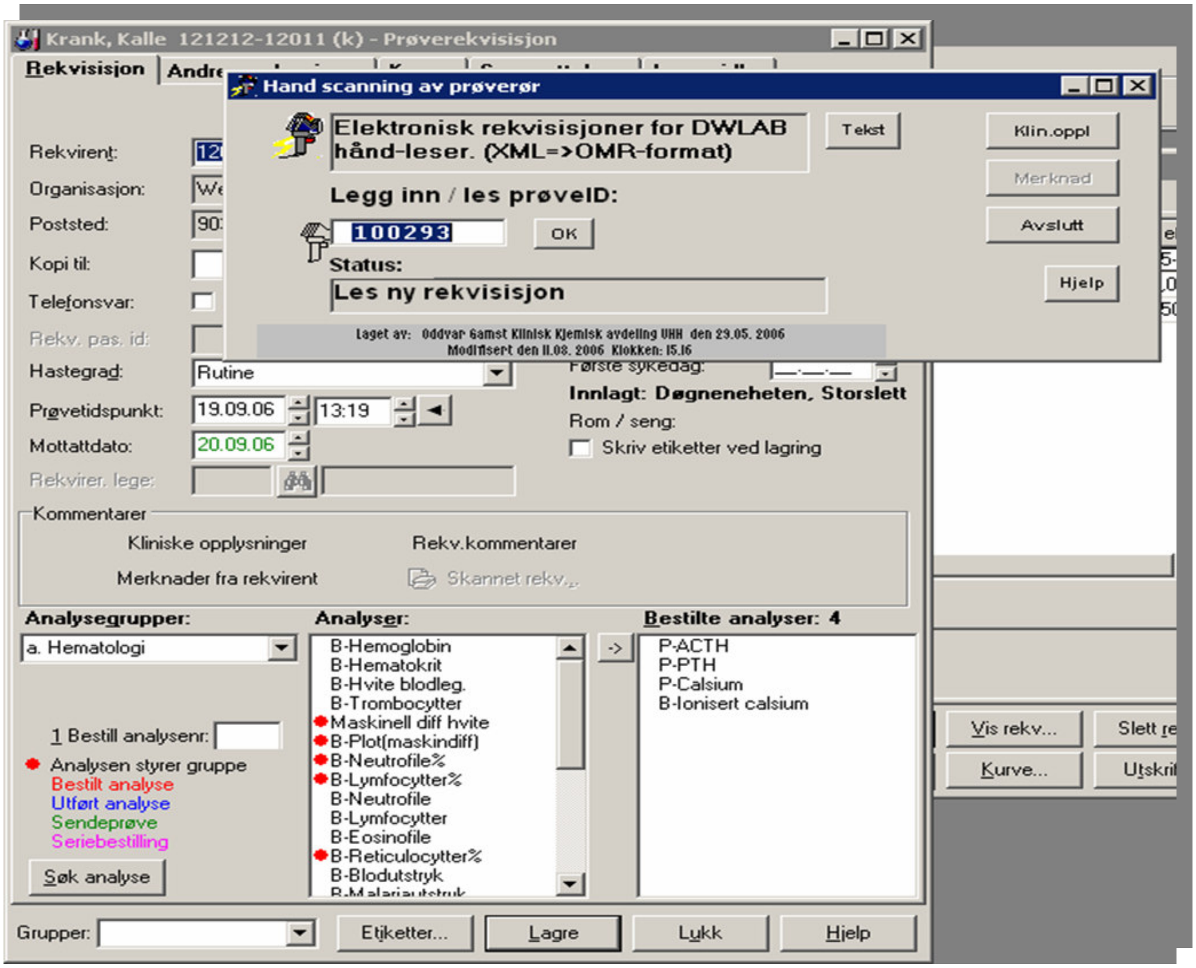

Figure 10: Illustrating DIPS Lab. The Medical Biochemistry laboratory is digital as long as the requisition is registered. (Kalle Krank is not a real person and the most forward window is not a part of DIPS Lab).

While DIPS Lab plays an important role in the work flow at the Medical Biochemistry laboratory, the situation at the histology part of the Pathological - Anatomic laboratory is completely different. In many areas of this laboratory the staffs do not use computers at all. Their Laboratory Information System, Sympathy, is mostly used to create bar code numbers, document the paper requisition, and write clinical information and to print out labels. The working process itself is manual (See Figure 11).

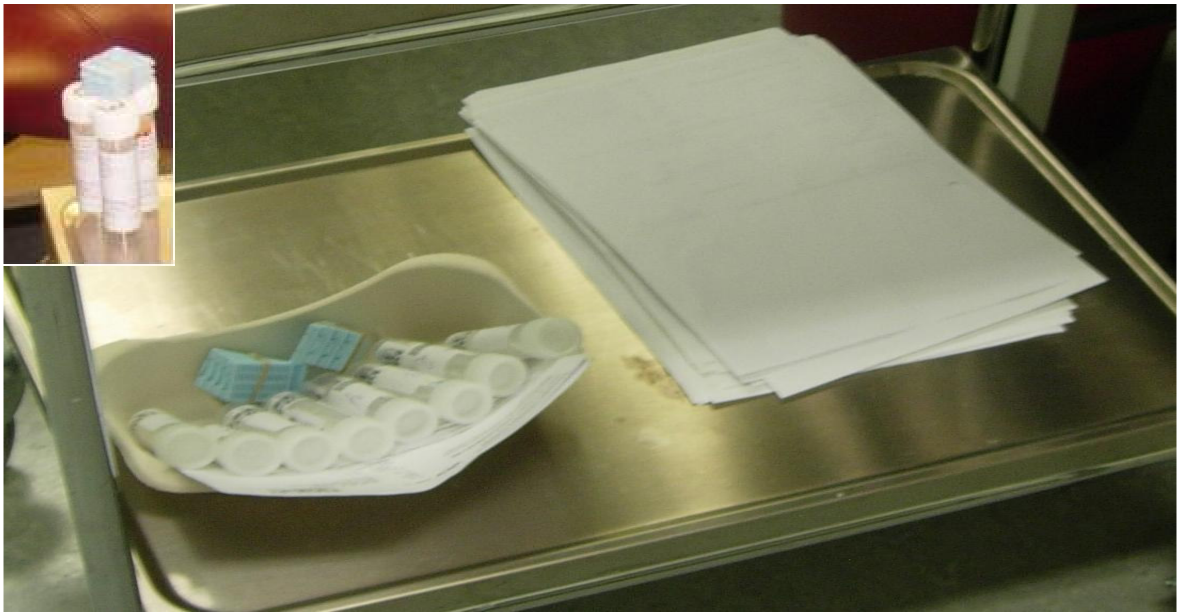

Figure 11: The histology part of the Pathological - Anatomic laboratory is paper based still after registration. The blue small boxes are used in the analysing work, not the sample tube. The sample material is moved from the tubes to those small boxes.

6.12 The Pre-Analytic Service Unit and its relation to GiLab

As an additional project to GiLab, UNN started in 2005 another project which has resulted in a Pre-Analytic Service Unit (PAS). This projects intention was to create a shared unit supposed to handle all internal and external electronic requested requisitions, no matter they are electronically transmitted or paper based.

> *"The intention of the Pre-Analytic Service Unit is to receive all samples, distribute them and deliver the samples to all laboratories" (Manager PAS)*

Many of the internal requisitioners at UNN use DIPS to electronically order laboratory services. On the other hand, the general practitioners will use Well Interactor when they order laboratory services electronically. This means that the Pre-Analytic Service Unit will receive electronic requisitions both from Well Interactor and DIPS Lab, in addition to also receive paper based requisitions until all requisitioners have implemented electronic requisition possibilities.

The main goal of the Pre-Analytic Service Unit is to create a seamless information flow where it is one way in and one way out. All requisitions are administrated by the Pre-Analytic Service Unit before the information and sample tubes reach each laboratory.

To enable appropriate seamless integration between the different laboratories, it is required that the Pre-Analytic Service Unit communicates with all Laboratory Information Systems.

> *"The development of the "Pre-Analytic Service Unit labdata" assumes coordination with interfering systems" (UNN Document 3 p 5)*

A common goal has been to use the same information system at all laboratories, but this has been considered hard to achieve (UNN Document 5). The only way to implement the Pre-Analytic Service Unit has been argued to make it communicate with all laboratories existing information systems.

> *"The computer system must cover the whole process and be developed and implemented as a whole. The Pre-Analytic Service Unit shall communicate with all laboratories at UNN" (UNN Document 3 p 5)*

The new unit was established in September 2006, at the same time UNN started to receive electronic requisitions. The new unit has become an independent division, and has been established in a new location at the Medical Biochemistry laboratory and some additional places as well. The employees, mostly assistants and medical secretaries are a mix of personnel from the different laboratories. The new unit is expected to reduce the amount of human resources and enable higher efficiency.

> *"A goal within 2 years of running should be that the amount of manual registration of requisitions is reduced to be lower than 1%" (UNN Document 3 p 9).*

The Pre-Analytic Service Unit project and the GiLab project have been seen as two separated projects, even though it might seem implicit due to the quote above that those two projects are related. In fact, the Pre-Analytic Service Unit project should be seen connected to the GiLab project because the main intention to create the unit was to better handle the electronic sent requisition.

> *"The reason to create the Pre-Analytic Service Unit was based upon the ability to receive electronically sent requisition" (Manager PAS)*

This argument was also supported by the leader of pre-Analytic Service Unit

> *"Our main thought behind the project is that we are able to get the sample tubes and do not need to do anything about it, just put it directly into the machine and distribute it" "We can then achieve a seamless process" "The processes about punching, registering, scanning and additional made requisitions is only a huge delay" (Leader of PAS)*

Then, despite that formally those two projects are separate, they have become interwoven.

> *"The Pre-Analytic Service Unit, GiLab and LabIT are a part of the same totality, and also what we are installing now, the new distribution machine. There are four partly projects which is intended to become an entirety at the end" (Leader of PAS)*

The idea to save human resources, increase quality and to increase efficiency has for instance resulted in a new distribution machine (See Figure 13).

> *"The reason to buy this machine was to save some of the assistant work we use to distribute the samples" (Manager PAS)*

A lot of the manual work is to move sample material from primary sample tubes to secondary sample tubes. This work is very time consuming. The new machine (not used yet) is intended to automatically move sample materials from primary sample tubes to secondary sample tubes and make the sample materials ready for analysing processes. The machine will distribute mainly blood based samples.

Another reason to create the unit was that the laboratories at UNN have been demanded by their administration boards and health authorities to fit into new economic requirements.

This has for instance resulted in dismissed positions at the different laboratories. To meet the new demands and to be able to compete with other service providers on a preventive level it was considered necessary that the different laboratory departments worked together. The different laboratories have a history of being isolated from each other. Previously for instance each laboratory was responsible to take care of all pre-analytic work. This work is now handled by the Pre-Analytic Service Unit.

Figure 12: One location of the New Pre-Analytic Service Unit.

Figur 13: The new distribution machine, (during installation).

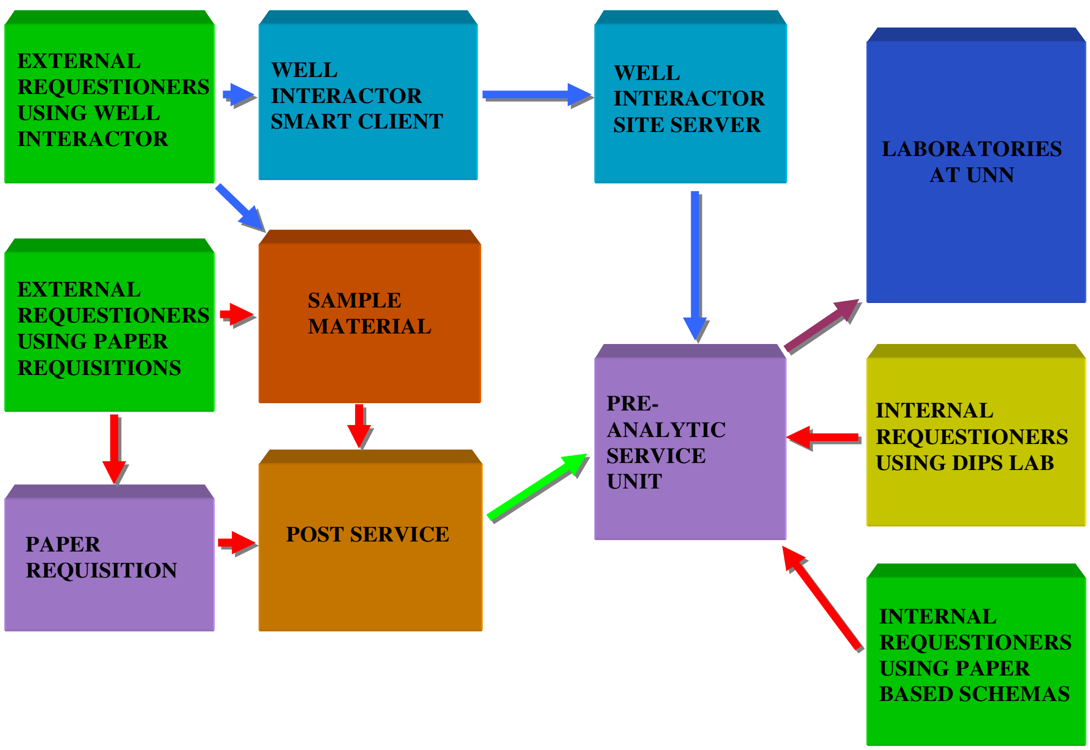

Figure 14: Illustrates the main intention of the Pre-Analytic Service Unit (PAS). All samples and requisitions are distributed by PAS.

6.13 Summary

The implementation of the new technology made to improve communication between the Primary Health Care System and the Specialised Health Care System, thus being a simplifying technology became a lot more complex than planned. As a result Well Interactor was installed in a work practice not only being complex in the first place, but also in a situation where additional projects was developed about the same time (instalment of the distribution machine and the creation of the Pre-Analytic Service Unit). The complexity related to the implementation of Well Interactor is discussed in chapter 7.

7 DISCUSSION

IT resources have been argued to have a considerable high potential to improve efficiency and work processes (Davenport 1993; Hammer 1990). Such implementation attempts are creating high expectations related to time savings and cost reductions, while the quality of their products and services are still improved (Tieso, 1995). This means that organisations are seeking improvements not by fragmental solutions, but aiming at the process flow as a whole. A vision in the GiLab project is to use Well Interactor and the Pre-Analytic Service Unit to enable a more seamless information flow. A goal is to save a lot of human resources and improve efficiency and reduce multiple work loads. This makes it possible to argue that Well Interactor is part of a large-scale initiative. The large-scale initiative will contribute to the changes, not Well Interactor alone.

It is unfortunately hard to carry out fast shifting improvements by implementing information systems in health care. The benefits are often considerably smaller than expected (Giuse and Kuhn, 2003; Lenz et al. 2002). “Technological fix” or positive changes caused by technology has also a tendency to be largely taken for granted by organisations (Orlikowski, 1996). This in contrast to that even after almost 30 years of IT implementations, the plug and play systems which were promoted in the 1970’s have still not become a reality (Giuse and Kuhn, 2003). According to Orlikowski (1996) implemental problems might be caused by the fact that it is not always easy to plan a stabile outcome in a complex work practice.

I will now introduce some of the complexity related to the implementation process of Well Interactor.

7.1 Different needs and different perspectives

In the reference meetings there were many discussions and different opinions. This has off course implied that some aspects are more prioritised than other areas. Additionally users, decision makers, developers and the included general practitioners have different perspectives on things.

One example is related to the development of the crucial Service Provider Profiles. This has outlined a need to improve communication. One general practitioner said for instance during one meeting in February 2007 that it was not very easy to find and select the services he needed.

> "*The requisition list is hopelessly long on Medical Biochemistry. It is over 60 or 70 different choices to choose from" "It should maximum be 20 in each category" (General Practitioner, Pilot Office 1)*

This argument was also supported by another general practitioner who felt that the Smart Client was OK to use, but was too complex compared to DIPS.

During the meeting in February 2007, the participant tried to find appropriate solutions about the design of the Service Provider Profile; for instance whether the list should be in alphabetic order or not.

> *"The "support personnel" [medical secretaries] does not think in same manner as we do in functions, they think in names. There should be an option which makes it possible for each user to enable alphabetic order. I think the" support personnel" at us would use this" (General Practitioner, GP Pilot office 2)*

Another point was that it was said by general practitioners that the design of the Service Provider Profile was important.

> *"The windows has been made with the old paper schemas as a basis and we who knows these we know how much we have to scroll to find them because we remember those old schemas, but within one year no one will remember them....It can therefore be worked a lot on the categorical, logical and clinical structure for us out there" "…While the schema is sort of logical it is more logical for the hospital physicians then for us" (General Practitioner, Pilot Office 2)*

These issues resulted in a lot of discussions about design and that it was stressed that it is important that all actors communicate with each other.

> *"It is important that we can make an appropriate communication among both, the general practitioners, and those who makes the Service Provider Profiles. This communication might not have been good enough yet" (Project leader, Well Diagnostics AS)*

Well Diagnostics AS has used a lot of resources being collecting feedback from general practitioners. Also, participants from UNN wished that general practitioners had been included during the design of the Service Provider Profiles. This underscores and emphasizes the need to bridge the different perspectives.

> *"We did not have the ability to talk to the general practitioners when we started making those Service Provider Profiles. We spent some time trying to find out what we thought was the best solution. We understood that there had been a meeting on higher levels connecting the physicians at UNN together with the general practitioners, but we never got this information. We decided to make it most similar to the existing paper requisitions" We had good connections with Well Diagnostics but we missed connections with the general practitioners" (IT Laboratory personal 3)*

Regarding the fact that the members wished a more appropriate communication among the actors, it has also been argued that it is very difficult to make solutions which fit all. One argument coming from one of the designers of the Service Provider Profile was that the users might have different view on how the product should be designed.

> *"The problem is that if you ask five persons you might get five different answers. It's very difficult to find agreements about how to make the list" (IT Laboratory personal 2.*

This argument was also considered in an earlier meeting in December 2006.

> *"There are lots of comments about how the service provider profile should be grouped" "It's difficult to put this in logical order for all" (Project leader, Well Diagnostics AS).*

Based on the situation that the general practitioners do not participate to large extent in the design process, and there exists potential of improvements, how is it then possible to argue that asking too many will create problems? It should be reason to argue that design challenges could be supported by asking more people, thus giving designers more feedback.

During the design of Well Interactor and the Service Provider Profiles the involved parts have seen it important to achieve a better communication. This emphasizes as well the need to bridge the different actors more together.

7.2 Improvised integration

While Well Diagnostics has made a really beneficial system for the general practitioners and for them built a streamlined interface, they have faced many integration challenges at UNN. One way of looking at Well Interactor is to view it as a black boxed system with well- defined boundaries to its surroundings (UNN). This means that Well Interactors ability to fit into the existing environment is dependent on what already exists. Well Interactor will then be seen as an additional component added into the installed base.

Well Diagnostics use standards defined by KITH. Since KITH is contributing to establish national standards the other vendors of the information systems at UNN might change their systems to fit into this standard as well. During the development of GiLab none of the existing information systems at UNN used the standard defined by KITH.

It has been necessary to make improvised alternatives to be able to use the Well Interactor. New systems which acts like bridges or converters are needed to let UNN be able to receive and use the XML messages. One of these improvised works is related to a program made by one of the users at UNN.

> *"In the beginning we had to just build something to make it work" (Technical consultant)*

The person related to the quote has created a gateway solution which converts the XML message so it can fit into DIPS Lab. This program simply bypasses the manual registration process at the Medical Biochemistry laboratory, and has enabled a smooth integration with UNN's internal system DIPS Lab (See Figure 15).

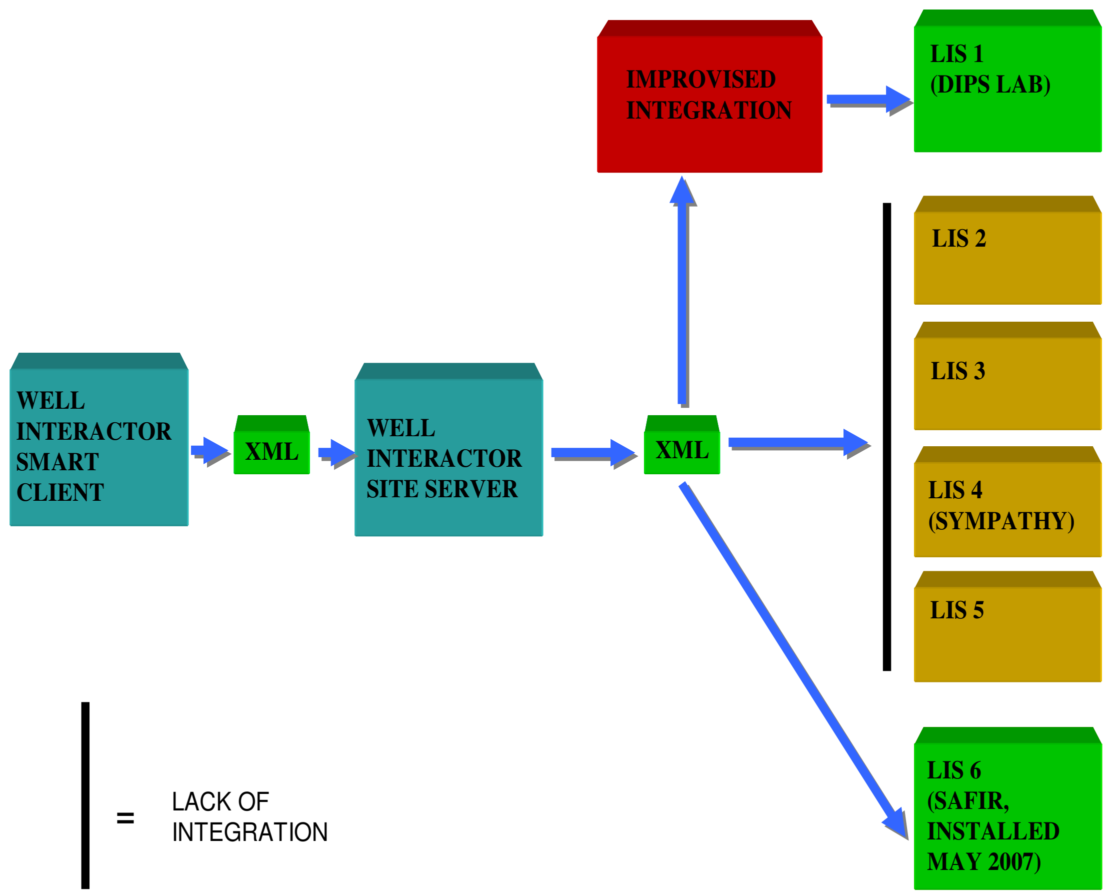

Figure 15: Illustrates integration problematic. The laboratory information system (LIS) Safir, used at the Microbiology laboratory was installed in May 2007. This system is able to receive the XML message defined by KITH.

7.3 Double work

Implementing a new technology may in a transition period cause double work for the users, so also with Well Interactor. The staffs are needed to both handle the old paper based solutions and the new electronic solution.

> *"The biggest change has happened to those who handle the received packages. This means that they have to do a new work task on the electronic sent samples in addition to the samples they usually receives. Those who are unpacking the post must also register those new samples as received" (IT Laboratory personal 2)*

Since it is only four general practitioners included in the pilot period and the total amount of requisitioners connected to the Medical Biochemistry laboratory was more than 1300 in 2002 (Table 2, section 5.2.1), this double work will probably continue until all general practitioners start to use the new system.

Another important issue is related to the Pathological - Anatomic laboratory for instance. All requisitions there are paper based. This means that the staff must keep on doing their old work flow until all general practitioners have established electronic requisitions. In addition internal requisitioners also use papers. This means that the old work flow must proceed until all internal requisitioners have established electronic solutions as well. However this might be more relevant to later stages in the developing process as there yet have been no changes to this laboratory.

Additionally, some indications do also show that the outcomes are different than planned. The implementation process so far has created additional work for the workers.

> *"We are now using half a day work to re-label the samples coming from those general practitioners included in the pilots" Within some time now we actually have more work to do" "There is more work now than before" "As long as we have to mark the sample tube there are no profits" (Leader of PAS)*

The additional work could according the leader of the Pre-Analytic Service Unit, also partially be caused due to the fact that the Medical Biochemistry laboratory has received more samples, but another person is also supporting the need to do additional work.

> *"What we save is the punching work [registering work]…But we are using much more time on the part related to scanning the sample tube. It takes more time to do the scanning work in total then the total work of both labelling it and register it in the computer system" (Manager PAS)*

7.4 Manual work supporting a seamless information flow - re-labelling of samples

One of the main reasons to build the new Well Interactor system and the Pre-Analytic Service Unit was to support the whole process flow. The expected savings of resources was planned from the beginning. A major goal was to receive the sample tubes, enable an automatic, or at least much easier distribution process, thereby using computer systems to achieve major improvements. By doing so, a lot of human resources and manual preparation work could be saved. This is not a reality. Firstly, UNN are not able to use the barcode created at the general practitioners in the analysing process. Secondly, each sample that arrives from the general practitioners has to be re-labelled before it can be analysed.

> *"Those who are requested electronically will on the long run have another ID number. Now we have to re-label. Due to the plan we were not supposed to do this" (Leader of PAS).*

The cost and time savings expectations related to the implementations are yet to be fulfilled. Therefore, to get rid of the re-labelling process has been considered.

> *"We have been told by our director that the routines about re-labelling shall disappear. We agree that this should be considered as a overall goal over time to reduce re-labelling to a minimum, but today this is not possible according to the existing routines and the resources we have" (Bioengineer 3, Medical Biochemistry)*

This argument was also supported by the technical consultant.

The need to re-label is caused by several factors. Firstly, the different analysing machines at the Medical Biochemistry laboratory need different barcodes generated by DIPS Lab to understand what to analyse (See Figure 16). This means that the sample tubes must be marked with the correct barcode label generated by DIPS Lab. This labelling process is a part of the manual work performed today, and since the re-labelling process must keep on, it still has to be performed manually in the new system as well.

> *"Some of the barcodes has more numbers than just the lab number. This numbers tells which analysis to be analysed". "If the labelling is not done properly we can just lay down everything we do" (Bioengineer 2, Medical Biochemistry laboratory)*

The point is that each lab-number, which can be seen as a special number for each requisition, are linked to many different barcode numbers. The barcodes contain different prefix numbers used to make the sample tubes able to fit into different analysing machines. The machine will as the bioengineer said analyse wrong analyses if this labelling is wrong.

Figure 16: Illustrates the amount of different barcodes to use.

Secondly, the urine sample tubes sent from the general practitioners to the Clinical Pharmacy laboratory are transported in tubes the analysing machines are not analysing directly. The tubes used in the analysing processes are a lot smaller than the sample tubes coming from the general practitioners. Manual resources are needed to move the urine from one tube to the other, and since movements are necessary the new tubes will need new labels as well (See Figure 17).

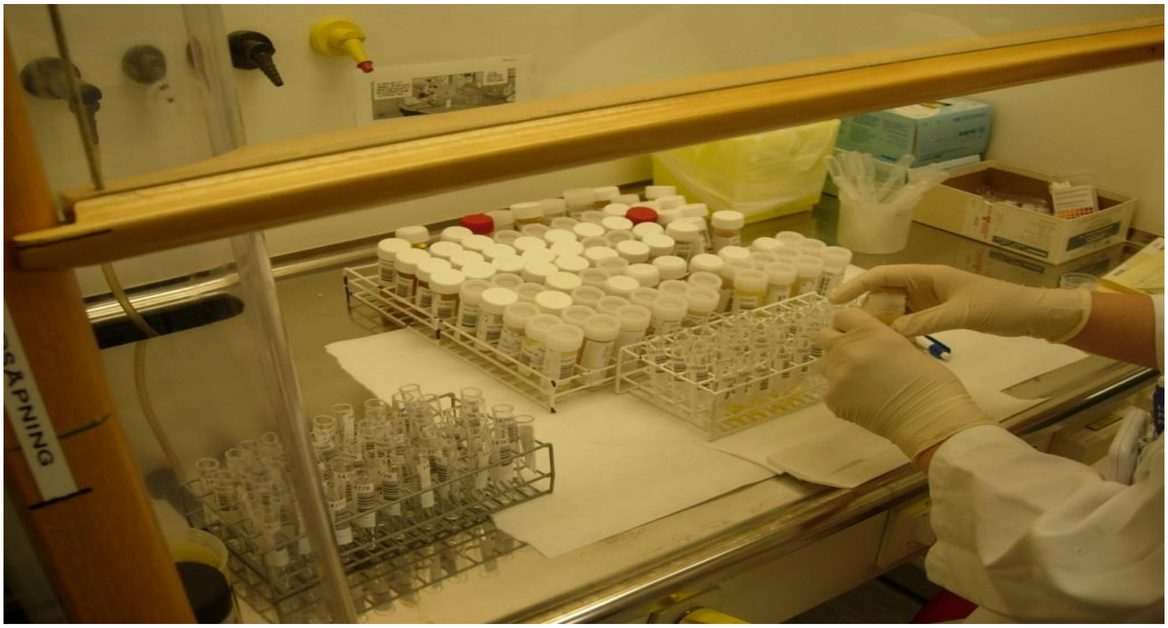

Figure 17: Illustrates the movement of urine from the sample tubes sent from the general practitioners to new and smaller sample tubes the analysing machine can handle.

Thirdly, histology samples to the Pathological - Anatomic laboratory represent a completely different workflow than the Medical Biochemistry laboratory and the Clinical Pharmacy laboratory. Its workflow is based upon mostly manual processes. The real analysing process is based upon a complex manual work process where the sample material is moved to new small plastic boxes to make it possible to transform the sample material into so called microscope plates used in the diagnosing process (See Figure 19, section 7.6)

Because of the problematic situations caused by the need to re-label, DIPS ASA has been contacted to create a solution.

> *"[UNN] have contacted DIPS and it seems like we will have a solution on the long run which makes us able to use the labelled tubes made by the primary health care" (Leader of PAS).*

The decision makers hopes to reduce re-labelling if they are able to let general practitioners mark the primary samples with a barcode DIPS Lab understands. This attempt illustrates what Gasser (1986) calls work around. When problems occur new solutions are created to make the system more able to fit. One important point is that DIPS is not directly included in the GiLab project. The company is included in that sense that UNN uses their system, but the GiLab project has mainly been created by UNN and Well Diagnostics AS, not DIPS ASA. The possibility to create a seamless information flow is therefore partially laying in the fate of DIPS ASA. This example does show that there are more involved actors than those directly involved in the GiLab project.

Even in case DIPS ASA find a solution this will only be partially helpful. At the Pathological - Anatomic laboratory for instance, manual re-labelling processes will still be necessary, since their work is based upon the number generated by Sympathy and the actual material, not the sample tube itself. The only way to quit the re-labelling process will either be to reorganise the whole laboratory, or let the general practitioners create the small boxes needed, since it is obvious that it is not possible to mark the sample material itself (See Figure 19, section 7.6). The same problem is relevant for the Clinical Pharmacy laboratory as well. Quitting re-labelling will require that the all general practitioners, also those who are not using the electronic solution, shift their sample tubes and starts using tubes which can be handled by the analysing machines. The analysing machines can only handle one type of tubes at a time.

Another important point related to the Pathological - Anatomic laboratory is that what to do with the samples is not decided by the general practitioners. The general practitioners are usually only required to write clinical information like asking whether the sample might contain pathology or not. The decision about how many boxes that actually are needed and what part of the sample material which will be analysed is decided at UNN after the requisition has been registered in Sympathy (See Figure 19, section 7.6). This could indicate that UNN's goal to quit re-labelling will require large work flows changes at the general practitioners. And in addition, contacting DIPS ASA will only be helpful for those laboratories using DIPS Lab, not the Pathological - Anatomic laboratory.

7.5 The dependency of the distribution machine to create a seamless work flow

According to the leader of the Pre-Analytic Service Unit, the GiLab project and the Pre-Analytic Service Unit project have been interwoven (See section 6.12). This indicates that the new recently installed distribution machine was bought with the electronic sent requisitions in mind.

During my observations I talked to some representatives from the vendor of the new distribution machine during installation. They said that the machine was primary made for blood samples. Blood samples are one of the most analysed sample materials at UNN, underscoring the machines potential. The same argument was also supported by the manager of PAS.

> *"The intention was that all blood sample tubes were supposed to go trough this distribution machine" (Manager PAS)*

By letting all blood sample tubes go trough this machine, the quality will increase and the manual work will decrease or be saved.

> *"The new machine will replace the manual pepitering [moving of samples from one tube to another] process" "There is always an error rate regarding these movements" (Manager PAS)*

The desired improvements related to machine's streamlined possibilities have unfortunately yet not been achieved since the new distribution machine cannot be used effectively. One problem is that the barcodes from the general practitioners can not be used to create the secondary barcode the installed information systems and analysing machines understand (See Figure 16 section 7.4).

> *"The machine is not able to do query, which means using the ID-number on the primary tube to ask for tasks from DIPS Lab or another laboratory system". "Every time each laboratory system gets information about received requisitions, messages must be delivered to this machine as well for each requisition. By date*

there is no functionality implemented in any laboratory information system supporting this" (Technical consultant)

According to one of the workers at Medical Biochemistry laboratory this machine was bought with other infrastructures as a basis.

"A team of many involved persons from the hospital spent some time travelling around in Sweden, Denmark and Norway to look at different distribution machines. But the use of these machines was based upon other infrastructures" (Technical consultant)

The new machine can not fill UNN expectations because other actors are influencing its outcome. Maybe UNN was not aware of this.

"The starting point of the group who was made responsible to buy the new machine was that a machine was needed. There were no questions whether we should by it or not buy it, just find a machine that is suitable" (Manager PAS)

Additionally the machine does also require work flow changes. In the existing routines there is a possibility move sample materials from one tube to another, and register the requisition it in a parallel process, because the registration work is performed at the same time as the other staffs moves the sample material from the primary sample tubes to the secondary sample tubes. The new machine will not allow such parallel process.

"The new system requires that all requisitions are put into the computer system before the machine knows what to do. So here we must put all requisition into the computer system and then put the sample tubes into the machine. Today we do this at the same time" (Manager PAS).

This example illustrates that all sample tubes must be scanned or manually registered before they can be put into the machine and become distributed. It is therefore good reasons to argue that the real benefits of this machine really depend on a more seamless information flow, which still needs to be established. The case is that Well Interactor would contribute very positively if such a seamless information flow was established. Then the majority of the sample tubes (blood samples) could be labelled at the general practitioners and become automatically distributed by the new machine. But unfortunately because of the trouble regarding achieving this seamless information flow the manual work must still proceed.

One of the intended goals of the Pre-analytic Service Unit was to reduce manual resources by January 2007. A new goal is that it is supposed to be solved within September 2007.

> *"The Pre-analytic Service Unit is not at the moment able to achieve its goals. We had a goal to reduce the manual resources by January 2007 and now September 1 2007. We will never be able to do this. The establishment of the electronic requisition possibilities will take much longer time" (Leader of PAS).*

The problem is that it might be hard to reduce or save these resources, because things do not always turn out to become like expected. The examples in this section makes it reason to argue that too much focus has been lent on ideal situations and that the outcome of the new technology has been taken for granted. According to Orlikowski (1996) an alternative approach of looking into organisational changes is to see its transformation as an ongoing improvisation enacted by organisational actors trying to make sense of and act coherently in the world, thereby assuming that the existing environment plays a huge role in relation to the end result.

> *"What is tragic is that when everything seems to be ready to be established we realise that we have focused on the wrong model" (Leader of PAS)*

Because of the need to re-label, it may take month, or even years before the new machine can be used effectively and contribute to save resources. Additionally, we can not know whether there will be a better machine in the future. And since the fate as mentioned lays partially in DIPS ASA, the re-labelling process must probably continue until DIPS ASA has established an improved solution. And still, if this vendor finds a solution to the described problem, it does not help the other laboratories which use other information systems. The overall success of a seamless information flow might then be dependent on how UNN are able to implement the needed barcode at the general practitioners, or pushing vendors to create ad-hoc based changes so Well Interactor can fit more properly into UNN's installed base, thereby increase the chance of using the machine to create a seamless information flow.

7.6 The role of paper requisitions at the Pathology Anatomic laboratory.

The detailed planning for the Pathological - Anatomic laboratory has been postponed to after Phase 1 of the GiLab project. This laboratory was scheduled to take part in phase 2 of the GiLab project; from December 2007 (See Figure 4, section 6.5). This has not happened. The state of the developing process is currently postponed to the future. However, including Pathological - Anatomic may prove to be even more challenging then including the Medical Biochemistry laboratory because the complexity regarding work flows and manual work are much higher. The deadline of the two laboratories has been planned to be the same. After one and a half year of developing work, the Pathological - Anatomic laboratory has still not received electronic requisitions.

The manual processes at the Pathological - Anatomic laboratory starts when the packages are received at the Pre-Analytic Service Unit. The first thing they do is to write a number on the paper requisition illustrating how many sample tubes which is connected to the same requisition (See green arrow on Figure 18). The staffs are then able to find out very fast how many barcode labels they need. The barcode number is especially made for the work processes. Each paper based requisition is also marked with the Sympathy barcode, which is quite unique. It plays a huge role in relation to documentation as well and can not be changed.

> *"We can not change our lab number. This will cause chaos for our documentation. It will puncture our series of numbers" (IT Laboratory Personnel 1)*

The barcode is also necessary to access the relevant patient information from Sympathy and illustrates the laboratory, requisition number and year. This number has been a part of the documentation for several years.

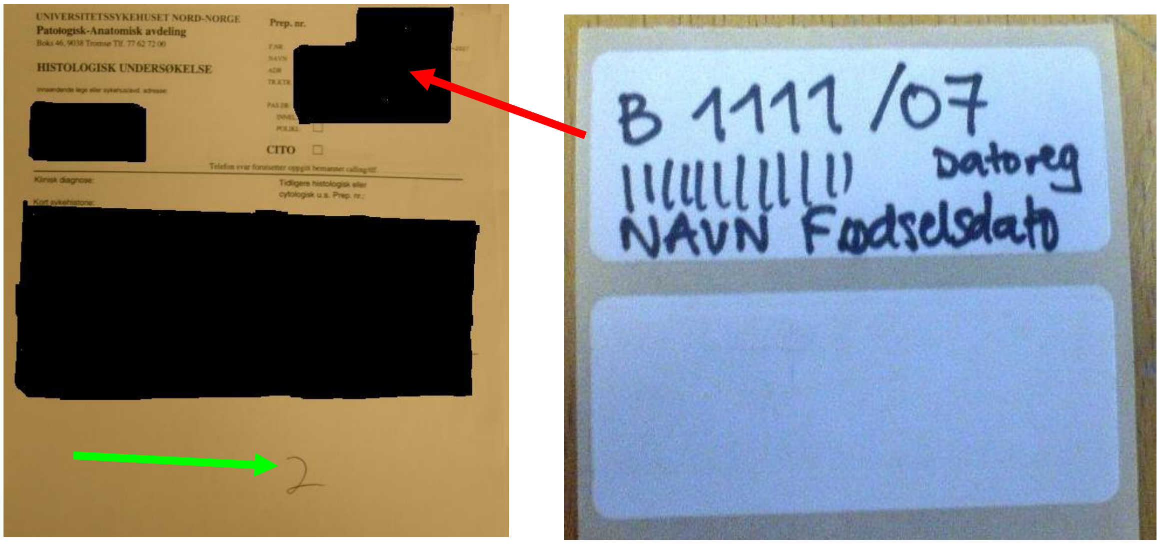

Figure 18: A paper based requisition with the manual number and an illustration of the Sympathy barcode. An original code could not be used.

When the registration process has been performed, all samples tubes and paper requisitions are transported together into a small room called the "macro room", (Figure 19). This is a room where all samples are being examined physically. Because the samples need to be diagnosed using microscopes, the selected parts of the samples needs to be temporary placed on small squared boxes. The staffs use the boxes to create sample material cross-sections which are placed on the microscope plates. The sample material not used are kept in the sample tubes and stored so it can be accessed if the staffs need more material later on. The use of the Sympathy barcode is therefore very important as might take many weeks to analyse the material and the fact that a patient might have two or more analysis within this period. Both the boxes, sample tubes and requisitions contain the same requisition number generated by Sympathy. Additionally the staffs scan the paper requisitions to access the information in sympathy make those small boxes.

> *"We scan the number to access the information stored in the requisition" (Bioengineer 1, Pathological - Anatomic laboratory)*

The quote illustrates that they use papers to access information from computers. Without the paper requisition and their specific barcode they cannot get their needed information, which means that if the goal is to quit papers, a lot of changes need to be performed internally at the laboratory.

During the examination and description of the samples, the staffs use the original paper based requisitions to read the clinical information. The clinical information is important as it gives information about what the requisitioners asks for. Most often the description is hand notes, but it could also be drawings.

> *"The drawings are usually used to show where they [requisitioners] have taken the sample from. They mark a cross on a body to show where they have cut out a part of the skin for instance" (Bioengieneer 2 Pathological - Anatomic laboratory)*

After examination in the macro room the findings are being described and dictated into a Dictaphone. Such descriptions could be sample size and variation between the samples for instance. After dictations the dictated cassette, which might include up to 15 requests is stored together with the paper schemas in plastic folders. The registration personnel can then write this information into Sympathy by listen trough the dictated cassette. A new paper sheet named "arbeidskopi" is then printed being very similar to the paper requisition but do also contain the described findings. Both these papers are used in later processes.

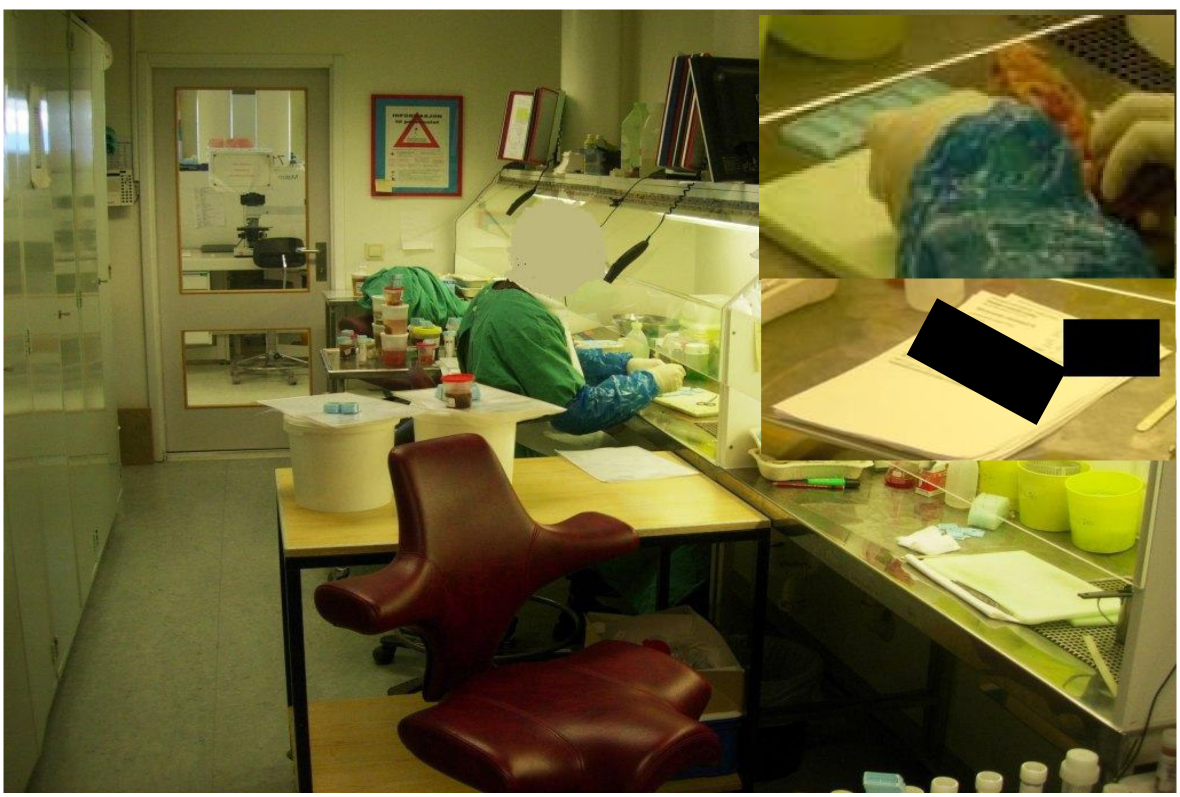

Figure 19: The work at the "macro room".

Additionally it also happens that the staffs working in the "macro room" make drawings on the paper requisition schemas as well. This is because they want to document how the sample looks like before they cut in it. This scenario is most relevant in the description of bigger body parts requested internally, but it is also relevant for smaller samples coming from the GP's.

> *"We make drawings to show where the cross sections are cut and how we handle and colorize the samples before we cut in it" "Sometimes this is very important" (Physician 2)*

According the fact that drawings sometimes are important, one may think that computers are needed in the "macro room" if the requisitions is supposed to be electronic. However these issues may be more apparent at later stages when becoming more relevant for the project.

When the work at the "macro room" is finished, the remaining work is to create the microscope plates used in diagnosing. During this work the staffs needs to "cut" out the part which might have pathological findings. This procedure is quite similar to factory work. It includes several steps and during these steps the paper requisition is used. Each time a carved part is placed on a microscope plate, the staffs write the number found on the small plastic boxes or the paper requisition manually on the plate using a pencil. Later the manually written number is replaced with a new label created by Sympathy by scanning the barcode on the paper requisition. Simply told, each time the staffs need to access information or create new barcodes from Sympathy they scan the paper requisitions. This is done because it is easier to scan the paper requisition then write the number into Sympathy manually. In addition the blue small boxes and the microscope plates are also so small that putting a barcode into these might be troublesome. However such issues will anyway cause the need for changing the laboratory's work flow, and may be more apparent at later stages when it is becoming more relevant for the project. (Diagnosing happens when the microscope plate is completely finished).

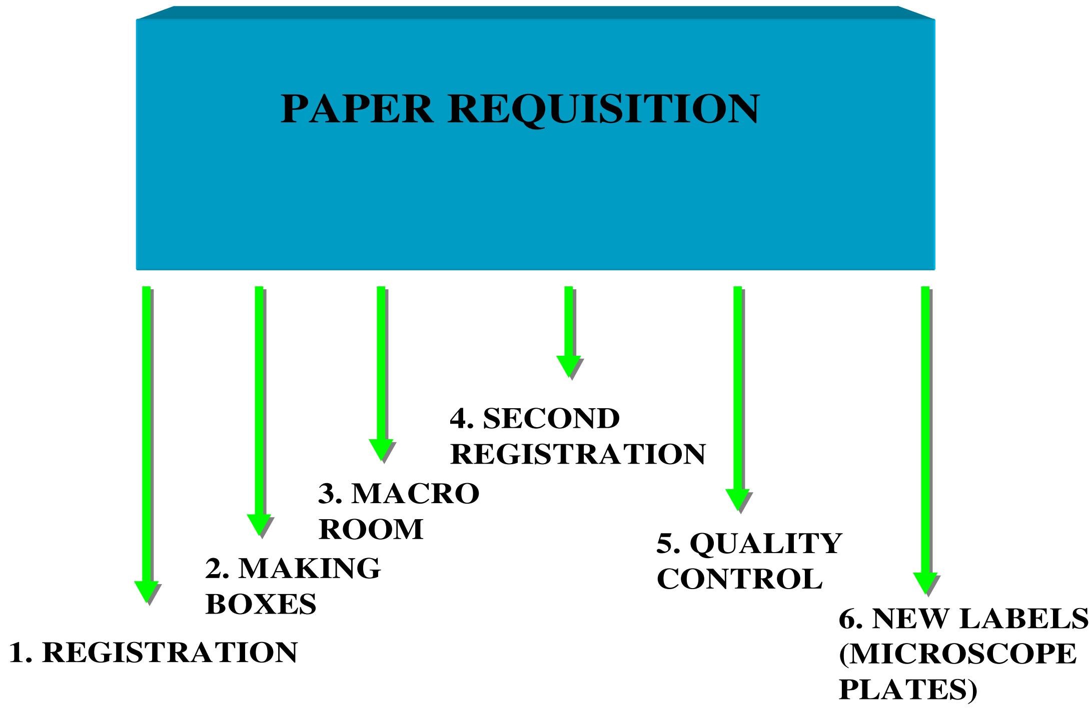

Figure 20: Illustrates each step the paper requisition is required to support existing workflow.

7.7 The paper requisition as quality control

Like told, the work at the histology part of the Pathological - Anatomic laboratory is based upon a work flow where samples goes trough different steps where bioengineers are doing "manual work" on the samples. The clinical information related to each box and the amount of boxes is seen in the "arbeidskopi". This means that the staff can perform quality assurance to make sure that nothing is missing because they can count the number of boxes and see if this is correct according to the described information seen on the "arbeidskopi" Another aspect is that paper requisition and its associated boxes may be stored for many weeks before more work can be performed. The sooner the staffs is able to do this quality assurance control the sooner they can trace missing samples or paper requisitions, something that might prevent medical consequences.

> *"We have to be sure that we are ajour when it comes to check if we have all the paper requisitions and its belonging boxes" "As sooner we are able to trace an error as more easy is it to fix this error". "At this time we save the garbage until we are sure that it is correct". "If some boxes are missing we have to search for them" (Bioengineer 3, Pathological - Anatomic laboratory)*

The quote above illustrates that quality control is important. Today the staffs at the laboratory are dependent on both, the small boxes (samples) and paper requisitions when they perform this manual quality control. If the paper requisitions are moved away, the staff will not know how many boxes that belong to one requisition.

7.8 Reorganise the laboratory or print out the electronic requisitions

One strategy for being able to use the received electronic requisitions at the Pathological - Anatomic laboratory is that the staff prints out a paper based copy of the electronic requisition. Alternatively if the laboratory may get rid of the papers they must reorganise the whole laboratory which includes large changes to the Sympathy software. Then, for the general practitioners to be able to request services related to this laboratory, the staff do still need to print out paper requisitions and perform the second registration work to support the work flow. Yet another alternative is that Well Interactor makes it possible to make requisitions to this laboratory in the future, for instance by converting the XML based requisition into Sympathy and let the laboratory proceed using their implemented lab number, and thereby reduce the registration work, but as emphasized earlier, someone needs to print them out again to support the current work flow. The benefits of implementing electronic requisitions are therefore harder to achieve for this laboratory. However this does not undermine the positive experience for that the general practitioners will become able to fully use the advantages of Well Interactor, as they do not need to shift between using paper requisitions in some laboratories and electronic in others.

7.9 Checking status – mostly relevant for time consuming analysis

One of Well Interactor's interactive services is the possibility to check the status of requested services. This should be seen very relevant to the histology part of the Pathological - Anatomic laboratory, since it might take many weeks before answers are ready. In contrast, the answers at the Medical Biochemistry are usually ready within a few days, or the next day. Today the Pathological - Anatomic laboratory receives phone calls where the requisitioners are asking the status of the samples.

> *"It happens that someone calls and asks: Is it finished soon?" (Registration personnel, Pathological - Anatomic laboratory)*

The point is that as long as the laboratory keeps on using papers the interactive status function should be considered as very hard to realise. Even today the Pathological - Anatomic laboratory does not give such answers.

> *"Not a single piece of information pass before it [the sample] is finished [diagnosed]." (Registration personnel, Pathological - Anatomic laboratory)*

If we take a look at the complex work flow it might not seem so strange that the laboratory staff do not give such answers. The paper requisitions are in some areas achieved in large piles. The staffs work is also in most cases based on numbers and not on names. If the staffs are being able to give answers on the actually status it will probably cause additional work and not less work. And if this status notification are supposed to be interactive or automatic (not based on giving the staff at the laboratory extra work loads), there is a need to reorganise the whole laboratory. The work is as told many times paper based. The general practitioners are also usually asking: "Are there any Pathology, Yes or No?" The status function can probably be seen relevant after diagnosing, but then the diagnosing work has already occurred and is likely to be transmitted to the general practitioner. If the analysis work has not been performed yet, the status function might give an answer "NO", but then the function is more a confirmation, and not a function giving the actual status. It might be easier to implement the status function at the Medical Biochemistry laboratory since their information is already stored in computers and the work flows based on using computers, but if the answer is ready within some days, the relevance of such function is decreased as well.

8 CONCLUSION

Throughout history, computer based information systems have been considered to have an enormous potential to improve efficiency, reduce costs, improve access to information independent of where the information is stored, and to make the daily based work easier to carry out. High expectations are desired to such systems and the visions are often very high. The quote below is an example of such a statement.

> *"e-Health is the single most important revolution in health care since the advent of modern medicines, vaccines, or even public health measures like sanitation and clean water" (Teamwork 2007, p 4).*

During the history, the Norwegian government has put a lot of efforts in improving health care by using Information Technology. The visions and expectation are quite high, but the benefits and created results are, at least at present, not in proportion to these expectations. We are still facing many of the same problems that were relevant decades ago. The health care work is still paper based to large extent. In contrast to this, the technology it self has rapidly developed the last decades and are today far more powerful than 30 years ago. This could be seen as a paradox. How can the health care system be so manual based while the condition of the technology are so good? It is the author's opinion that the process of reaching the goals is not only a matter of technology. It is also a matter of including social and existing work practices. The process of reaching the goals is either not only a question of good or bad planning because many such technological based project does not turn out to become like planned. Experience has shown that in many cases the end results for IT investments are often very different from what was initially planned. Of course it can be claimed by developers that it is not easy to plan and predict the result, and thus have a complete overview, but then we are also realising that it is difficult to plan everything from the start.

Since it is difficult to fulfil the complete potential of many health related IT projects, the project owners like for example hospital should put more resources into mapping the existing work practices and social contexts before technology is designed. The work practice in hospital is very complex. It is based upon heterogeneous elements including a great variety of unique work practices; a lot of different professions and lots of installed information systems often with complete different purpose. Tremendous resources are needed to map such work practices, probably more than what we can expect vendors to outline. Even if decision makers should have complete overviews it might be hard for them to reach such complete overviews of complex work practices.

The findings in this thesis are based upon looking at different laboratories as a whole. This has been done by starting with the simplest laboratories, and next goes on with more complex ones. The goals in the GiLab project are the same to all laboratories which are to enable electronic requisition possibilities. A lot of small micro level social dynamics, seen in the Pathological – Anatomic laboratory for instance, which seems to have lower focus in this project could cause problems in later stages. This can be a threat to the vision of achieving the wanted success and seamless information flow.

Integration could also be related to the connection of human resources and technology. The Installed Base at UNN is build upon many small micro elements for which the performance is very difficult to predict without an enormous resource used to map those elements. The actor's interests must be balanced and aligned to achieve the goals. Each goal must be designed in correspondence to what is possible to perform and achieve based upon the existing Installed Base.

The findings from the study show that the new distribution machine was bought with too little focus on the existing work practice. Indications show that the implementation benefits of this machine might be far beyond the expected ones. Ideal seamless information flows depends on ideal situations. Whether the general practitioners will use the new system or not can not be decided by UNN alone. UNN must change their work flows considerably and ad a lot of features into their existing Installed Base if they are going to be able to quit the re-labelling process for instance. An ideal situation is seamless information flow. The findings in this thesis show that UNN and Well Diagnostics AS can not establish a seamless information flow alone. The result is dependent on all involved actors.

The future work is then shaped and reshaped by all those actors, both technologically and human oriented ones. The construction of future work processes is then to seek to find answer about how all elements within the Information Infrastructure can communicate and be aligned to achieve the wanted goals.

9 REFERENCES:

Akrich, M. (1992): The De-Scription of Technical Objects. In Bijker, Wiebe E. and John Law (eds.) *Shaping Technology / Building Society. Studies in Sociotechnical Change.* Cambridge, MA: The MIT Press.

Aanestad, M. (2003): The Camera as an Actor: Design-in-Use of Telemedicine Infrastructure in Surgery, Journal of CSCW 12: 1–20, 2003.

Aksjonsprogrammet (2007)
www.aksjonsprogrammet.no

Aschehoug and Gyldendal: Store Norske Leksikon. Aschehoug og Gyldendal (1997) ISBN 82-573- 0699-1

Atkinson, P., Hammersley, M. (1998); Ethnography and Participants Observation. In N.K. Denzin and Y. Lincoln (eds): Strategies of Qualitative Inquiry. Thousand Oaks, California Sage Publications

Benbasat, I., Goldstein, D. K. and Mead, M. (1987) The case research strategy of information systems. MIS Quartely 11 (3) 369 – 386.

Brændvang, A-K og Kjelvik, J. (2005) Helseutgifter for 2002.
http://www.ssb.no/vis/magasinet/slik_lever_vi/art-2005-03-03-01.html

Breshbuhl, H and Margulius, D (2005) CIO Leadership Notes. Ralph Szygenda, group VP and CIO, On driving change at General Motors. Center for Digital Strategies. http://www.cioleadershipnotes.com/p/gm.htm

Callon, M. (1991) Techno-economic networks and irreversibility. In Law J., editor, A sociology of monsters. Essays on power, technology and domination, pages 132- 161. Routledge, 1991.

Callon, M. (1987). Society in the Making: The Study of Technology as a Tool for Sociological Analysis. in Bijker, Wiebe E.; Hughes, Thomas P.; Pinch, Trevor J. (eds.) The Social Construction of Technological Systems. New Directions in the Sociology and History of Technology. Cambridge, MA: MIT Press

Coiera, E. (2000) When conversation is better than computation,
J. Am. Med. Inform. Assoc. 7 (2000) 277 - 286.

Coiera, E. (2003) Guide to health informatics. 2nd Edition Arnold, London.

Davenport, T.H. (1993). Process Innovation, Harvard Business School Press, Boston, MA.

Dips ASA (2007)
http://www.dips.no/dipsnew.nsf/Display/Startside

Dreilinger, C. (1994). Why management fads fizzle. Business Horizons, November/December 1994, vol. 37 no. 6, p. 11.

Eisenhardt, K., M. (1989) Building theories from Case Study Research. The academy of Management Review, Vol 14. No 4. (Oct, 1989), 532 – 550.

Ellingsen, G and Monteio, E. (2006) Seamless integration: Standardisation across Multiple Local Settings. Computer Supported Cooperative Work. Springer.

Feiring E (2005) På Europa-toppen i helseutgifter. Tidsskrift for den norske legeforening. http://www.tidsskriftet.no/pls/lts/pa_lt.visnyhet?vp_id=7635

Forsythe, D.E. (1999): "It's Just a Matter of Common Sense": Ethnography as Invisible Work. *Journal of Computer Supported Cooperative Work*, vol. 8, pp. 127-145

Galliers, R. (1992): Choosing Information systems Research Approaches. In Robert Galliers (ed.) Information systems Research. Issues, Methods and Practical Guidelines, pp. 144-162. Oxford: Blackwell scientific publications.

Gasser, L. (1986): The integration of computing and routine work. *ACM Trans. on Office Information systems*, vol. 4, no. 3, pp. 205-225

Giuse, D. A. and Kuhn, K. A. (2003). Health Information system Challenges: The Heidelberg conference and the future. International Journal of Medical Informatics 69 (2003) p. 105- 114. Elsevier Science Ireland

Gripsrud, Silje (2002) Fastlegeordningen gir mer makt til pasientene. http://www.forskning.no/Artikler/2002/oktober/1034338934.74

Guba, E. and Lincoln, Y.S. (1994). Handbook of qualitative research. Newbury Park, CA: Sage.

Hammer, M. (1990, July-August). "Reengineering Work: Don't Automate, Obliterate," *Harvard Business Review*, pp. 104-112.

Hanseth, O. (2002) "From Systems and tools to networks and infrastructures - from design to cultivation. Towards a theory of ICT solutions and its design methodology implications.

Hanseth and Monteiro (1998): Understanding Information Infrastructure http://heim.ifi.uio.no/~oleha/Publications/bok.html

Hanseth, O and Monteiro, E. (1997). Inscribing behavior in information infrastructure standards. *Accounting, Management & Information*

Technology. Vol. 7, No. 4, pp. 183-211.

Harper, R.H.R. (2000): The Organisation in Ethnography: A Discussion of Ethnographic Fieldwork Programs in CSCW. Computer Supported Cooperative Work, vol. 9, pp. 239-264.

Helse-Nord (2007)
http://www.helse-nord.no/category635.html

Hughes, T.P. (1994): Technological Momentum. In M.R. Smith and L. Marx (Eds.) Does Technology Drive History? The Dilemma of Technological Determinism. The MIT Press.

Hughes, T. P. (1987) "The Evolution of Large Technological Systems" in Bjeker, W., Hughes, T. and Pinch T. (eds.), The MIT Press, 51-82.

Innst. S.nr.165 (1994-1995). Innstilling fra sosialkomiteen om samarbeid og styring – måk og virkemiddel for en bedre helsetjeneste
http://www.stortinget.no/inns/1994/199495-165-002.html

Kaplan B. and Maxwell J. A, (1994) "Qualitative Research Methods for Evaluating Computer Information systems" in Evaluating Health Care Information systems: Methods and Applications. Sage, Thousand Oaks, CA, 1994, pp 45 -68

King, W.R. (1994). "Process Reengineering: The strategic dimension" Information system Management, 11 (2) pp 71-73

King, G., Keohande R.O and Verba, S. (1995) The importance of research design in political science. In: *American political science review*, 89, no.2

KITH (1997)
http://www.kith.no/templates/kith_WebPage____1230.aspx
http://www.kith.no/templates/kith_WebPage____498.aspx

Klein, H. and Myers, M (1999): A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, vol. 23, no. 1, pp. 67-94.

Kudyba, S and Diwan, R. K. (2002) Information technology, corporate productivity, and the new economy Westport, Conn. : Quorum Books ISBN 1-56720-420-1

Latour, B. (1987): Science in Action Harvard University Press, pp. 103-144.

Latour, B. (1999): Pandora's hope. Essays on the Realitiy of Science Studies. Harvard University Press. Cambridge, Massachusetts London, England, pp. 174-193.

Latour, B. (1991): “Technology is society made durable”. In John Law (Ed.) A Sociology of Monsters: Essays on Power, Technology, and Domination (London: Routledge) pp. 103-131.

Law, J. (1992) Notes on the theory of the actor-network: ordering, strategy, and heterogeneity, /Systems Practise/, 5(4):379 - 393.

Lenz, R., Elstner, T. Siegele, H., Kuhn, K.A. (2002) A Practical Support to Process Support in Health Information systems. Journal of the Medical Informatics Association Volume 9 Number 6 Nov/Des 2002 p. 571-585.

Lovdata (2007)
http://www.lovdata.no/all/tl-19990702-063-002.html#2-4

Maykut P. and Morehouse R (1994) Beginning Qualitative Research. Falmer Press.

Monteiro, E., 2000. Actor-Network Theory and Information Infrastructure. In: Ciborra, C.U., Associates (Eds.), From Control to Drift: The Dynamics of Corporate Information Infrastructures, Oxford University Press, Oxford, 71-83.

Myers M.D. (1997) Qualitative research in information system *MIS Quarterly*, vol. 21, no. 2, pp. 241-242

Norsk Forskningsråd (2007) Resultatsevaluering av Sykehusreformen-Tilgjengelighet, prioritering, effektivitet, brukermedvirkning og medbestemmelse. ISBN 978-82-12-02396-3 (PDF) OSLO
http://www.regjeringen.no/upload/HOD/Vedlegg/Sykehusreformen%20endelig%20rapport%20evaluering.pdf

Norge.no (2007) http://www.norge.no/emne/samfunn.asp?id=763

Oostendorp, H., Breure, L., Dillon, A. (2005) Creation, use, and deployment of digital information. Mahwah, N.J. : Lawrence Erlbaum Associates ISBN 0-8058-4781-2

Orlikowski W.J. and Baroudi J. J. (1991) Studying information technology in Organizations: Research Approaches and Assumptions. Information system Research Vol 2, no 1, pp 1-28

Orlikoswski, W.J. (1996): Improvising Organizational Transformation Over Time: A Situated Change Perspective. *Information Systems Research.* Vol. 7, No. 1, pp. 63-92.

Orlikowski, W. J., and Iacono, C. S. (2001). Research Commentary: Desperately Seeking the "IT" in IT Research -- A Call to Theorizing the IT Artifact. Information systems Research, 12(2):121-134.

Ot.prp.66 (2001-2002) Det kongelige Sosial og Helsedepartement. Om lov om helseforetak m.m (Helseforetaksloven).
http://www.regjeringen.no/en/dep/hod/Documents/regpubl/otprp/20002001/Otprp-nr-66-2000-2001-.html?id=165010

PLS Rambol management (2004 Evaluering av tiltaksplanen "Si@" Rapport.
http://wwwupload.pls.ramboll.dk/dan/Publikationer/Sundhed/FinalRapport_SIA.pdf

Profdoc (2007)
http://www.profdoc.com/norge/omprofdoc/

Robson, C. (2002): Real World Research. Blackwell Publishing. Second edition

Sosialdepartementet, Helsedepartementet (2004). Teamwork 2007. Electronic Cooperation in the Health and Social Sector. Oslo

Stoop,A.P.; Berg,M. (2003): Integrating Quantitative and Qualitative Methods in Patient Care Information system Evaluation: Guidance for the Organizational Decision Maker, Methods of Information in Medicine, 42, pp. 458-62

Sæter, T., Heimly, V. (1996) En kort beskrivelse av helsevesenet i Norge. KITH-rapport R13/99 ISBN 82-7846-027-2.
http://www.kith.no/upload/2154/R13-96HelsevesenetNorge.pdf

Tieso, J.V. (1995): Business process Reengineering in Telemedicine: A Discussion of Models, Methods, and Technologies. MedTec 1995 Orlando, FL

Universitetssykehuset Nord-Norge HF (2007)
http://www.unn.no/category10083.html
http://www.unn.no/category10083.html

UNN Document 1, UNN: Fri Flyt presenterer "prøvenes gange" En Mor Produksjon.

UNN Document 2, UNN: Administrasjonens gjennomgang.

UNN Document 3, UNN: Felles prøvemottak "En vei inn, en vei ut" En Mor Produksjon.

UNN Document 4, UNN: UNNs forskningsinnsats i prosjektet "Gi Lab"

UNN Document 5, UNN (2005) Laboratorieprosjektet Teknologisk Samhandling.

UNN and Well Diagnostics AS (2006) Prosjektplan for prosjekt "Gi Lab!" "System for sikret sanntidsrekvirering og tilgang til medisinske tjenester"

Van Maanen J. (1979) The fact of fiction in organisational ethnography. Administrative Science Querterly 24 (4), 539 – 550.

Vigerust, I. (2007a) Helse og Omsorgsdeparementet. Hovedtrekk i fastlegeordningen etter to og et halvt år – foreløpelig oppsummering og statusrapport.
http://www.regjeringen.no/nb/dep/hod/dok/rapporter_planer/rapporter/2004/Fastlegeordningen-etter-to-og-et-halvt-ar.html?id=106155

Vigerust I. (2007b) Ministry of health and care services (1996) Mer Helse for Hver B *IT*
http://www.regjeringen.no/en/dep/hod/Documents/Veiledninger_og_brosjyrer/1996/Mer-helse-for-hver-bIT.html?id=87401

Walsham G. (1993). Interpreting Information systems in Organizations. Wiley, Chichester

Walsham,Geoff (1995): Interpretive case studies in IS research: nature and method, European Journal of Information systems, 4, pp. 74-81.

Well Diagnostics AS (2005) Well Interactor – System for sikker nettbasert bestilling og tilgang til medisinske tjenester.

Yin, R.K. (1981) The case study as a serious research strategy, Knowledge: Creation, Diffusion, Utilisation, 3, 97- 114.

Yin, R.K. (1994) Case study research: Design and Methods, 2nd Edition. Thousand Oaks, California.: Sage