UNIVERSITY OF TROMSØ UIT

FACULTY OF HEALTH SCIENCES
DEPARTMENT OF CLINICAL MEDICINE
TELEMEDICINE AND E-HEALTH RESEARCH GROUP

Socio-technical integration in health care

A case study from a hospital-based laboratory context

Kristoffer Røed

A dissertation for the degree of
Philosophiae Doctor

October 2011

Abstract

This thesis deals with socio-technical approaches to the work of implementing ICT systems in health care. In the thesis, I address and reflect on challenges related to design and implementation as well as integration of ICT systems with hospital laboratories. Based upon empirical examples gathered from a longitudinal case study using interpretive methods, the results suggest how health care practices can shape the implementation of integrated systems and what role users may have in these projects. The thesis concerns not only the practical challenges of integration, but also how large-scale integration challenges may be handled.

In recent decades, several projects and national strategies aimed at enabling electronic interactions within the health care system have failed. Despite heavy investment of resources, the results of many projects are still far from the initial goals. Major delays and budget overruns are common. One important reason for such outcomes is that designers and project managers do not manage to grasp the complexities in the existing practices when they draw up strategies for more efficient health care. My objective is to spell out this complexity in detail.

By reflecting on previous research, I emphasize that ICT systems, when designed, do not adequately address existing practices and existing portfolios in health care organizations. In the light of the diversity and variations across different health care practices, a broader approach and understanding is necessary to understand the impact of these differences. In this thesis, integration is seen from a broader socio-technical perspective, which offers an important foundation for increased cooperation between designers of ICT systems and members of organizations. I illustrate the importance of such cooperation by showing that users may be an unexploited resource in large-scale ICT projects. In some cases, users should be regarded as co-designers of ICT systems.

Preface

The thesis has been submitted to fulfil the requirements of for the degree of Philosophiae Doctor (PhD) at the University of Tromsø (UIT). The work has been carried out at the Faculty of Health Sciences, Department of Clinical Medicine, Telemedicine and the E-health Research Group in Tromsø, Norway.

The thesis includes four articles and an extended introduction to provide a synthesis of these. The introduction focuses on the motivation behind the thesis and the theoretical framework. It describes the case on which the thesis is based, and covers the methodological approach. The results, implications and conclusions are described at the end. The following four articles are included as appendices:

Article 1: Røed, K. (2011): "Slow organizations and fast technologies". How existing practices and systems shape integration projects in health care. Submitted to: New Technology, Work and Employment.

Article 2: Røed, K., Monteiro, E. and Ellingsen, G. (2011): Integration as Escalation of Complexity. Accepted for publication at the 6th Mediterranean Conference on Information Systems (MCIS), Cyprus, September 03 - 05, 2011.

Article 3: Ellingsen, G. and Røed, K. (2010): The Role of Integration in Health-Based Information Infrastructures. Computer Supported Cooperative Work (CSCW) Vol. 19, No. 6, pp. 557-584 [Diana E. Forsythe Award Finalist (American Med. Info Assoc.) 2011].

Article 4: Røed, K. and Ellingsen, G. (2011): Users as Heterogeneous Engineers - The Challenge of Designing Sustainable Information Systems in Health Care, 44th Hawaii International Conference on System Sciences (HICSS), pp. 1-10.

Acknowledgements

I really wish I could personally thank all contributors. I hope that you understand that I am very glad that you have helped me to realize my goal of writing this thesis. First and foremost, I owe my deepest gratitude to my supervisor Gunnar Ellingsen for your patience, help, and interest in making this work possible. Writing a PhD thesis is far from easy, and I feel honoured that you have had faith in me, Gunnar. I also owe special gratitude to my secondary supervisor, Eric Monteiro. What you have done, Eric, is not only to motivate me to continue my education. You have also given me tremendous inspiration to be more analytic and put effort into my work.

I would also like to thank the Scandinavian IS community and all the people I have met during the PhD days in Oslo, during my visits in Denmark, and during my conference visits to Australia, Hawaii and Cyprus. While there are many here who deserve credit for motivating me, I owe personal gratitude to Margunn Aanestad, Irene Olaussen, Ole Hanseth, Espen Skorve, Jørgen P. Bansler, Finn Kensing, Keld Bødker, Karlheinz Kautz, Kalle Lyytinen and Lars Mathiassen.

I would also like to thank all the staff at Well Diagnostics AS (DIPS ASA), for giving me the opportunity to work for (and with) you during the summer of 2006 and for the patience and time you have devoted to answering my questions. Equally appreciated is the help from everyone I have talked to at the University Hospital of Northern Norway and the staff at the GP practices that I have visited. I am enormously grateful for everything you have done for me.

I would like to thank my family, the staff at NST and TTL, and off course all my friends and colleagues in Tromsø, especially Rune Pedersen, Torbjørg Meum, Eli Larsen, Liv Karen Johannessen, Monika Johansen, Terje Solvoll, Frank Larsen, Gunnar Hartvigsen, Lodve A. Svare, Phillip Conzett, Can Capar, and Melania Borit. I would also like to thank all my friends in the student society and everyone else who has inspired me. Finally, I thank all who have conducted reviews of my articles and the Norwegian Research Council, which granted funding for the project "Regional Communication". Thank you all ☺

Tromsø, October 2011.

Table of Contents

1.0 INTRODUCTION

1.1 Motivation

In recent decades, the Norwegian health care system has undergone continuous improvement and is now one of the best in the world (Norwegian Directorate of Health, 2009). However, despite this situation, paper-based work procedures and manual work practices are still dominant. The sending of paper documents, memory sticks, or CD-ROMs in the post rather than using information technology (IT) to transfer information expresses a prevailing fragmentation of the health care services and is a constant burden for patients. Patients must explain their medical history several times when they are in contact with the different parts of the health service. In addition, information is neither available nor in the correct form when needed (SHD, 2005:12).

Since paper-based documentation is dominant, there are restrictions on how many people can read it at the same time. Paper-based patient records are also considered more vulnerable than electronic patient records, because one cannot easily prohibit access to them (HOD, 2009:135). The lack of appropriate interaction in health care has caused great frustration among politicians, health care leaders, and staff in information and communication technology (ICT) communities. The result is increased pressure to introduce ICT for supporting health care processes and services, and for replacing existing paper documents:

> "A comprehensive focus on the priority areas of information and computing technology (ICT) is regarded by many as the most effective measure for improving quality and effectiveness in the health and social sector" (SHD, 2005:4)

In response, the authorities have launched several strategy plans (SHD, 1996; SHD, 2001a; SHD, 2005; SHD, 2008; HOD, 2009) where a key concern has been to implement ICT for establishing seamless communication of information as well as improved continuity of services and care:

> "The concept "continuity of patient care" places emphasis on coordination and continuity in provision of services and preventive care. The aim is that patients and

> clients shall experience continuity of care when they use the services. Electronic interaction is decisive in order to ensure the improved flow of information that is necessary to achieve this goal" (SHD, 2005:5)

Accordingly, ICT is essential to realize the future goals for a better health care system.

> "The technology will facilitate that all necessary information is available when needed where the patient is in order to ensure seamless patient care" (HOD, 2009:133)

1.2 Research theme

Although ICT offers several benefits in the health care service, it is still difficult to achieve them. Ever since Gudmund Hernes, then Minister of Health, launched the Norwegian national strategy "More health for each bIT" at the end of 1996 (SHD, 1996), the many national strategies have not lived up to expectations. In contrast, they indicate that ICT implementations in health care are extremely challenging and certainly not something that one can take for granted. In many cases, it is difficult to coordinate the many actors involved; many of them have divergent opinions about what they want as well as different strategies for conducting ICT projects. There is also a tendency to underestimate the complexity of the existing practices, which frequently results in the lack of a clear overview of the overall domain, particularly in large-scale ICT integration projects. Ultimately, this implies that ICT projects tend to end up differently from what was initially expected.

Generally, a key problem seems to be that integration is largely considered a technical phenomenon where social-technical factors are underestimated and where unforeseen organizational challenges tend to appear as "surprises". As a result, socio-technical perspectives on integration emerge as more important than ever. In this thesis, two promising theoretical approaches have been applied for conceptualizing the social-technical interplay: *Information Infrastructures* (Hanseth and Lyytinen, 2004; Star and Ruhleder, 1996; Bowker and Star, 1999) and *Actor-Network-Theory (ANT)* (Callon, 1986; Latour, 1987; Latour, 1991; Latour, 2005; Law, 1999).

1.3 Research setting

A five-year study of a project called GiLab has been carried out since 2006. The GiLab project was established by the University Hospital of Northern Norway (UNN) to allow general practitioners (GPs) to use an ICT system to send laboratory requisitions electronically to the hospital. The electronic solution was highly desired by the hospital management because the paper-based solutions had many drawbacks. According to the project plan, it would not take more than two years to build the system, and after two years of use, paper would account for less than one per cent of requisitions. However, the project did not play out as planned: In 2011, only a few of the medical practices in the Northern area of Norway practices were able to send electronic laboratory requisitions to the hospital.

1.4 Research questions

In order to specify the objectives of this thesis, four research questions are addressed:

- *What is the nature of integration in health care?*
- *How can integration projects in health care be better understood and managed?*
- *How do existing practices shape integration efforts in health care?*
- *What is the role of users in large-scale integration projects?*

1.5 The remaining structure of the thesis

The rest of the thesis is organized as follows: Chapter 2 deals with the Norwegian health system. Chapter 3 explores theoretical approaches and provides a more detailed explanation of the contrast between the expectations for integration and the outcomes of integration. This chapter also elaborates on the concept of Actor-Network-Theory and information infrastructure. Chapter 4 describes the research setting. Chapter 5 presents the method, which involves the research design and the data collection as well as reflections. Chapter 6 summarizes the results of the four articles. In the final two chapters, the implications and conclusions are addressed. After the last chapter, the four articles are presented.

2.0 THE NORWEGIAN HEALTH CARE SYSTEM

2.1 Costs, statistics and facts

Today, Norway is one of the wealthiest nations in the world (Norwegian Directorate of Health, 2009). In January 2011, the population in Norway was 4 920 305, approximately one million more than in January 1970 (SSB, 2011a). While life expectancy at birth was 71 years for men and 77 years for women in 1970, it had increased to 78.2 years for men and 82.7 for women in 2007 (Norwegian Directorate of Health, 2009:7).

Having a predominately public health care system, Norway is one of the OECD countries with the highest levels of public financing of health care services (84% in 2008) (SSB, 2011b). In 2007, mainland Norway spent 11.7% of its gross domestic product (GDP) on health (SSB, 2011c). In comparison, the USA spent 15.7% of its GDP on health care in 2007 (SSB, 2011b), while the UK spent nearly 8% of its GDP on the National Health Service (NHS) in 2007 (Appleby et al, 2009:5).

The health care system in the Western world is considered a large financial burden, with the prospect of increasing costs in the coming years. While Norway spent NOK 36 billion on health care in 1980 (Hubbard, 2006:117), the total expenditure for public health care services was NOK 102 884 billion in 2000 (SSB, 2011c). In 2009, the total public health expenditure had increased to approximately NOK 192 billion (ibid). In comparison, the United States' health care system is still more expensive and it is expected that the US will pay out 18.7% of its GDP on health care by 2014 (Heffler et al, 2005). Correspondingly, in the UK spending on the NHS has "risen around 10-fold in real terms" (Appleby et al, 2009:5) to approximately £120 billion in 2009, which reflects a large increase in spending. Over the past 60 years, then, with the greatest increase in the last 10 years, NHS expenditure has grown as a share of national income, from around 3% to nearly 9% (ibid:5).

In Norway, the high costs of health care are reflected in the goals of providing all citizens with the care they need, whenever they need it, without economic constraints. An overarching aim is to provide services of high quality for everyone, regardless of the patient's financial situation, social status, age, gender and ethnic background (Norwegian

Directorate of Health, 2009). In addition, the services should be available within acceptable waiting times and distances (ibid). For instance, the Prime Minister stated in June 2011 that a cancer patient should not wait more than 20 days from diagnosis until treatment starts.

2.2 Primary health care system

Built upon the Norwegian Primary Health Services Act of 1982, the responsibility for the primary health services has been assigned to the 430 local authorities (Norwegian Directorate of Health, 2009:18). The primary health care system is financed through the national government, local tax revenues, and reimbursements from the National Social Security System (ibid). The system has many underlying services such as general practitioners, pregnancy and antenatal care, school clinics, nursing homes, rehabilitation, physiotherapy, as well as health promotion (HOD, 1997). The services are carried out either by health care personnel hired by the municipality or by private enterprises in cooperation with the municipality (Norwegian Directorate of Health, 2009).

When patients feel ill, they normally contact the primary health care service. Here, general practitioners, usually private practitioners who treat patients on the basis of a contract with the municipality, have an important role. In addition to treating patients locally, general practitioners also refer patients to medical specialists, nursing care or hospitals when required. In addition, they send laboratory sample materials to medical laboratories around the country.

In order to improve the relationship between general practitioners and patients, the regular general practitioner scheme was introduced in 2002 (Berg, 2006). In 2007, about 3,862 physicians were enlisted in this scheme (NAV, 2011), which gave individuals the right to choose one general practitioner in order to improve continuity and access to physicians (Berg, 2006). Accordingly, the scheme allowed each general practitioner to have a minimum of 500 and a maximum of 2,500 persons on their list (Lovdata, 2009). General practitioners must provide services in health clinics, school clinics, local authority nursing homes as well as emergency units, among others (Norwegian Directorate of Health, 2009). The regular general practitioner scheme was evaluated as useful, especially for patients (Gripsrud, 2002), as the majority of general practitioners had become more considerate with regard to their relations to their patients.

2.3 Secondary health care system

Unlike the primary health care system, which is controlled by the municipalities, the secondary health care system is directly connected to the national health care authorities. In 2007, 84 public hospitals were directly a part of the secondary health care service (Norwegian Directorate of Health, 2009:23). In addition, several outpatient departments, centres for training and rehabilitation, institutions for drug addicts, retraining centres for people with disabilities and chronic illnesses, pre-hospital services and private specialists, laboratories and x-ray facilities form part of the secondary health care service (ibid:22).

Several changes have occurred in the secondary health care system during recent decades. For example, when the government took over ownership and responsibility for all public hospitals on 1 January 2002, they also introduced a hospital reform. As a result, all the hospitals previously managed by the 19 counties were operated and controlled by five independent health enterprises (SHD, 2001b). An aim of the hospital reform was to deliver better care through an improved focus on patients' needs (ibid). In addition, the reform was intended to improve political control and financial control as well as greater equality of services across the country (ibid). However, transferring the public hospitals, policlinics and district psychiatric centres to full control by the state was also one of the largest and most challenging shifts in Norwegian health care (Norges Forskningsråd, 2007:13).

In addition to being responsible for the health care workers who live and work within each region, each health enterprise is financially responsible for its work (SHD, 2001b). Furthermore, the enterprises must plan and manage the local hospitals and other specialized care in their regions (Norwegian Directorate of Health, 2009:23). Each health enterprise is further divided into sub-authorities, where underlying independent enterprises serve their own regions. For instance, Helse Nord RHF (the Northern Norway Regional Health Authority) has five underlying independent enterprises, which also have their own management (Helse Nord RHF, 2009). After a merger of Helse Sør RHF and Helse Øst RHF in 2007, four health enterprises exist in Norway today: Helse Sør-Øst RHF (South-Eastern Norway), Helse Vest RHF (Western Norway), Helse Midt-Norge RHF (Central Norway) and Helse Nord RHF (Northern Norway). Figure 2.1 illustrates the structure of the Norwegian health care system:

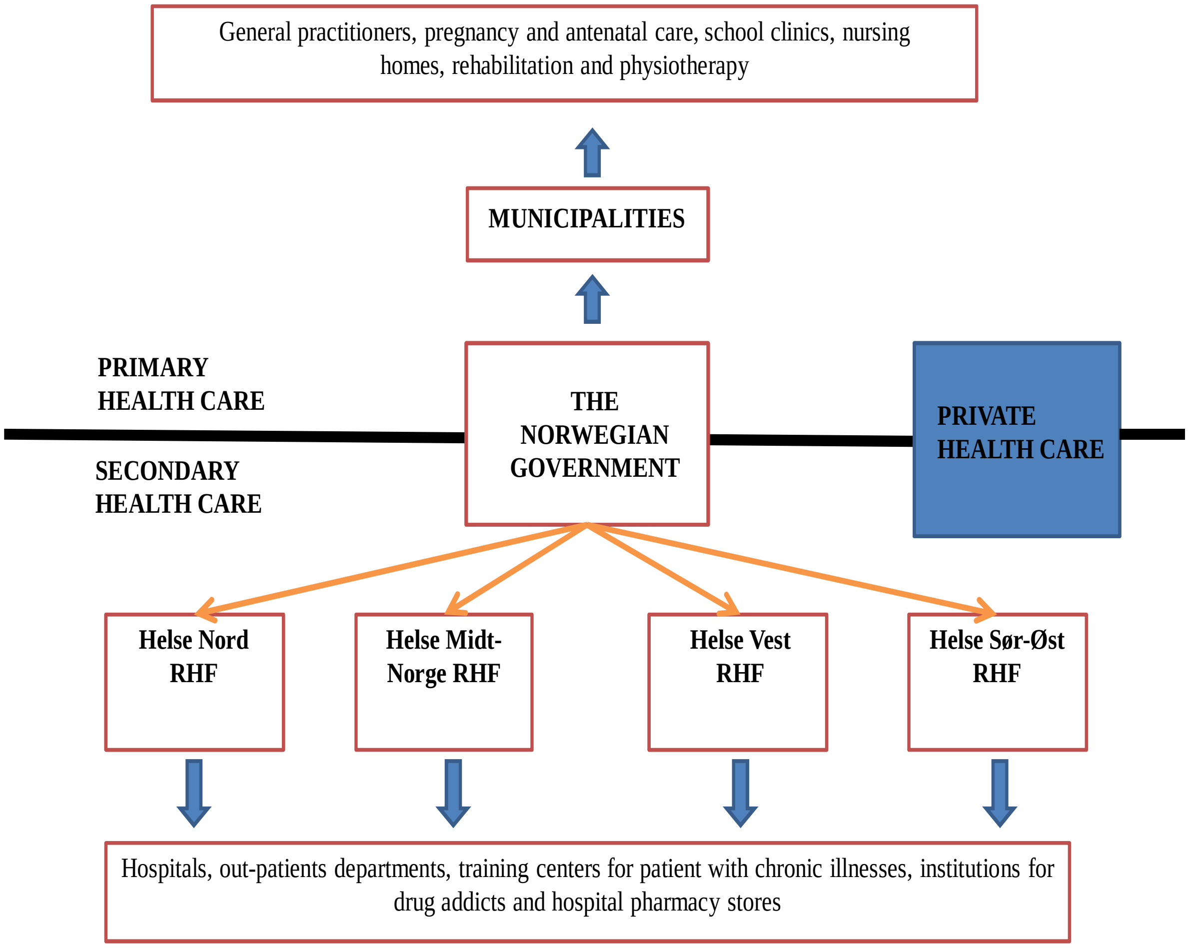

Figure 2.1: The organization of the Norwegian health care system.

2.4 The coordination reform

Like many other Western countries, Norway wants continuity of care and increased efficiency in the health system. A major goal of the coordination reform is to improve services by transferring existing services in hospitals to the municipalities so that patients can be treated and followed up where they live rather than in hospitals. An important goal is to focus on prevention and to provide funding so the municipalities can provide the health services that the patients need. Accordingly, the hospital will provide specialist help as before, but patients will also return to their home community more quickly after discharge. To achieve this, the municipalities provide follow-up for patients after treatment, which means that the municipalities increase their responsibility. The goal of the coordination reform is thus to improve integration by linking primary and secondary health services closer together and giving patients the right treatment in the right place at the right time (HOD, 2009).

Another motivation of the reform is “value for money”, as the health care sector is regarded as spending too much money compared to what the community gets back in the form of good health (HOD, 2008; HOD, 2009). This is especially applicable to elderly people and chronically ill patients who do not receive the level of service they are entitled. In addition, preventive health care is promising for reducing the number of sick patients in the future.

The result of today’s “not ideal” services is that patients must wait in line for treatment, they do not get suitable rehabilitation after illness, and it takes longer to get patients back into daily work (HOD, 2008). Well-established and holistic patient care is therefore essential to improve the system:

> “Comprehensive patient pathways should to a larger extent serve as a common reference for all stakeholders in the healthcare services. This is to ensure that all healthcare systems and services are focused on patient care in the form that the individual can cope with his life or restore functions / self-efficacy as far as possible” (HOD, 2009:14)

The lack of holistic health care also means lack of seamless communication as well as poor integration between municipalities and hospitals and various professions and departments (HOD, 2009). This means not only that patients must explain their medical history several times when they are moved around in the system (HOD, 2009), but also that patients experience services as confusing:

> “The lack of a holistic approach to patient care is a problem for the individual patient in that they do not receive coordinated services” (HOD, 2009:22)

Because care is not seamless, health information is sent via paper, diskettes or CDs. Therefore, the reform has concrete goals regarding the use of information and communication technologies (ICT). An important goal is to use information technology to make sure necessary information is available when needed. As a result, users can expect less travelling to hospitals, leading to reduced travel costs and travel time.

In order to succeed, the reform also underscores a need to adjust the management model for ICT in the health care sector. Accordingly, coordination becomes increasingly important. A major goal has been and still is to develop a national infrastructure that facilitates interaction between participants. In particular, three goals have been specified (HOD, 2009:35):

- Connect care providers to a common secure health network.
- Establish electronic message exchange between participants (referrals, test results, medical certificates, settlement of fees and charges, etc.).
- Improve the use of electronic medical records - which can communicate and send the available information across organizational boundaries.

A prominent goal regarding integration is then that electronic interaction should be the main form of communication:

> "In the development of ICT policy is a goal that electronic communication should be the normal way of communicating" (HOD, 2009:135)

Hence, to succeed in solving the ongoing health care challenges, it is important that health care information systems are integrated.

3.0 THEORY

There are several reasons why implementing ICT in health care is challenging. This theory section emphasizes an important aspect of this, particularly related to why it is difficult to integrate technology with health care organizations as well as with existing portfolios of information systems (IS). The first part is dedicated to socio-technical perspectives on IS implementation and use in general. The second part narrows the focus on integrated IS in health care and elaborates on expectations, integration mechanisms, and experience in integration. The third and final part suggests a framework for conceptualizing and analysing integrated information systems in health care.

3.1 Socio-technical perspectives on the use of information systems

3.1.1 The complexity of health care work

A key concern in clinical work is to ensure the best possible treatment and care through agreed-upon "best practice" routines. Many of these routines are described in various forms in manuals, procedures and documents, serving as best-practice instructions for novices as well as for more experienced health personnel. However, such descriptions frequently do not manage to cover all the complexities and nuances peculiar to health care work. While the procedures describe explicitly how work is expected to ensure *best practice*, they do not communicate much about the hidden and tacit tasks people do to accomplish exactly this goal (Berg, 1999; Goorman and Berg, 2000; Plsek and Greenhalgh, 2001). The key issue here is that medical work entails considerable uncertainty about diagnoses as well as about how to treat patients. This makes it essential to understand the patient's situation and to discuss information and impressions with other health care staff before making decisions on what to do (Xiao, 2005; Berg, 1999), clearly underscoring the distributed nature of health care work:

> "Health care work is further characterized by its distributed decision making, by 'multiple viewpoints' and by its 'inconsistent and evolving knowledge bases" (Berg, 1999:91)

As team interactions are not explicitly defined, it is difficult to control and prescribe all aspects of how people do their daily work and their mutual interactions. For instance, when problems or medical errors occur, such as in cases where a procedure has not been followed the way it was supposed to be, health care workers manage to work around them or improvise (Spear, 2005:4). For example, if a patient has accidently received the wrong medication, several unplanned ad hoc interventions are performed in order to correct the deviation from the normal procedure.

> "Health care work involves simultaneously dealing with sick individuals, with varying needs and problems, and with other health care professionals and organizational units. Standard organizational 'solutions' never wholly fit a patient's individual problem; and where a standard solution would be appropriate, chances are that it is not available as such. As a result, health care workers are constantly 'matching' one to the other, matching 'problem' to 'solution', constantly handling contingencies that require ad hoc and pragmatic responses" (Berg et al, 2003:298)

Consequently, due to the ambiguity and complexity of work that health care staff experience, it is difficult to structure the work in purely standardized and rational ways (Berg, 1999; Berg et al, 2003). This makes it hard to implement formal instructions adequate to cover all aspects of how the many individuals should coordinate their activities into an integrated whole (Spear, 2005:2).

Laboratory work clearly falls into the category of health care work as distributed processes (Atkinson, 1995). Many individuals coordinate their activities both within the various laboratories and with requisitioners in the clinical wards and in the GP practice. Routines and practices may also vary widely between the different practices (GPs, clinical wards and the different laboratories). For example, while a GP simply sees a requisition to a microbiology laboratory, the physicians at the laboratory have a completely different perspective. When receiving the requisition, the physician at the laboratory will carefully assess it based on the accompanying clinical information and may decide to order specific analyses from a vast analysis repertoire. This sometimes takes the analysis process in a completely different direction than what the GP initially requested. Another example of such variation is how the object of investigation may be transformed during the analysis process, such as samples sent for investigation at a pathology laboratory. In the operating theatre, a surgeon might look at a skin sample. For a pathologist, however, the object of investigation has been transformed into several thin slices of paraffin-encased samples to be examined closely in a microscope. Accordingly, information should be seen in relation to the context, which implies that the relevant work settings play an important role in the process of understanding the work in question (Berg and Goorman, 1999:53).

3.1.2 Designing ICT for health care organizations

Due to the large gap between expectations and results of the many ICT projects in health care, it seems reasonable that one cannot (or should not) focus solely on the technical aspects of ICT implementations. What is needed is a more nuanced approach (Goodhue et al 1992), where it is acknowledged that the health care field is built upon a large number of different and complex work practices as well as diverse technologies and architectures.

However, as implementation usually results in major challenges in aligning the web of social and technical artefacts, when technologies are introduced in organizations, it is important to look more closely at the process of creating these solutions. What typically occurs is that decision makers, project leaders or developers define the product they want developed without paying sufficient attention to those destined to use the systems. Kaplan and Harris-Salamone (2009) explain:

> "Some projects are undertaken for reasons other than need for the project: because requirements come down from the top, or because the project was simple to do, or because developers like the people who want the project" (Kaplan and Harris-Salamone, 2009:295)

During the planning, project managers or ICT developers draw on their previous experiences of engaging with different technologies to show how they intend the technology to be used (Orlikowski, 2008:291) rather than reflecting on ideas that users have contributed. Designers define actors with specific tastes and competence and may assume technology will evolve in particular ways (Akrich, 1992:208). ICT designers thus make assumptions about the world in which the new system is supposed to function, as emphasized 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. I will call the end product of this work a "script" or a "scenario." The technical realization of the

innovator's beliefs about the relationships between an object and its surrounding actors is thus as attempt to predetermine the settings that users are asked to imagine." (Akrich, 1992:208)

However, these "scripts" do not always capture what users actually need. Examples of problematic scenarios might be systems that distract users from their core work when "users have to 'visit' different windows to accomplish a task" (Berg et al, 1998:247). Instead, many projects are too ambitious, involving plans for large-scale organizational changes:

> "On the other hand, if a health information system tries to change too much this brings with it a risk of failure and, the more you change, the greater this risk" (Heeks, 2006:128)

These are typically changes where neither decision-makers nor users have a complete overview. Consequently, there is a need to explore in greater depth and try to understand what actually goes on within the many health care settings, rather than using external sources and top management to initiate change programmes that probably will not work. As stated by Atkinson (1995):

> "In attempting to understand a cultural domain such as medicine it is often necessary to acquire some degree of "insider" knowledge" (Atkinson, 1995:18)

Other projects tend to escalate and hence induce more complexity, involving many different actors with various interests. As a consequence of the many and diverse interests, it becomes difficult to coordinate projects and work towards shared goals:

> "There is a complex picture of the actors involved, with many stakeholders and imbalances of power between them. The ICT field in the health sector is fragmented. The field is characterized by a large number of players with different agendas, unclear definitions of roles and responsibilities, and a lack of national administrators who are in charge of the development in the sector" (HOD, 2009:134)

The shortcomings in traditional system design processes are that insufficient attention is paid to socio-technical perspectives, since those who develop the requirements are not the same people as those who do the actual design. In addition, those who order new information technologies are not necessarily the same people as those who will work with them (Berg, 1998:458). The information the designers have to rely on is usually provided through interviews, surveys, questionnaires or protocol analyses (Hess et al, 2008:32).

Although Suchman's (1987) study of situated action has influenced designers to pay attention to ethnography, it has not yet been fully deployed in system design (Crabtree et al, 2009:879). Developers' knowledge of the future information system therefore represents only a limited model of the work practice, rather than a complete picture of it. In this sense, the designers are forced to rely on incomplete information such as "the flow of work, the sequencing of tasks, the hierarchy of responsibility and control, and so forth" (Berg, 1998:458), rather than a full understanding of the work itself. As a result, information systems implementations often have unintended consequences (Ash et al, 2004; Harrison et al, 2007), and therefore one can never fully predict what the new system will deliver. The unintended consequences may be serious and dramatic:

> "A CT examination revealed a cancer that had spread, which is a serious finding. A message was sent to the doctor, but because the doctor was a substitute, the message arrived in the in-tray of the physician in charge of the department. There were already large quantities of email in the in-tray, and the test result was never forwarded because the computer program made it possible to sign the test result without the doctor actually having seen it. The cancer spread and the patient died." (Schreurs, 2011)

Since many projects may lead to unintended and paradoxical results, it is difficult to keep them on a steady course (Hanseth and Ciborra, 2007). Another factor causing unintended consequences is the high degree of mutual dependencies between various information systems in play. Ellingsen and Monteiro (2005) explain:

> "Therefore, half-way into the implementation it was discovered that completely replacing PAS [the patient administration system] was extremely risky as many of the existing systems would stop working because they especially depended on functionality provided by the PAS system (searching records, reimbursement functionality, different codes, reports, etc.)" (Ellingsen and Monteiro, 2005:270).

A strategy for dealing with the unintended consequences might be the design of conceptual models of the unintended consequences (Harrison et al, 2007:543). As long as the integration involves social and technical artefacts, as they do in the context of health care information technologies (HIT), they will both play a role in shaping the outcomes. In order to spot the unfolding consequences of the socio-technical interactions, "managers, designers, clinicians, and researchers need to carefully track HIT-in-use throughout implementation" (ibid: 547). In sum, it is fair to say that IS implementations should be based on a socio-technical approach (Anderson, 1997) where both technical and organizational elements are closely intertwined (Mumford, 1994; Mumford, 1983; Leonard-Barton, 1988). That is, when information systems are integrated with social settings, they do more than deliver improved health care - they also affect the patterns of practice (Anderson, 1997:87).

3.1.3 The user role in ICT development

Even though social factors such as user participation are increasingly considered important in ICT development, it is still common to delimit the users' role as information providers rather than participants with real influence (Millerand and Baker, 2010). The traditional design strategy demands functional requirements to be clear-cut and detailed, so computer scientists can focus fully on fulfilling these requirements efficiently, smoothly, and aesthetically (Berg, 1998:458). More concretely, the developers ask for the users' specification of the success and failure criteria (Maciaszek, 2007) as well as what users expect the system to do. However, since system developers do not do health care work themselves, but rather make assumptions about how the new system is supposed to be used, their product might not fully cover the needs of the users. In this sense, there might be conflicts between designers and users regarding the correct thing to do. The consequence is emerging gaps between users and designers (Hess et al, 2008; Suchman, 2002; Lyytinen et al, 2006) in which the realities of system development become obscured (Suchman, 2002:141). For instance, as previously described, one cannot take it for granted that users actually use the systems the way they were intended to be used.

While unsuccessful implementations have many causes, it is still, from a technology-driven point of view, assumed that users have a tendency to reject changes as "users often are seen to suffer from a lack of training as well as a lack of sufficient interest" (Millerand and Baker, 2010:138). However, developers do also generate a set of "best practices", understanding that practices can be transferred between contexts. Unfortunately, this tends to ignore the crucial fact that practices are situated and localized actions (Orlikowski, 2002), and knowing in practice is an "ongoing social accomplishment, constituted and reconstituted as actors engage the world in practice" (ibid:249).

Furthermore, even though developers try to be objective, they still make assumptions about how they predict the systems will be used, which might also be different from what the users expect. Thus, if the users do not use the systems as intended, the outcomes of such scenarios will be difficult to foresee (Wears and Berg, 2005). Therefore, in order to achieve a more socio-technical understanding of ICT implementations, decision makers as well as system developers must look more deeply into how technologies intervene with the complexity of the existing work situations. If system designers are not familiar with the work situations, the systems have less chance of being successfully implemented, and the designers will have less insight into the organizational consequences of the system. As Wears and Berg (2005) argue, lack of self-insight may be a core problem for system developers:

> "In addition, this lack of self-insight is the fundamental reason why system developers cannot objectively evaluate the systems they have developed. No matter how much they may try to be objective, the very process of development and refinement has created in them hidden assumptions about "the way things work" that make it impossible for them to envision some of the ways in which things might go wrong when users who do not share those assumptions interact with the system" (Wears and Berg, 2005:1262-1263)

Even though traditional system design is often not successful in terms of integrating users in the design process of technology, there are also initiatives that reflect a contrasting way of thought. In particular, the participatory design research community (see, for instance, Schuler and Namioka, 1993; Bjerknes and Bratteteig, 1995; Kensing and Blomberg, 1998; Hartswood et al, 2000) is strongly committed to exploring the different roles users have (and should have) in design. In participatory design, user involvement is argued to be a precondition for making good solutions (Schuler and Namioka, 1993) as it is the skills, experiences, and interests of the users which are considered to make the system useful and well integrated into the work practices (Kensing and Blomberg 1998).

> "Participatory Design is a maturing field of research and an evolving practice among design professionals. PD researchers explore conditions for user participation in the design and introduction of computer-based systems at work" (Kensing and Blomberg, 1998:167)

There are many reasons why users should participate. First of all, users and designers have different practice, which means that they belong to different communities of practice (Bødker and Iversen, 2002:12). Secondly, users should also participate because new information systems may create new work practices (ibid:12). Hence, to reduce the chances of mismatches between user requirements and what is designed, users should participate in order to increase the likelihood of sustainable systems.

A key issue in ICT projects is to keep track of many different systems, users and vendors. Law (1987) uses the notion of heterogeneous engineers as a way to capture the challenges of those who coordinate all the necessary activities. This might be a key role for users in the future:

> "It is […] fundamental problem faced by system builders: how to juxtapose and relate heterogeneous elements together such that they stay in place and are not dissociated by other actors in the environment in the course of the inevitable struggles" (Law, 1987:117)

Since it is challenging to integrate technology in health care organizations, it is important to go beyond purely technical issues and pay more attention to users. Rather, we have to continually go back and forth between the designer and the user and in this sense look more closely into how diversities, heterogeneities, as well as technology and humans are related to each other.

3.1.4 ANT - Conceptualizing the relationship between technology and organizations

While designers and managers claim that they take organizational issues into account in IS implementation projects, there is a clear tendency to split development and implementation projects into technical (cf. the section above) and organizational issues, and therefore treat these two as separate entities. A striking example was a recent bid for tender process in several of the Norwegian university hospitals, where the hospitals established different working groups to target different areas. One group was supposed to focus on technical infrastructural issues; one group was dedicated to functionality and user needs, and so on. Dividing a task in this manner creates an artificial boundary between the different domains and subsequently requires substantial coordination between the different groups involved in large-scale acquisition and implementation projects.

However, the explicit division between social and technical issues not only comes to the fore in practical project work; it reflects a broader discourse in the Science and Technology Studies (STS) research literature on which factors are driving change in organizations and more broadly in society. At the extreme points, one finds the notion of "social constructions" and "technological determinism" respectively. Social Construction of Technology (SCOT) emphasizes that social groups interpret the same technology differently where the technology has little influence. Pinch and Bijker (1984:411-412) describe how a multi-directional model can be used to illustrate why some artefacts die and some survive. However, SCOT has been criticized as insufficient, because it views society as being composed of groups (Klein and Kleinman, 2002:30). In addition, the interpretative flexibility may be seen as consisting of endless options as there will always be groups that do not participate in design processes (Williams and Edge, 1996:867).

In contrast, from a technological determinism perspective there is a clear relationship between cause and effect, where it is assumed that technology will cause a given organizational outcome. The technological determinism view is often found in communities dedicated to technical activities, for instance among software vendors and consultants (Grant et al, 2006). The core of the perspective is that social groups have little influence on the outcome of technology, as technology is a powerful agent of change. Hence, it is expected that technology will lead to cost savings and increased profits regardless of organizational contexts (Grant et al, 2006; Davenport, 1998; Buckhout et al, 1999; Trunick, 1999). In this sense, the technological determinism perspective is reflected in management literature, where ICT is viewed as a key enabler for implementing change in organizations where the effects may be anticipated as a given in advance. See, for instance, Hammer (1990), who argues that:

> ”We should ‘reengineer’ our businesses: use the power of modern information technology to radically redesign our business processes in order to achieve dramatic improvements in their performance” (Hammer, 1990:104)

However, neither a purely social construction nor a technological determinism perspective takes us very far in understanding and conceptualizing the role ICT plays in organizations (Orlikowski and Iacono 2001). It is more fruitful to take a middle position, acknowledging that both technical and social aspects drive change processes in organizations in various ways. Along these lines, Orlikowski (2007) argues that organizations and materiality are interrelated.

> “[Instead,] the social and the material are considered to be inextricably related — there is no social that is not also material and no material that is not also social” (Orlikowski, 2007:1437)

The key point is that technical and social issues are inseparable and need to be dealt with as an integrated whole. Actor-Network-Theory (ANT) is a useful conceptualization of the relationship between the technical and the social (Latour, 1987; Latour, 1991; Law, 1992; Monteiro, 2000; Walsham, 1997).

> “ANT deals with the social-technical divide by denying that purely technical or purely social relations are possible. [...] ANT considers both social and technical determinism to be flawed and proposes instead a socio-technical account” (Tatnall and Gilding, 1999:957-958)

ANT assumes that the world is constituted by a heterogeneous network of actors (Latour, 1987; Law, 1992; Monteiro, 2000; Walsham, 1997), in which humans, artefacts, manuals, norms, routines and organizational arrangements all shape the network. Each of the actors has “interests” and each will act in accordance with these to achieve their own individual goal. According to Latour (1987), “interests” lie between the actors and their goals, creating a tension that will make actors select only what, among many possibilities, helps them reach these goals in their own eyes. The actors in a network may include users, project participants, existing systems, practices, and so forth. In order to make technology work in organizations, it is important to take into account all the different actors and factors that exercise an influence on the network (Law, 1987).

An example illustrating such mutual dependencies between the actors in an actor network is provided by Aanestad (2003), who observed what happened after the introduction of a camera into an operating theatre. According to Aanestad's (2003) findings, the camera was an actor that changed the whole network configuration in both planned and unplanned ways:

> "The camera acquired its status as an actor in the network by being delegated the role as the receivers' "eyes and ears". This defined its capacity for action as relational and dynamic, changing with different configurations of the network. [...] Due to this relational and dynamic character of the camera's capacity for influence, the effects of introducing the camera were only possible to identify at a network level, as composite effects or *displacement* of the whole network" (Aanestad, 2003:18)

Here, Aanestad (2003:18) writes that the camera "acquired its status as an actor" and it is relevant to ask under which conditions one piece of technology (or a user for that matter) is an actor. This may depend on the focus of the analysis and perspective chosen as well as on the degree to which it is possible for a given technology to influence the network (Law, 1987: 131).

A key point in ANT is how networks become stabilized or aligned, that is, when a stable relationship emerges between the actors in the network. This can be compared to the implementation of an integrated ICT system, where during the process of implementation, there are various degrees of differences in opinions and strategies among the project participants. However, when the project is terminated, either successfully or unsuccessfully, one may say that some alignment has been achieved. During the process towards alignment, the actors negotiate with each other and *translate* each other's interests. *Translation* refers to the process where interests are negotiated, since different actors may have diverse sets of interests (Monteiro, 2000, Hanseth and Monteiro, 1997). The translation process generates ordering effects (Law 1992) and involves re-interpreting, representing or appropriating others' interests to one's own (Monteiro, 2000:77). This also includes technical actors.

"And when they [translations] are embodied in texts, machines, bodily skills and the rest, the latter become their support, their more or less faithful executive" (Callon, 1991:143)

Inscription reflects this process and refers to the way technical artefacts embody patterns of use (Monteiro, 2000). The main goal is to inscribe what was made in the translation process into the system. The inscription includes programs of action for the users, and it defines the roles that users are imagined to play. According to Akrich (1992), technical objects embody and measure a set of relations between heterogeneous elements. The technology embodies the beliefs, practices, and relations, etc. of the society from which it emerges. In this sense, the technical objects participate in the building of heterogeneous networks that bring together actors of all types and sizes, no matter whether they are human or nonhuman (Akrich, 1992). If a component is removed from a system, this will influence the whole system, as the alternation will cause other artefacts in the system to change. What is crucial, however, is that the inscribed patterns of use may not succeed, because the actual use deviates from them. This also reflects the issues of complexity and design challenges mentioned previously.

3.2 Towards integrated information systems

3.2.1 Expectations of integrated information systems in health care

Given the distribution and the fragmentation experienced in health care work, there are many expectations related to what integrated information systems can do in this regard – not related only to specific laboratories, but also to the health care sector in general. Such expectations are not particularly new. In the early days of information systems, many projects were aimed at improving integration and collaboration (see, for instance, Lipkin et al, 1961; Slack et al, 1966). The IFIP/IMIA Working Conference on Hospital Information Systems held in Cape Town in South Africa in 1979 debated how technology could contribute to a shared hospital information system (Giuse and Kuhn, 2003:106).

More recently, many Western countries have incorporated integrated ICT as part of their national action plans. For instance, the Norwegian action plan "more health for each bIT" from 1997 outlined visions of integrating different ICT-based systems to make the information flow more seamless (SHD, 1996). The initiative was continued in the action plan "Si@!" from 2001, where it was stated that electronic interaction will "improve information exchange and cooperation between the various players in health and social sector" (SHD, 2001a:22). In 2004, the Norwegian Ministry of Social Affairs and the Norwegian Ministry of Health launched another e-health initiative, called "Te@mwork 2007", which aimed at promoting improved electronic interaction in the health and social sectors:

> "A comprehensive focus on the priority areas of information and computing technology (ICT) is regarded by many as the most effective measure for improving quality and effectiveness in the health and social sector" (SHD, 2005:4)

Accordingly, it was expected that technical infrastructure and information structures as well as improved exchange of electronic messages would contribute to a more efficient electronic information flow. Similarly, in 2008, the action plan Samspill 2.0 [Teamwork 2.0] stated:

> "The goal is clear. Today, 80% of health care interaction is paper-based and 20% is electronic. We have to turn this around. Within three years, 80% of the most important communication between collaborating partners in the health care services must be routed electronically" (SHD, 2008:7)

As in Norway, integration projects have been established in several other Western countries. In the UK, the National Health Service (NHS) has invested large amounts of money to build a modern ICT infrastructure (Cross, 2006; Avison and Young, 2007). Run by the government agency "NHS, Connecting for Health", the aim was to "create the most comprehensive electronic health records infrastructure of any healthcare system" (Cross, 2006:599). Accordingly, the NHS National Programme for IT (NPfIT) implied that 30 000 GPs and 270 emergency, community, and mental health institutions should be able to access health care information whenever needed (ibid:599). Similar initiatives for improving interactions between health care institutions have also been initiated in other Western regions, such as Scotland (see Jones et al 2008), the United States (see Singer 2009), and Canada:

> "By seamlessly and electronically linking all points of care across geographic borders, ICTs would make the health system more accessible and efficient. The right health

> care provider would be in the right place at the right time, to achieve the best possible outcome" (Pascal, 2000:22)

Health care managers, too, have many expectations regarding integration. Recently, in Oslo, four large hospitals were merged and were renamed the Oslo University Hospital (OUH). Here, integration was considered crucial for improving efficiency and for establishing a shared management and budget. It was assumed that the new hospital would communicate seamlessly and would manage information about patients, independent of which system information had been stored at information stored at the former hospitals. Such ambitions related to integration are also described in the medical informatics research literature, for example:

> "An electronic, interconnected regional infrastructure represents the rational approach to handling the volume and specificity of health-related information required to efficiently deliver optimal care, particularly in information-intensive specialties such as internal medicine" (Adler-Milstein et al, 2007:61)

Improved integration between information systems is also intended to simplify work for health staff and help them to access necessary information faster. Integrated systems should also provide the staff with a complete picture of a patient's medical history at the point of treatment and care:

> "Since healthcare practitioners would be able to view a patient's relevant medical history, they would be better positioned to offer more effective and efficient treatment, and could spend more quality time with the patient. Contrast this with the current situation, where medical practitioners have access, if at all, to a partial or inaccurate patient history and may recommend a course of treatment that could potentially be life-threatening" (Tsiknakis et al, 2002:5)

In other words, since integration improves the transfer of discharge letters and the ordering of laboratory and radiological examinations (Tsiknakis et al, 2002:11), as well as improving the overview of the patient's medical information (Liu et al, 2001), the aim of integration is that multiple information sources can be "accessed seamlessly from a single point of end-user interaction" (Boochever, 2004:16).

3.2.2 Technical integration mechanisms

In technical terms, integration refers to the interconnection of different information systems. The integration mechanisms imply that messages can be transferred electronically through a number of exchange protocols for standardized character-based messages (Hutchison et al, 1996), such as “Messages for Exchange of Clinical Laboratory Information”, “Request and Report Messages for Diagnostic Services Departments” and “Messages for Patient Referral and Discharge” (Ibid:29).

Several integration mechanisms have been developed, and each of them targets different layers for the technical infrastructure – from low-level integration such as database schema integration and middle-level integration such as Common Object Request Broker Architecture (CORBA) and Web services to high-level integration such as Service-Oriented Architectures (SOA) (Sahay et al, 2007). One of the integration mechanisms in health care that is most frequently used at present is Electronic Data Interchange (EDI), which has been important for conducting business-to-business transactions for more than two decades Narayanan, 2009:121). EDI has been used to exchange information structures such as orders, invoices and prescriptions (Hanseth and Aanestad, 2003:388). The EDI mechanism has also played an important role in implementing the exchange of routine messages, including laboratory results and discharge letters (Hanseth et al, 2006:568-569).

In recent years, Web service technologies have also been implemented to overcome interoperability problems among systems (Dogac et al, 2006). While both CORBA and Web services are used to make health care data available for other information systems, Web services are far more extensively used than CORBA (Cruz-Correia et al, 2007:8). In this sense, Web services are widely used to “wrap and expose existing resources and provide interoperability among diverse applications” (Dogac et al, 2006:322). Web services have also been supported by major IT vendors through their commercial platforms such as Microsoft’s .NET and SUN’s J2EE (Shen et al, 2007:316).

> “Web services allow for seamless integration of disparate applications representing different and, at times, competing standards. [...] Web services will extend the healthcare enterprises by making their own services available to others” (Dogac et al, 2006: 322)

Service-Oriented Architecture (SOA) also holds great promise as a way of dealing with fragmented systems in the health care sector (Omar and Taleb-Bendiab, 2006). SOA is advantageous for integrating heterogeneity and systems distributed over various locations, as it can "bridge clinical and related administrative entities with improved flexibility regardless of platform and physical location" (Vasilescu and Mun, 2006:94). In order to implement and deliver SOA platforms, Web service technologies provides a useful foundation (Fox et al, 2009:131). An example of an SOA-based integration platform used to integrate heterogeneous EPR systems is "Plug and Play Electronic Patient Records" (PPEPR) (Sahay et al, 2008:2298). Based on Web services, PPEPR can mediate the messages being transferred between various and heterogeneous EPR systems (Fox et al, 2009:134), a helpful approach to overcome interoperability.

Portal systems are another strategy to overcome interoperability problems. Here users can efficiently perform tasks that require access to information that resides in multiple disparate systems. Portal systems also offer patients access to health information, services and clinical care online (Weingart et al, 2006:91). For health administrations, portal systems are helpful to integrate related information (Bernstein and Haas, 2008:76). Portal systems allow users to share information via the Web, which enables health care workers to access health status, patient conditions, and prescribed treatments (Wakefield et al, 2010:470). An advantage of framing systems into a portal framework is that it allows the health care institutions to maintain their old IS portfolio. This is increasingly important since many health care institutions have invested huge amount of money in large-scale information systems (EPRs, laboratory systems, patient administrative systems, etc.), and the costs associated with replacing these would be enormous. Accordingly, portal solutions may be an economical and sensible strategy, which was reflected in the role such solutions were intended to play in the merger of the four large hospitals in Oslo (Amundsen, 2011:43).

3.2.3 Standardization – a condition for integration

Standardization is related to integration in several ways. Standardization is considered a condition for integration to enable harmonization of technical interfaces and infrastructures as well as organizational routines:

> ”Full-scale electronic interaction requires escalation and standardization of the electronic health care infrastructure as well as well as a growing number of services provided by the Norwegian Health Network” (HOD, 2009:136)

A well-known standard essential for interconnecting disparate applications in the health care field is the messaging technology HL7 (Health Level 7). HL7 was originally accredited by the American National Standards Institute and has for more than two decades been an important standard for the exchange of health care information (Kush et al, 2008:1738). One of HL7’s benefits is to “improve care delivery, optimize work flow, reduce ambiguity, and enhance knowledge transfer among all of its stakeholders” (ibid: 1739). It is more widely used than middleware solutions such as DCOM and CORBA (Cruz-Correia et al, 2007:8).

Another important standard that has influenced integration in health care is Digital Imaging and Communication in Medicine (DICOM) (Bidgood et al, 1997). Compared to proprietary file formats and transfer protocols, the DICOM standard is advantageous as it improves interoperability, asynchronous communication and integrity (Vossberg et al, 2008:145). The DICOM standard is suitable for exchanging data between the various imaging systems of different vendors (PACS and RIS systems), as well as for ensuring that images as well as messages are identified and matched to their origin.

Since open Internet standards such as HTTP, Extensible Markup Language (XML), Web Service Description Language (WSDL) and Simple Object Access Protocol (SOAP) provide possibilities for utilizing Web services, these integration mechanisms are more suitable for connecting heterogeneous information systems than middleware technologies such as DCOM and CORBA solutions, which are more dependent on single-vendor implementations (Cruz-Correia et al, 2007:8). Utilizing the open Internet standards enables data to be shared more easily across various EPR implementations, overcoming interoperability issues.

In health care, it has been common to use the Extensible Markup Language (XML) to connect data from multiple sources. In XML, variations in information content can be handled, in which makes it very flexible. The XML is therefore an “interesting format for integrating information across systems with differing representations of data” (Bernstein and Haas, 2008:76). XML is increasingly being used for transferring data between systems in health care today. For example, the Norwegian Centre for Informatics in Health and Social Care

(KITH) has implemented XML for various types of messages, including radiology and laboratory requisitions, referrals, discharge letters and results from radiology departments and laboratories (KITH, 2009).

Other related initiatives have been to standardize Electronic Health Records (EHR) through the standards CEN TC251, ISO TC215 and GEHR (Dogac et al, 2006:323). In addition, the Norwegian health authorities have also worked on installing identical information systems and EPR within the same health care enterprises to increase interoperability among the hospitals in each region (Ellingsen and Monteiro, 2008:226). The choice of standardized systems is often strategically related (ibid), as these systems are helpful in simplifying and coordinating tasks (Sahay, 2003:5). For example, many firms establish global strategies (Bartlett and Ghoshal, 2000) for gaining efficiency, and standardized systems can be treated as “a single integrated market based on similarities rather than differences” (Sahay, 2003:5).

Standardization is also reflected in attempts to standardize work processes and treatment of care. Since the literature illustrates that health care suffers not only from heterogeneous systems but also from heterogeneous patterns of care (Rozich et al, 2004), it is assumed that standardized work processes will lead to better patient treatment. Through the aim of increasing efficiency and reduce costs, there have been many initiatives for defining “best practices”, for instance evidence-based medicine, which is supposed to integrate individual clinical expertise with the best available external evidence from systematic research (Grimson, 2001:114; Ferlie and Shortell, 2001).

An expressed benefit from standardization is that work procedures and patient pathways become more predictable. Further, by standardizing outputs, the consequences of the work are standardized, and when skills and knowledge are standardized, different people know what to expect from each other (Glouberman and Mintzberg, 2001). Hence, standardization efforts may also contribute to a clearer overview and better planning of the treatment and care process.

As standardization of work processes is also related to well-functioning integrated solutions, it is expected that standardization will eliminate fragmentation, overlaps, and redundancy in work processes:

> "It is a goal of the National ICT initiative that the processes in the secondary health care system should be standardized. Areas where standardized processes can provide large benefits are standardized patient care in the systems, professional guidelines, and system configuration for receiving and handling referrals (Nasjonal IKT, 2010:14)

Examples of further readings on standardization of work and routines include Pedersen et al, 2011; Ellingsen et al, 2007; Timmermans and Berg, 1997.

3.2.4 Experience and status of the many integration projects

As this thesis is limited to health care, the experience of integration elaborated on in this section is related to health care projects. However, there are many other fields where similar experience and problems may be found. In this sense, the findings are generally applicable to other type of organizations as well.

A number of integration projects in health care have been run in Western countries, not at least in the Norwegian health care sector. Some of these are electronic prescription (KITH, 2004), message-based interaction (KITH, 2008), and portal systems where health staff can access clinical information from heterogeneous information sources (OUS, 2009). Despite great efforts to establish seamless care, integration in health care is still far behind expectations. An illustration from the Norwegian media is illuminating:

> ”It is quite shocking that hospitals are not able to interact electronically” (Lundh, 2008)

The problem is also recognized on the Governmental level:

> ”Even though Electronic Patient Journals have been established, they do not communicate very well. [...] Although the Norwegian Health Network has resulted in communication among many actors, the potential services and communication possibilities are not utilized. The numbers of actors connected are also too low” (HOD, 2009:134)

Comparable issues have also emerged in Denmark. Here, successful experiences associated with ICT implementation in the public sector are the exception rather than the rule

(Finansministeriet, 2010), where the project suffers from budget overruns of 40 per cent and time delays of 75 per cent compared to the planned project schedule. It is no surprise then that Finansministeriet (2010) paints a gloomy picture of the situation:

> “There are several examples of unfortunate interactions between government customers, vendors and consulting houses. The relationship between councils and suppliers is often characterized by mistrust and mutual recriminations. The experience in many agencies is that vendors promise more than they can deliver. (Finansministeriet:10)

One explanation for the slow progress in integration issues is that different information systems have been built on heterogeneous sources over long periods of time (Mykkänen et al, 2003:173). In addition, developers have for many years used different programming models, naming concepts, and so forth during the design, which has resulted in a myriad of different technologies and platforms. Still, this is only the tip of the iceberg. Unfulfilled expectations seem to be more the rule than the exception. Avison and Young (2007:71) reported how the Wessex Regional Health Authority had a vision of using ICT to link every ward, surgery and district nurse in the mid-1980s. The £3.3 million mainframe purchased for the project was not used until its value had declined by over 75%, as clinicians had problems accepting it (ibid:71). Another ICT blunder took place in the late 1980s, when hundreds of millions of pounds were invested in installing IT systems in most UK hospitals (ibid:71). In both these projects, cultural and organizational differences between the organizations and the IT systems turned out to be much more serious and influential than initially expected in the planning phase.

Similar issues are also surfacing in a Norwegian context. After major delays, the portal system project at the Oslo University Hospital turned out to be a resounding failure. After being terminated in May 2011, the project had spent approximately NOK 160 million, which is probably just the tip of the iceberg. In retrospect it was argued that the time schedule as well as the overall complexity of the project was seriously underestimated (Amundsen, 2011:43) and the hospital could not afford to spend more money to complete the project (Moe, 2011). Although the portal project was intended to reduce operating costs, the project resulted in increased costs for the hospital.

Comparable challenges emerged on an even grander scale in the enormous NHS national programme for information technology (NPfIT). Launched in April 2005, this programme was aimed to link more than 30,000 GPs to nearly 300 hospitals by 2014 (BBC News, 2006). According to media reports, the project has not yielded any benefits for patients so far:

> "It is perfectly clear that throwing more money at the problem will not work. [...] This turkey will never fly and it is time the Department of Health faced reality and channelled the remaining funds into something useful that will actually benefit patients. The largest civilian IT project in the world has failed” (Health Direct, 2011)

The NHS’s initial plan was to create one comprehensive system of patient records, but the goal has not been achieved. Instead, the initiative has been reduced to a patchwork of different systems across the country, and it will be very costly to make them compatible with each other (Curtis, 2011). As a result, the project had to tone down the grand visions and ambitions considerably:

> "The NHS is now getting far fewer systems than planned despite the department paying contractors almost the same amount of money. This is yet another example of a department fundamentally underestimating the scale and complexity of a major IT-enabled change programme (Curtis, 2011)

Another large-scale integration project is the 30 million Euro ePrescription project in Norway, which started in 2004. The initial goal was to establish faster handling of prescriptions with fewer medical errors (Larsen and Ellingsen, 2010:98). Both doctors and patients saw the positive potential of the e-prescription initiative. For doctors, the project should enable them to do work of higher quality and to spend less time and effort on writing prescriptions. For patients, their prescriptions could be distributed to any pharmacy, an option that made their choices far more flexible. However, as reported through several studies, the goals differed substantially between the authorities and the physicians. The first version of the system was discarded and a completely new version had to be built up from the ground (ibid: 99).

The projects mentioned above are just a few examples of many ICT projects that have gone wrong in the sense of not being used as intended, being delayed, exceeding the budget, or being stopped (Heeks, 2006; Hanseth and Ciborra, 2007). However, the result should not come as a surprise. Anderson (1997:90) wrote more than a decade ago that studies indicated that half of all ICT systems fail. Similarly, during the 1990s Paré and Elam (1998:331) wrote that “Research shows that many health care institutions have consumed huge amounts of money and frustrated countless people in wasted efforts to implement information systems”. Heeks et al (1999) also argue that there are more failures than successes. According to newer research reported by Kaplan and Harris-Salamone (2009:291), the failure rate was 40%; rates as high as 75% were reported by Littlejohns et al (2003:860) as well as by Wears and Berg (2005:1261). Regarding sustainability, the current approach has drawbacks:

> “Although interoperability seems to hold great societal benefit, it still might not be possible to implement it sustainably under the current approach” (Adler –Milstein et al, 2007:61)

In relation to the slow development of standards (i.e. the condition for integration), it is also argued that standardization attempts may result in several alternative standards, not only one (Fleck, 1994; Pollock et al, 2007). Further, standardization (i.e. at the global level) is also difficult as it may conflict “with the need for flexibility at the “local” level” (Sahay, 2003:5), which makes the question of how much to standardize relevant. Other challenging issues are that standards do not address meaningful cooperation of functions of different software components.

> “The problem faced is partly to find an arrangement that would serve the needs of all countries and different stakeholders. But more difficult has been to find a solution which can easily replace the installed base of multiple national and institutional systems at a reasonable cost and risk” (Hanseth and Lyytinen, 2004:234)

Another factor preventing the benefits of standardization is that standards are often developed faster than the vendors’ ability to adapt their software (HOD, 2009:134). For instance, the “Health Level 7” (HL) has not been adapted as planned (Smith and Ceusters, 2006). Although HL7 was intended to support standardization, health care software that is commercially available still does not comply with large portions of HL7. Similarly, the usefulness of EDI has been questioned:

"However, even after more than 25 years of use of EDI in various industries, the literature is still inconclusive regarding the benefits gained from its usage." (Ahmad and Schroeder, 2001:16)

3.3 Information infrastructures – a framework for integration

The previous section on experience clearly suggests that a broader approach to integration projects is needed. Along these lines, several studies have increasingly highlighted the need for an alternative socio-technical approach to integration (see Ellingsen and Monteiro, 2006; Ellingsen and Monteiro, 2003; Hartswood et al, 2003). A major reason is that the effects of the current integration initiatives are low, while the aspirations for integration remain high (Ellingsen and Monteiro, 2006:446). Similarly, Adler-Milstein et al (2007:61) argue that the traditional and current approach to integration does not seem to result in interoperability. However, most ICT projects have been technically oriented.

What appears to be needed is a framework for conceptualizing the design and evolution of large-scale integrated information systems. The notion of information infrastructures (Hanseth and Lyytinen, 2004; Star and Ruhleder, 1996; Bowker and Star, 1999) is a promising concept in this regard. According to Hanseth and Lyytinen (2004:208), information infrastructures are "a shared, evolving, heterogeneous installed base of IT capabilities among a set of user communities based on open and/or standardized interfaces". Therefore, as outlined by Hanseth and Lyytingen (2004), information infrastructures are composed of various technologies and organizations.

"As a result separate information systems (IS), system functionalities and software tools have over time become integrated into complex ensembles of heterogeneous IT artefacts, which are increasingly connected with and dependent upon one another. Such a complex, evolving and heterogeneous socio-technical system we call here an information infrastructure (II)" (Hanseth and Lyytingen, 2004:208)

When shared communities perform actions, they may draw upon several shared resources, materials and facilities (Hanseth and Braa, 2001; Hanseth and Lundberg, 2001). In this sense, it is difficult to make a clear distinction between the different resources, as they will always somehow be related to each other. In addition, technologies are used differently across contexts, which imply that communities of practice play an important role in how technologies are implemented and used (Star and Ruhleder, 1996).

While a traditional view of the use of technology tends to make distinctions between technology and use, information infrastructures conceptualize the use of ICT as heterogeneous interplay between socio-technical elements, rather than individual tools (Hanseth and Monteiro, 1998). Bowker and Star (1999) also emphasize how information infrastructures are a relational concept, meaning that various artefacts, routines and people are inseparable, hence mutually dependent on each other.

The existing (or old) infrastructure in an organization is called the installed base (Hanseth, 1996: Hanseth and Lundberg, 2001; Hanseth and Lyytinen, 2004). An important aspect of the installed base is that it represents not only various technologies, but also social factors, such as human work tasks and various sets of work procedures. Hence, since work practices are organized differently across different contexts (Star and Ruhleder, 1996), an installed base typically involves a complex structure. An information infrastructure is therefore a heterogeneous foundation composed of a variety of socio-technical artefacts (Hanseth and Lundberg, 2001:349).

What is special about the installed base is that it strongly influences how new elements can be implemented (Rønnebeck et al, 2007:1278). Since the installed base is complex, containing many heterogeneous elements, it is not just another concrete tool that can be freely managed as one may see fit (Hanseth, 2002). Rather, it is a dynamic actor in its own right, which makes it impossible for designers and users to have complete control over it (Rønnebeck et al, 2007:1279). Hanseth (2002) describes the growth of this actor - the installed base - as a self-reinforcing process where the installed base achieves momentum as more and more users are attracted to it. In this process, it becomes much harder to change due to its increasing size and complexity. Here Hughes (1987) points that it may take considerable force – or extraordinary circumstances - to change an established momentum. This makes it crucial to take into account the installed base when designing new information systems.

The complexity of the installed base explains why information infrastructures are difficult to control and change (Hanseth and Lyytinen, 2004:212). It is hard to control how diverse sets of artefacts interact with each other and how they are used, making it difficult to anticipate organizational adaptation (ibid:212). In this sense, information infrastructures can be used as an approach to face heterogeneity rather than to support assumptions that "design can start with a stable and complete set of requirements" (ibid:212). This also implies that an installed base has a large influence on the future development of the infrastructure (Hanseth and Braa, 1998:189), as new systems and old system portfolios must be interoperable in order to maintain sustainable alignments (Ciborra and Hanseth, 1998:310).

An important aspect of an information infrastructure is thus that it evolves slowly and is never designed from scratch, but is rather open to be extended little by little or bottom-up in modular increments:

> "[Information infrastructure] is fixed in modular increments, not all at once or globally. Infrastructure is big and complex, thus meaning different things in different contexts. And changes take time and negotiation. That implies that it is never changed from above. A top-down approach is not possible" (Bowker and Star, 1999: 35)

Information infrastructures depend on standards (Hanseth and Lundberg, 2001; Hanseth and Lyytinen, 2004). "Standards enable the evolution in scope and functionality, and they are a key means by which the infrastructure is architected and who is inscribed in its development" (Hanseth and Lyytinen, 2004:215). To bridge various infrastructures based on different protocols and standards, standardized gateways are needed for interconnecting different infrastructures for providing some coherent services (ibid:215).

Information infrastructures are open in the sense that they lack borders, thus encompassing continuous growth and evolution (Hanseth and Lyytinen, 2004:215). This also means that information infrastructures have no limit to the number of participants who can participate and contribute to their design. Similarly, there are no limits on their time frame, implying that they can take into account ongoing changes without specific plans and design (ibid).

Exploring information infrastructures in detail reveals great complexity in the work practice and the systems. Typically, the components involved depend on each other, thus contributing to even more complexity (Hanseth and Ciborra, 2007; Boudreau and Robey, 2005; Volkoff et al, 2007). In this regard, Perrow (1984) points out that artefacts involved in an information infrastructure can be loosely or tightly coupled. This means that the degree of dependencies between the various components may vary dramatically in a larger system portfolio. As Page-Jones (1980:101) argues, good design quality is obtained when the coupling is “loose” or minimized, that is “to make modules as independent as possible”. In other words, a well-functioning information infrastructure is achieved when unnecessary dependencies are eliminated (Orton and Weick, 1990:210). In contrast, tight coupling is not desirable as this leads to decreased modularity of the system (ibid: 210). Information infrastructures not only evolve because of technological change, but are at the same time also adaptive to new technologies.

Since information infrastructures reflect the complexity of implementing and using ICT in health care, they also indicate that one should not rely on new technology as the only strategy for addressing the integration challenges in health care. Rather, one should focus on how the installed base can improve or gradually change the current situation, instead of aiming for large-scale replacement of existing technologies.

4.0 RESEARCH SETTING

4.1 The University Hospital of Northern Norway

The University Hospital of Northern Norway (UNN) is owned by the Northern Norway Regional Health Authority (Helse Nord RHF), one of four health authorities in the Norwegian secondary health care system. Currently it employs around 5900 people, making it the largest organization in northern Norway. The hospital is geographically distributed over several locations in Tromsø, Harstad, Narvik and Longyearbyen (UNN, 2009).

The university hospital provides expertise at several levels, including treatment, research, education, and training. Due to the vast geographical distances in the northern part of Norway, UNN tries to exploit the use of telemedicine, e-health and information technology. In line with the government's reform plan for health care cooperation, UNN has made a great effort to establish seamless collaboration with other institutions (UNN, 2009). The goals are reflected in various organizational initiatives as well as in new ways of establishing cooperation between the different levels in the health care sector.

UNN has seven medical laboratories, which analyse various types of samples received from general practitioners (GPs) and clinical wards at the hospital. This study encompasses the three largest laboratories: the Medical Biochemistry, the Microbiology and the Pathology laboratories.

The Medical Biochemistry laboratory is the largest and performs about two million analyses a year. The Microbiology laboratory has a production of about 160 000 analyses a year on each of the two sections, Bacteriology and Virology. At the Pathology laboratory, the production volume is based on the number of requisitions rather than the number of analyses, totalling approximately 53 000 a year. The majority of the staff members in the laboratories are laboratory technicians, but the laboratories also include physicians, secretaries and other employees.

There are large differences among the work practices at the laboratories. At the Medical Biochemistry laboratory, the analyses in question are usually straightforward: the analysis reflects what the requisitioner orders. For example, if the GP orders a lactate dehydrogenase

(LDH) test, the laboratory performs exactly that and finds out whether the results are outside or within a given reference range. The workflow in the Medical Biochemistry laboratory is highly automatized, where more or less standardized sample tubes are channelled into one of the 30 analysis machines in the laboratory. In contrast, the analysis processes in the Microbiology and the Pathology laboratories are far more complex. Here, the specific analyses to be performed are decided by the laboratory staff after they receive the requisition. In addition to the requisition, the analysis will depend on clinical information provided by the requisitioner, the type of material, and location on the body.

The laboratories at UNN are distributed over several locations in the hospital. Many of the laboratories have also installed a laboratory-specific laboratory information system.

Laboratory	**No. of analyses/requisitions per year**	**Typical samples**	**Laboratory system**
Medical Biochemistry	2 000 000 analyses	Blood, Serum	DIPS Lab
Microbiology	326 000 analyses	Urine, Chlamydia, HIV, PCR, hepatitis	SafirLisDeltrix
Pathology	53000 requisitions	Body parts (skin samples, cancerous tissue, etc.).	Sympathy

Table 4.1: Illustrates key characteristics for the laboratories most relevant to the case study.

4.2 General Practitioners

As a part of the diagnostic and treatment process, the GPs in the northern health care region order services from UNN’s laboratories. Most GPs are familiar with the use of electronic patient records (EPR), which has increased in recent years. However, while GPs have received discharge letters electronically for years, they have not been able to order hospital services electronically. In addition, the GPs’ experience in using ICT systems varies widely between GP practices, which are spread geographically over large distances. However, due to the work being invested in establishing the Norwegian health network as well as national collaboration initiatives (such as “Meldingsløftet”, a national programme for messaging in health care), ICT-based communication across primary care and secondary care is increasing.

4.3 Well Diagnostics AS

Well Diagnostics AS was a Norwegian computer software developer located in Tromsø and Oslo. Initially, Well Diagnostics AS was established as a spin-off from the Norwegian Centre of Telemedicine in 2000. Well Diagnostics AS was recognized as a fast-growing company, with growth of 480% from 2000 to 2004. In terms of growth, they were ranked number 117 of 500 technological companies within Europe, the Middle East and Africa. They were also ranked as number 24 among Norwegian companies. According to their corporate vision, the company produces systems aimed to facilitate cooperation and secure exchange of health care information. The company's core competence is related to secure communication, integration, and design of user interfaces.

In 2007, Well Diagnostics AS was acquired by DIPS ASA, Norway's largest EPR vendor. Today, Well Diagnostics software is incorporated as part of DIPS ASA's portfolio, where the product Well Interactor has become DIPS Interactor. Since Well Diagnostics AS had core competence in collaboration, the acquisition was strategically very important for DIPS ASA. By acquiring Well Diagnostics AS, DIPS ASA could deliver a complete integrated software portfolio, supporting not only EPRs, but also integration between systems in primary and secondary care.

4.4 The GiLab project

For many years, inefficient work procedures in the laboratories had been a key concern for the management at UNN. This was related in particular to the complex and manual work processes of receiving, registering and managing the paper requisitions and sample tubes received each day (see figure 4.1). For instance, the staff had to distribute sample materials from the original primary tubes to several secondary tubes manually, since most analysis equipment was not designed for direct analysis of primary tubes. In addition, the medical secretaries who worked at the laboratories had to handle several different types of procedures for registration of the information read manually on the paper requisitions in the many laboratory systems. Against this background, in January 2006, UNN and the vendor Well Diagnostics AS established the GiLab project, where the primary goal was to develop a system to send laboratory requisitions electronically from the GP practices to the hospital.

Figure 4.1: The manual and time-consuming workflow at the Pathology and Medical Biochemistry laboratories.

4.4.1 Expectations of the new system

In order to ensure successful implementation of Well Interactor, a reference group was established consisting of laboratory technicians from UNN, developers from Well Diagnostics AS and personnel from four GP practices. At the first meeting in January 2006, there was high enthusiasm among the group members. They discussed several ideas regarding technical details, graphical user interfaces as well as how to label the many sample tubes with a new type of barcodes. The members agreed that this was a very good product with many advantages. The hospital leadership also had high expectations as they envisioned that paper requisitions would only be 1 % within two years of use.

The advantage for the GPs was a simplified work procedure, as they would be able to order analyses directly from their computer screen (see figure 4.2). For the hospital, Well interactor implied reduced work time, since the staff could simply scan one of the received sample tubes and have full access to the e-requisitions, rather than manually entering data from each paper requisition into the laboratory system. In addition, new functionality – such as accessing the status of non-completed requisitions as well as possibilities to add supplementary analyses to an ongoing analysis process – was also a part of the new system design.

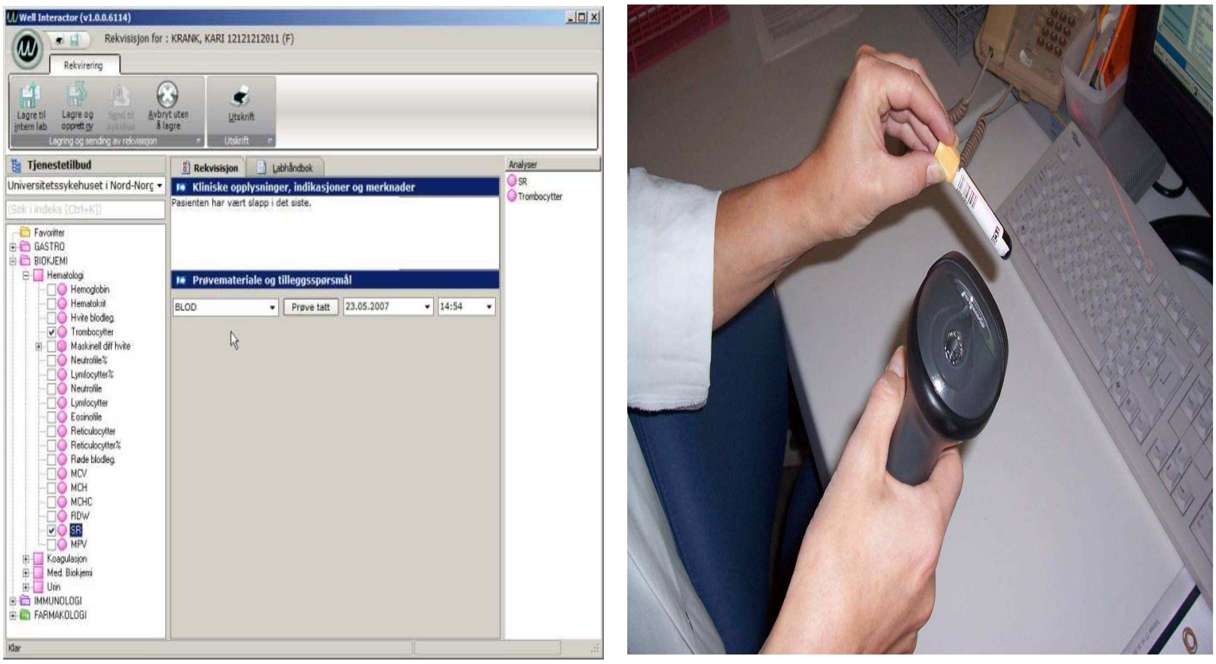

Figure 4.2: The graphical user interface of Well Interactor installed in the GP practices as well as the new scanning procedure deployed at the pre-analytic receiving unit.

4.4.2 Establishing a pre-analytic receiving unit

While Well Interactor meant simplified work, the project management at UNN had also a goal of reducing the inconsistencies among the many laboratories. In order to use Well Interactor efficiently, as well as to make the information flow between the GPs and the laboratories more streamlined, a pre-analytic receiving unit (Pre-unit) was established as an addition to the GiLab project, with the aim of improving the distribution processes for sample tubes and laboratory requisitions. According to the strategy, the Pre-unit project would result in a "one way in and one way out" solution, where standardized work procedures among the many laboratories would imply that fewer staff members were required. According to the plan, approximately 10 full-time equivalent years would be saved.

After completing some rebuilding work at the Medical Biochemistry laboratory in order to meet the receiving unit's requirements, UNN also acquired and installed a new distribution robot from Roche in May 2007 to automate the handling of the received sample tubes.

According to the plan, the GiLab project, the pre-analytic receiving unit as well as the distribution robot were to be up and running in May 2007.

4.4.3 The GiLab architecture

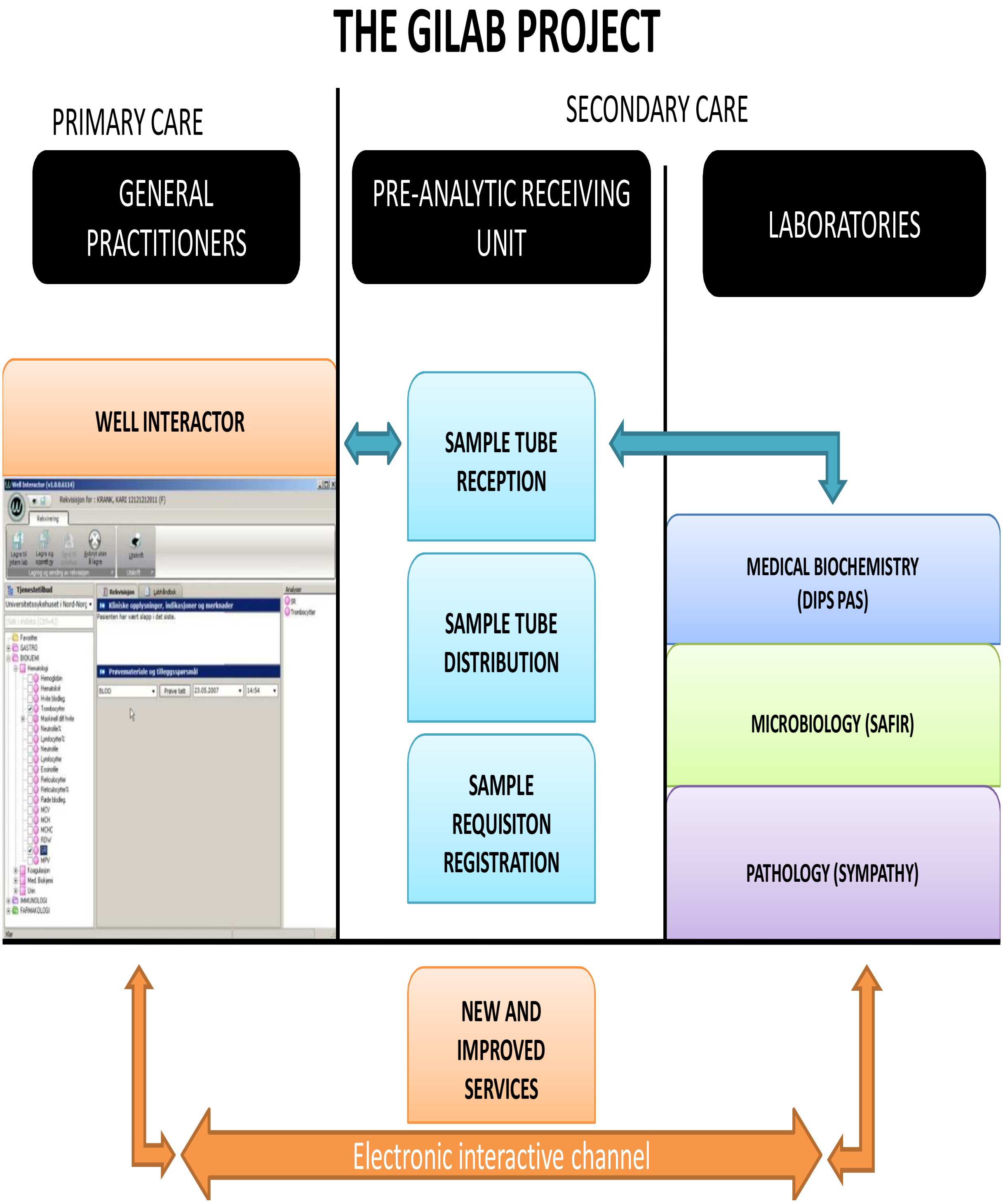

Figure 4.3: Illustrates in broad terms the architecture behind the GiLab project.

5.0 METHOD

This method chapter includes three parts. The first part is about the *research approach,* which describes relevant aspects related to an interpretive research approach. The second part, *the data collection*, describes in detail how the empirical data has been collected. The third part contains reflections on the research process.

5.1 Research approach

The study was conducted within the framework of an interpretive research tradition (Geertz, 1973; Walsham, 1995a-b; Klein and Myers, 1999), which has gained increasing recognition in information system research in recent years (Walsham, 2006; Klein and Myers, 1999). Since the implementation and use of technology is closely intertwined with social aspects, an interpretive research approach is useful to shed light on the complex process of introducing ICT in organizations (Orlikowski and Baroudi, 1991; Walsham, 1995a; Walsham, 2006; Klein and Myers, 1999). A fundamental aspect of interpretive research is the assumption that the knowledge of reality is achieved through social constructions such as "language, consciousness, shared meanings, documents, tools, and other artifacts" (Klein and Myers, 1999:69). This means that many fragments and pieces contribute in sum to an integrated understanding of a phenomenon. This represents the point of departure for all interpretive research, namely the hermeneutic circle:

> "We come to understand a complex whole from preconceptions about the meanings of its parts and their interrelationships" (Klein and Myers 1999:71)

Accordingly, the starting point in interpretive research is not to write a predefined hypothesis and rigid research protocols, but rather to start out with an open mind and study what is "out there". This implies trying to grasp the characteristics and patterns in a concrete setting and trying to understand why and how things happen. In the process, the researcher interprets what happens and tries to understand the meaning of what is going on in the field (Ahrens & Dent, 1998; Denzin, 2001; Dyer & Wilkins, 1991).

There are typically two types of studies associated with interpretive research, namely in-depth case study and ethnographies. Case studies are generally associated with a focus on a single case or a small number of related cases that may later spawn several types of analyses

(Robson, 2002; Eisenhardt, 1989). In comparison, ethnographies are targeted towards producing an in-depth understanding of the social processes that take place in various settings (Forsythe, 1999:129). Furthermore, ethnographies seek to capture, interpret and explain how a group, organization or community lives, experiences and makes sense of their lives and their world. For the purpose of my study, I refer to Klein and Myers (1999:69), who argue that the principal difference between ethnographic studies and case studies is the time spent in the field.

Since this study involves several contexts (general practitioners (GPs), laboratories, vendors and administration boards), it has been important to reflect upon their differences, thus taking into account that human sense making (Kaplan and Maxwell, 2005) may be largely different among contexts. In order to be able to understand these contexts and their differences, the researchers should strive to become familiar with “the everyday behaviors, habits, work routines, and attitudes of the people involved as these people go about their daily business” (ibid:36).

Adopting an interpretive research stance involves the researcher to reject an "objective" account of events and situations, and instead seeking a relativistic understanding of deep structures of phenomena (Orlikowski and Baroudi, 1991:5). For this reason, the actual context under study is particularly important, as it paints a picture of the cultural and contextual situations. By understanding the context, the researcher is able to explain how and why current situations emerge (Kaplan and Maxwell, 2005; Klein and Myers, 1999). Interpretive studies thus contribute to insight into the way people understand and relate to certain phenomena (Boland, 1985; Boland, 1991; Orlikowski and Baroudi, 1991). For IS projects, this implies that the researcher must always account for the relationship between the context and the new technology to be implemented and must pay careful attention to how the involved “information system influences and is influenced by its context” (Walsham, 1995b: 389; Walsham, 1993:4-5).

Since human sense making is different among participants, multiple stories or narratives of the same sequence of events may appear. Therefore, the researcher should strive to carve out these differences and try to gain an understanding of how and why they are different (Klein and Myers, 1999:72). It follows that there may be contradictions among the many viewpoints. Klein and Myers (1999) have summarized this point and its implication in the principle of dialogical reasoning, as this:

> “Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings (“the story which the data tell”) with subsequent cycles of revision” (Klein and Myers, 1999:72)

However, contradictions may also be valuable in the sense of enabling researchers to achieve significant insight (Kaplan and Maxwell, 2005; 46). As Orlikowski (1992:412) explains, “contradictions helps us to understand points of tension and instability in organizations and how these may interact to change and transform organizations”, hence shedding light on complex organizational issues.

As the interpretive researcher tries to grasp an understanding of the nuances and peculiarities of organizational work (Kaplan and Maxwell, 2005), the researcher must take into account the process of implementing ICT which is a complex process with many unpredictable events. This has two implications. First, to obtain a sufficient understanding of what is going on, the researcher must spend some time in the field to capture the situation as it emerges and how it changes in unforeseeable ways. Second, as they engage in the field over time, it is quite common that the researcher and the informants influence each other (Maykut and Morehouse, 1994). Therefore it is crucial that researchers reflect on their own role in the study and on how, as research tools, they influence the research (Walsham, 1995a:77).

In this type of research, a broad range of qualitative techniques is in play with the use of multiple sources of evidence (Robson, 2002:178). These multiple information sources may include interviews, participant observations and document analysis (Stoop and Berg, 2003:459).

Conducting research so close to the informants requires researchers to explain how they understand and interpret the data they obtain from the people they observe (Klein and Myers, 1999). Critical reflections on the researcher’s own role are therefore important, because others may interpret the “reality” differently (Klein and Myers, 1999:72). As Forsythe explains, field research is not a simple and straightforward approach and “it takes talent, training, and practice to become a competent field researcher" (Forsythe, 1999:129). Since the researchers are placed in a situation where knowledge is supposed to be gained over time, and the method demands training and social skills, fieldwork can also provide room for mutual learning and knowledge sharing.

Interpretive research has been criticized for being heavily dependent on the researcher's interpretation of events, documents and interview materials (Galliers, 1992) and because it is difficult to generalize the findings in the same way as in a positivist research approach where generalizations are made from a small sample to a larger population (Darke et al, 1998). Despite this, the phenomenon studied in one context can still be used to inform other settings (Orlikowski and Baroudi, 1991:5), hence contributing to an increased understanding of how ICT interacts with organizations. Interpretive research can also be generalized in the form of concepts, theories, specific implications or rich insights (Walsham, 1995a:79; Walsham, 2006:322). Pushing further, Lee and Baskerville (2003:233) have illustrated that a generalizability framework can be illustrated with four components: from data to description; from description to theory; from theory to description; and from concepts to theory. The findings illustrated through interpretive studies are therefore valuable in many aspects, not only in describing case studies and ethnographies, but also in producing theory.

5.2 The data collection

The research material in this thesis is based on a five-year case study of a health care project aimed at establishing e-requisitions between GPs in northern Norway and the University Hospital of Northern Norway (UNN). The research material involves a substantial amount of data, collected at different laboratory locations. The research material constitutes 48 interviews, 14 meetings, and various documents. In addition, I have taken part in informal conversations, e-mail conversations and phone calls with health personnel at the laboratories, GPs, system developers, and business consultants.

5.2.1 Observations

The majority of the fieldwork has been conducted at three laboratories at UNN, as well as at the pre-analytic receiving unit. This has been supplemented with 10 hours of observations at the GPs and an eight-week summer work period (300 hours) at Well Diagnostics. Figure 5.1 illustrates the observation counted in hours at each location.

Location	Hours spent on fieldwork
Well Diagnostics AS	300
Pre-analytic receiving unit	140
Medical biochemistry laboratory	90
Pathology laboratory	80
Microbiology laboratory	80
General Practitioners	10
Total	**700**

Table 5.1: Hours spent on the fieldwork.

5.2.2 Interviews

In all, I have conducted 48 interviews, of which a few have been conducted with colleagues. The interviews are based on an open-ended structure and lasted approximately 30 – 60 minutes on average, even though some were longer than one hour. The professional background of the persons interviewed varied from laboratory technicians, laboratory physicians, ICT developers, GPs, project leaders, managers and medical secretaries. The table on the next page provides detailed information about the interviews. In all the interviews, I used a tape recorder. After each interview session, I transferred the interviews to my computer, in which they were categorized according to profession and work location. I transcribed each interview immediately after completing it. Many of the interviews were quite extensive, and therefore I usually spent a couple of days transcribing each of them. Table 5.2 on the next page illustrates numbers of interviews according to professions.

Profession	**Number of interviews**
IT technicians	10
Laboratory technicians	13
General practitioners	4
Medical secretaries	4
Hospital physicians	8
Project leaders	3
IT developers	6
Total	**48**

Table 5.2: Numbers of interviews

5.2.3 The data collection in a time perspective

When the GiLab project was launched at the end of 2005, I started to follow the design and development process of Well Interactor. At that time, I also participated in the first meeting and I was introduced to Well Diagnostics AS. Here I was also introduced to the University Hospital of Northern Norway (UNN), where I met physicians, information systems developers and project leaders. While participating in the meetings I became acquainted with the different members from the different institutions. The persons I met in the reference group represented a diverse set of professions, being four GPs, medical secretaries, chief physicians from UNN, laboratory technicians and personnel from the administration board. By listening carefully, I tried to collect as much information I could and started to make notes on the contexts of the meetings. In addition to the reference meetings, I joined the vendor of the system, Well Diagnostics AS, when they undertook an observation tour at the laboratories in February 2006. During the day, when I also was introduced to the members of all laboratories at UNN, I talked to the employees and sketched a preliminary map of the workflow.

In March 2006, the project leader at UNN recommended that I observed work in the hospital laboratories. Accordingly, I spent three days at Medical Biochemistry laboratory, trying to understand how the different analyses were implemented in DIPS Lab, how the analysis machines and other infrastructure worked, and finally how the various components functioned together.

During the summer of 2006, I was appointed as a summer employee at Well Diagnostics AS. I was hired to prepare a documentation protocol for Well Interactor, the new information system in the GiLab project, as well to develop a presentation to be used for training sessions. In total, I spent 8 weeks working for the company. During this period, I read several technical documents in detail. I also asked questions, which gave me a unique understanding of the vendor's expectations for the new system. In addition, I had the opportunity to attend various internal meetings, which I do not think would have been possible if I had not been working for the vendor.

In September 2006, I started the third part of my data collection. At this time, the members of the GiLab project were working on the design of the service provider profile (SPP) in which the analysis repertoire would be presented (see figure 4.2 on page 40). When the system entered a pilot phase, I started to visit the different laboratories more frequently to collect data. Since I wanted to document the existing workflow as thoroughly as I could about, I took pictures, talked to people, wrote notes regularly, clarified aspects that were not well defined, and drew sketches illustrating how people worked.

After being in the field for a while, I started to operate more independently. I visited the hospital regularly, carrying out observations and interviews with many people who had different professional backgrounds. During this period, the interviews changed from being well prepared to being more open-ended. This implied that I did not follow any well-defined interview guide. Instead, I became more focused on the problematic areas and concerns raised by the informants, which I could relate to the concepts and theories I was interested in.

When talking to laboratory technicians or physicians during the observation sessions, I wrote notes in an effort to find out and record as much as possible about how they executed the work and how they communicated with each other. I was surprised to see how much health care work was based upon ad hoc interactions. The staffs were frequently interrupted by several questions from other staff members. Because I felt uncomfortable using a voice recorder during the observations, I wrote several notebooks with quotes and figures, which were later categorized together with data from the interviews.

In addition to the hospital observations, I spent some time at two of the pilot GP practices, where I could also talk to medical secretaries. Here too, I had no problems in making appointments with the staff at the GP practice. To make appointments with GPs was challenging, however, because they were very busy. Still, I managed to conduct one interview with a GP at his office. During my work at the research park, I also occasionally met two of the GPs who were participating in the pilot, and I conducted three interviews with them. I also talked to one of the GPs participating in the project at one meeting we had in Trondheim. In addition to the four interviews, I visited or called five more GP practices that were using Well Interactor, to hear about their experience of the system.

5.2.4 Data analysis

Since studies of complex settings tend to create an abundance of information, the researcher naturally needs to structure the data, create overviews, and establish strategies for what to include and what to omit. One can choose from several analysis methods, ranging from using theory as a basis for data analysis to more loosely oriented approaches where the researcher is guided by his or her own assumptions and experiences (Walsham, 2006).

Throughout the fieldwork, from the start to the end, I used different ways of processing and interpreting the data. The data analysis was motivated by the hermeneutic circle (Klein and Myers, 1999), with constant switching between the empirical data and the theory. I have tried to relate my findings to various theoretical concepts that I have read about. I have also experimented with drawing shapes and forms of different settings in an effort to achieve a better overview of the data I had collected. In addition, I discussed my thoughts with colleagues, users and my supervisor as a strategy to make sense of the data.

Later in the process, when I had achieved greater theoretical and practical understanding, I and other PhD students participated in weekly reading groups where we discussed various themes and ideas emerging from the data. In addition, I had regular contact with my supervisor, with whom thoughts and ideas were explored, suggested, discussed and transformed. Through this process, I was able to "identify themes and gaps, and to strategize how to begin filling those gaps" (Schultze, 2000:12).

The data were organized in accordance with the viewpoint, role and theoretical perspective of the various people involved. For example, I separated users of the systems from decision-makers and managers. I also chose to classify general practitioners and system developers in separate categories. The advantage of doing this was that it was easier for me to identify differences among the groups. This in turn made it easier to relate the data collection to theoretical concepts. In addition, I looked through the data in several phases. This was very helpful, as I could both reflect upon other perspectives of the information that I had overlooked earlier and pay attention to my own understanding and knowledge development. In this way, I could see the interpretations with "new eyes" as time went by. This resulted in an ongoing iterative processing of the empirical material.

Taking the above into account, as well as the process of writing articles, I was still forced to choose and use certain parts of the data while other parts were omitted or put on hold for later use. Here I tend to agree with Miles (1979:593) who claims that "analysis of qualitative data is a mysterious, half-formulated art". In this sense, it is not easy to formulate exactly how I chose the materials to use. I was also partly driven by the interests of other stakeholders, in both an academic and a practical sense. Still, I believe I managed to make sense of the data material by doing what Schultze (2000) and Miles and Huberman (1994) suggest, namely to compare the groups I interviewed with each other. Here I took note of Miles and Huberman's (1994) recommendation to reflect on the data collection, and to identify similar patterns, themes and relationships among the data. In this way, I was able to generalize the data and associated my findings with concepts and theories.

5.3 Reflections

A key concern in empirical research is access to the field. For most of the laboratories, this was not a major problem, although some laboratories were harder to access than others were. Initially I had obtained formal access to the pre-unit (I had signed a contract and arranged to use a locker there; I had also asked people for permission to observe them when they worked). Soon after I started to observe work there, however, I realized that that the work in the pre-unit was closely connected to activities and routines in all the other laboratories. Personnel from these laboratories came to the pre-unit to unpack and prepare samples for further processing in each of the laboratories. In this process, I became acquainted with these staff members as well. As a result, it was relatively easy (through this snowball effect) to ask them whether I could just “follow the samples” when these were distributed to each specific laboratory, such as the Medical Biochemistry laboratory and the Pathology laboratory. This enabled me to have informal access to these two laboratories. In comparison, obtaining access to the Microbiology laboratory was more difficult. Although I followed the same procedure as for the other two laboratories, the staff questioned my presence at the laboratory; due to a lack of internal resources, the chief physician was reluctant to give me access. He contacted my supervisor (whom he happened to know) and asked in detail what the participatory observation would involve for the laboratory. We did not make a formal agreement in this connection, but I was able to move back and forth between the pre-unit and the Microbiology laboratory as before, although I was very careful not to disturb the laboratory’s work procedures. As time went by, however, I had increasing contact with the personnel in the laboratory, and was able to conduct several interesting interviews.

By far the most difficult research site to access was the GP practice. It was not difficult to see that the GPs had a great deal of work to do, and their pay was closely linked to the work they did for each patient. The GPs whom I contacted therefore argued that they would need some reimbursement for allowing me to conduct observations of their work. I did not agree to this, both because as a PhD student I had limited resources, and, more importantly, because I felt that this would mean that I had bought information, which might influence how the GPs provided the information to me as well as my own interpretations of this information.

Even though I had learned through my previous education as a radiographer and radiation therapist that health care contexts are complex, I was not able to predict what would emerge as the most difficult challenges during the project. Since I did not have any previous knowledge about ICT projects in health care, I lacked a frame of references for my observations. This situation can be related to Klein and Myers’ (1999:72) fundamental principle of the hermeneutic circle as human understanding, which is achieved by “iterating between considering the interdependent meaning of parts and the whole that they form”. In my case, a wealth of detail provided me with more insight into the bigger picture. I listened to what people said in the meetings and reflected on the different opinions. I also studied various contexts in which I learned that perspectives could vary widely among the various staff and contexts. I also realized that some participants were more listened to than others were, which made me reflect on how some participants were more influential than others. However, I tried not to let this reflection influence my choice of whom I should talk to. As a result, I talked to a broader range of people, which gave me a deeper insight into the field. For example, while I initially believed that physicians and super-users were the most important staff I learned that it was crucial to speak to laboratory technicians and laboratory assistants to gain an increased understanding of the workflow and of how people actually worked and interacted with technology and with each other. In addition, talking to different professions made me more aware about the diverging perspectives across the many work contexts. As a result, I became more critical about my own role as a researcher, meaning that achieving a complete overview of the different perspectives would be difficult. This is similar to what Trauth (1997) notes when she started to question her own assumptions after experiencing that being part of various field studies improved the overall understanding of why people act the way they do. Along these lines, Klein and Myers (1999:72) emphasize the importance of "The principle of interaction between the researchers and the subjects" which:

> "Requires critical reflection on how the research materials (or "data") were socially constructed through the interaction between the researchers and participants" (Klein and Myers, 1999:72)

In retrospect, I realize that I started my data collection process with many preconceptions. For instance, I was fairly critical of the project in the beginning, since the literature had made me aware of failures and challenges regarding ICT implementation in health care. However, in retrospect I realized that it is difficult to know anything specific about a particular setting before digging into the details. Second, it occurred to me that I did not own the truth, as phenomena really can be comprehended differently by different people. Consequently I had to face my preconceptions and take into account that "reality" was far more complex that I initially had thought, thus paying attention to Walsham's (1995a:76) argument that there is a need to “preserve a considerable degree of openness to the field data, and a willingness to modify initial assumptions and theories”.

I had some similar experiences during interview sessions. My first interview was based upon many questions that I had prepared and I was eager to ask all of them. However, in the middle of the interview, I found that it was not easy to ask questions in quick succession and some questions were not relevant at all. I discovered that the more I talked, the more I guided the interview subject towards my own presumptions. In addition, I managed to interrupt subjects in such a way that I missed what they were about to say. This was revealed to me later when I transcribed the interviews. Therefore, I gradually learned to be more open and let the subjects speak more freely.

As a result, my interviews changed from being well planned to becoming more open-ended. I listened and reflected regularly upon my interviews. To listen to the interviews at different times was also beneficial, as this provided new understanding and interpretations. For instance, as my field knowledge increased, I became aware that the interviews were far more valuable than I initially imagined. For example, when I performed the interviews I could only grasp the facts related to my existing frame of references. However, when I listened through the interviews again sometime later, I found that the interviews contained a much broader set of information, which was valuable for further work. My first interviews therefore achieved more than motivating me to keep on exploring the field.

Based on this experience, I also realized that the best way of studying was to be driven by the data and not driven by the theory. Here, I agree with Walsham (1995a:76) that theory is a good way to motivate you to create an initial theoretical framework. For instance, the literature on the ANT and information infrastructure motivated me to study the relationship between people and technology as well as what interests were driving the various user groups.

When I was working for Well Diagnostics AS during the summer of 2006, I had the chance to become what Walsham (1995a:78) describes as an insider and observed the day-to-day work of the vendor itself. During my work at Well Diagnostics, I was able to talk with the vendor, listen to the company’s goals and strategies related to their market strategy, to the design strategies, and finally to how they collaborated with other vendors and users. During this period I learned a great deal about how ICT developers work, which contributed to providing me with a more complete picture of developing and implementing an integrated system.

However, during this period, I realized that I increasingly looked at the project “through the eyes” of the vendor. To some degree, I felt I had lost some of my critical views on the phenomena happening around me. Forsythe (1999:130) addresses this, and argues that being an insider does not necessary make you an accurate observer. Ethnography works best when conducted by an outsider with considerable inside experience. This is because the researcher can then analyse it through systematic comparison between inside and outside views of particular events and processes. Thinking about this in retrospect, I realize that I gradually paid less attention to viewpoints from other actors in other contexts. However, since I only worked for them for two months, the experience and critical reflection on this experience made me more aware of the viewpoints of others, such as the difference between the various health care professions. Hence, working in many contexts was very profitable as I was better able to distinguish various people’s interpretations. Still, I agree with Walsham (1995a:77) when he argues that being an insider creates possibilities of having a personal stake in various situations.

Van Maanen (1979) argues that the researcher has no guarantee for collecting valuable data no matter how long the researcher stays in the field. I agree on this, but still I claim that in my case it was a great advantage to carry out observations over a longer period and to participate in many different contexts. The long time perspective meant that my insight matured, and that I had time to better understand the overall picture of the nature of ICT in a complex laboratory context.

6.0 RESULTS

6.1 The four articles:

Article 1: Røed, K. (2011): "Slow organizations and fast technologies" How existing practices and systems shape integration projects in health care, submitted New Technology, Work and Employment.

A former version of the article exists as:

Røed, K. (2010): Heterogeneities and complexities in IS design: still a need to juxtapose organizational elements and design related ideas? In Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction (OZCHI '10), ACM, New York, NY, USA.

Article 2: Røed, K., Monteiro, E. and Ellingsen, G. (2011): Integration as Escalation of Complexity. Accepted for publication at the 6th Mediterranean Conference on Information Systems (MCIS), Cyprus, September 3–5, 2011.

Article 3: Ellingsen, G. and Røed, K. (2010): The Role of Integration in Health-Based Information Infrastructures. Computer Supported Cooperative Work (CSCW) Vol. 19, No. 6, pp. 557-584 [Diana E. Forsythe Award Finalist (American Med. Info Assoc.) 2011].

A former version of the article exists as:

Røed, K. and Ellingsen, G. (2009): Transformations through laboratory work – When visions are facing complex work processes. IRISS-32 Information Systems Research Seminar in Scandinavia, Molde, August 9-12, 2009.

Article 4: Røed, K. and Ellingsen, G. (2011): Users as Heterogeneous Engineers - The Challenge of Designing Sustainable Information Systems in Health Care, 44th Hawaii International Conference on System Sciences (HICSS), 2011, pp. 1-10.

6.2 Short presentation of content

The four articles in the dissertation reflect more or less how the GiLab project developed.

Although all four articles are related to the GiLab project and the development of Well Interactor, they have different approaches. The first article focuses attention on the old infrastructure and existing work practices at three laboratories in the hospital. The article illustrates the complexity of laboratory work and the role of paper, thus exploring the gap between technology and practice in more detail. Article 2 has an explicit project focus and discusses how complexities around the integration escalated as the project developed. Article 3 emphasizes a work practice perspective, in which three different laboratory work settings are presented. Finally, Article 4 focuses on implementation and draws lines all the way to deployment of the Well Interactor, as well as looking at the users in the context of heterogeneous engineers. You can read the results of each article in more detail on the following pages.

Figure 6.1 below illustrates each article's main relationship with the empirical setting.

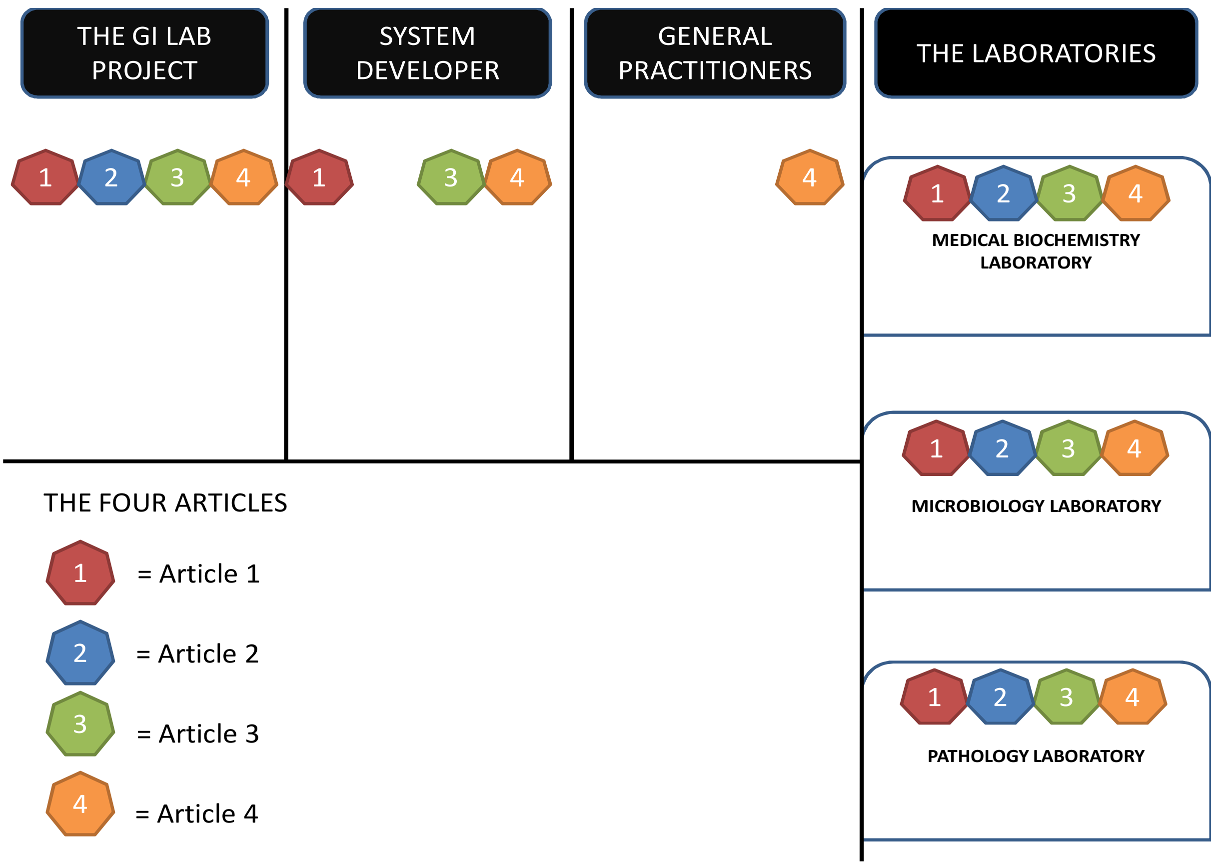

Figure 6.1: How the four articles are related to the empirical setting.

6.3 Results of the four articles

6.3.1 Article 1: "Slow organizations and fast technologies" How existing practices and systems shape integration projects in health care

As pointed out in this article, it often takes many years to implement new technologies in complex organizations. While designers and decision makers easily envisage well-defined goals, they may overlook the fact that realizing these goals also depends on the installed base. In order to illustrate how existing practices and systems shape integration projects in health care, this article suggests that successful implementations are obtained only when information systems are adapted to existing organizational structures and draw on existing technology as well as manual work in organizations.

First, since an installed base is complex due to multiple network connections and heterogeneity, it is very difficult for one system to support all prior installed systems and work processes. Hence, even though new systems aimed to simplify work are implemented, the old work processes may continue as before, resulting in increased complexity and an even higher workload for employees. Furthermore, because plans are seldom realized as envisioned, and because technology is being developed continuously, employees may also need to depend on temporary solutions. In the GiLab project, one such temporary solution was implemented when the GPs sent a paper copy of the e-requisition along with the sample tubes. With the slow progress of the project, this solution is still in use in the laboratory, due to its usefulness and its function in supporting the integrated portfolio. It may thus take some time to achieve the expected results. In this sense, decision makers need to anticipate that old and new routines will have to function together over a considerable period, echoing a central argument in the information infrastructure concept that new technology should build on and extend the installed base (Hanseth and Lyytinen, 2004:214).

Another argument in this article is that the role of paper is frequently ignored, especially among those actors who are not directly involved in health-related work. For instance, the paper documents and paper forms play an important role in gluing the work together in a surprisingly seamless way, and may serve many different functions depending on the context. First, the paper-based artefact provides a very good overview. Second, the paper has an important coordinating role because it represents the transfer of responsibility from one work task to the next. In this study, this was especially evident in the Pathology laboratory's work practice. Third, the attributes of the paper artefact make it suitable for specialized needs. Paper represented a very flexible tool for adding ad-hoc notes, drawings and requests in this case. Furthermore, in specialized contexts, such as at the PCR section of the Microbiology laboratory, where the costs outweighed the benefits of establishing an electronic system, it was very easy to design paper lists and forms for the specific work task. Paper is also characterized by mobility. It helped the staff to maintain flexibility, as they could bring the lists with them wherever needed, for instance when they walked from the sample distribution room to the extraction room. It is therefore difficult to eliminate the use of paper: its usefulness reflects the fact that the installed base is a structure that cannot be easily removed or replaced.

A third key finding in this article is that the different actors and technologies are conceptualized as a complex socio-technical ensemble. One should take into account that each work task has a place in a larger ensemble of systems and routines (Gasser, 1986), which means that they are related to a greater or lesser degree. In line with an ANT perspective, one stakeholder (i.e. the vendor) cannot have a complete overview of how a new system affects a given practice. Similarly, one could not expect the laboratory staff to be fully aware of how Well Interactor would play out in their daily work context. It is necessary to keep in mind that when deploying a new ICT system in a complex work practice, complexities may increase and the relationship between the elements may be reconfigured. New technologies are therefore at high risk of inducing unintended consequences for the people involved (Ash et al, 2004). In this study, they generated new kinds of workaround for the laboratory staff. It is then important to accept that information systems alone cannot meet the needs of organizations. Instead, one must focus the investment of resources on achieving the goals in ways that take account of the current infrastructure and of how this might be changed. This implies that successful implementation really depends on how well designers are able to consider both organizational and technological issues in a broad sense and thus to exploit the existing infrastructural portfolio – the installed base.

6.3.2 Article 2: Integration as escalation of complexity

Due to higher demand for improved interaction and collaboration between different health care practices, it is obvious that integrating information systems is central. However, establishing integrated systems in health care is also very difficult, as integration initiatives may escalate and become very large as time passes. Although strategic objectives often take integration for granted, integration is still not easily carried out, as many unforeseen events become relevant after the initial and planned implementation process has been established.

In this article, the goal is to illuminate the challenges of unforeseen events through a *project implementation perspective* as important happenings. As many previous studies show, technical integration mechanisms alone hardly create working integration. Accordingly, this article provides a broader elaboration of the challenges of integration, as it illustrates more clearly why a socio-technical perspective is important in the design and implementation phases. The main goal of this article is to examine the process of integration more closely, particularly how complexities escalate stepwise during implementation.

Based on the results, it is argued that complexity increases in spite of good planning, competent users and project managers. Good planning alone is therefore not enough to create good integration solutions, since elements assumed to be under control by decision makers and vendors can easily be affected and altered by the unforeseen events. For example, the strategies in the GiLab project changed several times during the implementation, due to the new challenges and feedback from users at the many laboratories. At the same time, improvisations and workarounds helped in overcoming emerging and "hidden" challenges. Therefore, the article proposes the importance of looking more into how elements (the different work procedures, various information systems, communication methods, etc.) interact, how they are connected and distinguished, and how they relate to each other.

Because there are complex mutual relationships among elements, it is hard to blame specific challenges on individual factors. Rather, a "weakness" in one part of the project may easily result in problems in other parts. For instance, some design strategies acceptable at the Medical Biochemistry laboratories were not suitable at the Microbiology laboratory or at the Pathology laboratory.

Since there are different understandings and perceptions of a project, it makes sense to argue that an integration project should not be seen as either a success or failure. Most of the recent projects in health care are large and complex, and to categorize a project as either wrong or right hardly captures the full picture. Rather, to dismiss a project as a failure might lead to loss of important insight into those areas where one actually is successful. In the GiLab project, the integration was considered much more successful at the Medical Biochemistry laboratory than at the other two laboratories. It is therefore suggested that each laboratory-specific area should be investigated in more detail to determine the differences between them.

Another fruitful finding explaining why a project may be successful for some while not successful for others involves looking at the specific laboratory systems. Since there are differences among systems, a portfolio of systems should not be regarded as a black box. Rather, each system should be seen as fragmented and diverse, tightly connected to its specific use. This also highlights why it is important to focus more on what eventually went well and what went poorly for each of the contexts. Since this means that outcomes are nuanced rather than right or wrong, it better reflects the dynamics of information system implementation projects where substantial time and context are taken into account.

However, the major contribution of this article is to illustrate a characterizing degree of integration rather than a complete form of integrated information systems. In this sense, the work on integration needs to be split up; it should be greatest in those areas where the opportunity for success is greatest. In order to define the areas of potential success, one must distinguish different contexts from each other and define their differences. While this article contributes to defining the complexity of integration in a particular project, it may also be helpful to assist other integration projects where multiple systems and different contexts are involved.

6.3.3 Article 3: The Role of Integration in Health-Based Information Infrastructures

In contrast to the previous article, where the focus was project-oriented, this article has a work practice perspective in order to understand the process of integration in health-based information infrastructures. The article focuses on the work tasks at the three laboratories and illustrates their similarities and differences as well as some challenges related to the implementation of the GiLab project.

In order to exemplify the heterogeneity found in the various laboratories, the article illustrates an infrastructure spanning from almost full automation to dependence on paper-based manual work practices. The difference in work practices demonstrates different needs and aspirations regarding how and why the integration should be achieved, and why integration initiatives need to be related to each specific context. Since the findings show that different actors have different objectives, the article is also helpful to improve insight into the diversity of complexity that takes place in organizations.

In a traditional perspective, integration is often related to how IT vendors design new systems and manage to integrate them with systems developed by other vendors. However, this article demonstrates that integration also occurs during the work of negotiation and improvisations, and may be supplemented by the efforts of users. Using ANT as a theoretical framework, the article illustrates how various actors, both users and vendors, contribute in the integration implementation process. The aim is to exemplify the complexity of establishing integration between various information infrastructures, and how actors work together to achieve the goals.

In practical terms, the heterogeneity among actors makes coordination difficult, as it becomes difficult to achieve common goals. However, this article illustrates that coordination also can be achieved when actors negotiate and improvise in order to implement the necessary measures. During the process of negotiation, actors undertake essential roles, which help to achieve integration. For example, although Well Interactor was dependent on systems provided by other vendors to work as intended, it was still difficult for Well Diagnostics AS to have control over other vendors' strategic choices. Here, the users of the Pathology laboratory did an important job, as they negotiated directly with the supplier of their laboratory system, and influenced them to implement the changes they needed. Similar measures were also relevant at the Microbiology laboratory, in which some staff also negotiated with the vendor of their laboratory system in order to promote their viewpoints.

Regarding the effort to standardize work processes, the article suggests that redesign needs to be approached carefully and needs to emerge from the practices themselves in order to avoid failure. This is because a locally established work procedure can be difficult to implement elsewhere. For example, the Microbiology and Pathology laboratories perform tasks that are fundamentally different from the work tasks at the Medical Biochemistry laboratory. While the work tasks of the Medical Biochemistry laboratory are rather straightforward, the practices at the Microbiology and Pathology laboratories are far more complex.

In conclusion, this article emphasizes that it is important to take into account the complexity of local infrastructures as well as the need to study such infrastructures in more detail. Doing so is important not only to capture the heterogeneity of various departments and work processes, but also because understanding the details may make it easier to distinguish their differences. In addition, one must look at all the involved actors as essential contributors where each, in their own way, contributes to increased integration. By increasing the involvement of users, constructive feedback that is helpful to enhance the success rates of the product can be obtained. The next article illustrates this in more detail.

6.3.4 Article 4: Users as Heterogeneous Engineers - The Challenge of Designing Sustainable Information Systems in Health Care

In this article, the aim is to see the GiLab project in the context of the design, deployment and support. The aim is to illustrate that users not only play an important role in the design phase, but also take the initiative to increase a product's practical value. In this sense, the user perspective should be viewed within a broader organizational context, as users may also configure designers. More concretely, the article suggest that users are comparable to what Law (1987) calls Heterogeneous Engineers, as users help to negotiate diverging interests as well as assuring that heterogeneous elements are in place to ensure a sustainable technology. In this sense, users are capable of filling a role that designers traditionally have not been good at, more concretely “how to juxtapose and relate heterogeneous elements together such that they stay in place and are not dissociated by other actors in the environment” (Law, 1987:117). In order to overcome the typical gap between designers and users, the main intention of this article is to illustrate that users may also be seen as system designers, by their efforts and will to establish sustainable technologies.

When the development of Well Interactor started, user involvement was considered important. Actually, the project team saw it as crucial in order to create the best possible product. Thus, to ensure and provide the best outcome, a reference group consisting of computer developers, a number of hospital users and GPs were established. At the starting point of development, the division of labour between the various actors was also well defined, in which reflected unmistakably defined responsibilities as well as a “plug and play” thought. Accordingly, seen from the vendor’s perspective, the service provider profile (SPP) (list of analyses) was meant to be included in the system at the same time as Well Interactor was planned to go into a pilot phase. In this sense, the responsibilities among the design group became concrete: it was the hospital users’ responsibility to develop the service provider profiles, while the vendor assumed responsibility for taking care of the technical aspects of the product. From the hospital users’ standpoint, this was constructive as they had a say in developing the system, and could safeguard their desire to create a well-functioning system.

Although the development work involved users, problems still arose in quick succession. The first version of the SPP was poorly received by GPs since they could not find the analysis without spending a great deal of time searching for it. Major disagreement developed, as the right thing to do was not clear to the staff. Therefore, the workload for developing the service profiles increased, causing a delay in the project because the hospital staff now had to change the work they had already done. In other words, this was the first step into uncertainty, as the project started losing the grip on the original idea at this point.

It was also a burden to deploy Well Interactor to many GPs since the development team had not clearly defined what would happen after the pilot period was completed, which meant unclear roles and responsibilities in relation to who should ensure that the product was installed in the many GP practices. What occurred was increased motivation among the hospital staff, which inspired them to take part in the work of deployment. In addition, there were also a number of challenges in relation to who should be responsible for support of the product, which also stimulated the hospital users to take even more responsibility.

Therefore, this article highlights that users may have a very important role in the effort to capture the ambiguities, and sew together the parts of the development that are not clearly defined. This is highly relevant as “there is almost always some degree of divergence between what the elements of a network would do if left to their own devices and what they are obliged, encouraged, or forced to do when they are enrolled within the network” (Law, 1987:114). Thus, as described in the article, several challenges occurred along the way, in which the hospital users helped to catch up and juxtapose. For example, while there was a considerable gap between GPs and hospital staff at the beginning, in the sense of what was the correct thing to do, the gap was reduced when the hospital users interacted with the GPs. One of the results of the cohesion between the two parties was increased flexibility of the Well Interactor software.

What is more interesting, however, is that the escalating interaction between the two parties helped the hospital users to gain an even higher sense of responsibility, which meant that they in turn worked more to increase their influence. Nevertheless, the main point here is still that this effort was not without reason. Because of the many unresolved issues, for example, challenges around installations, a variety of computer server problems, and lack of understanding of GPs' needs, the users’ work makes sense as it provides valuable feedback for the system developers. For example, what a developer may look at as a matter of course is not necessarily as obvious to an end user, which means that feedback from users is helpful to ensure that developers can better acquaint themselves with the use of their own system, and thus better understand the weaknesses of the product they make. As a conclusion, this article illustrates that “user roles” are far more valuable than merely being helpful input for developing system requirements. In this sense, some users should be viewed as system designers.

7.0 IMPLICATIONS

7.1 Theoretical implications

7.1.1 Integration as hidden work

In previous chapters, I have pointed out that in most of the medical informatics literature integration is regarded as fundamentally a technical phenomenon where the primary challenges appear to be establishing proper integration mechanisms and interfaces between different systems. In comparison, a socio-technical perspective on integration emphasizes that such an effort involves far more factors than just the technical ones. The socio-technical approach to integration is essential in health care contexts, which consist not only of a number of diverse technical solutions, but also of many different work procedures – often manual – which in sum constitute the organization's installed base. In Article 1, I have elaborated on the complexity of the installed base by illustrating that the health care system consists of many manual procedures, often "hidden work", socio-technical dependencies and complex network connections across the many existing heterogeneous elements. This complexity suggests that health care practices are not easy to understand without extensive, in-depth examination. There is therefore good reason to maintain that integration involves a considerable number of "hidden" work processes, which both shape and are a condition for successful integration.

Accordingly, it is important to identify and take into account the existing practices and interdependencies between artefacts and practices in a better way before embarking on integration projects. This means that better insight into what happens in practice is required. The traditional perspective, where information systems vendors define the framework for the introduction of ICT in health care, begs the question of whether people who come from backgrounds completely different from the healthcare sector are the ones who should have this role. Without sufficient practical insight, many projects face considerable risk in the efforts to integrate systems and practices.

7.1.2 Integration as information infrastructure

In a traditional perspective, decision makers often assume that standardization and reduced fragmentation will make situations easier for organizations (see Ellingsen and Monteiro, 2006). An important strategy is then to standardize work processes and technologies in order to achieve greater harmony and interoperability. Although these strategies are based on the best intentions, it is also important to remember that standardization itself might be problematic since standardization in one area can create disarray elsewhere (Berg and Timmermans (2000:45; Star and Ruhleder, 1996). Along similar lines Star and Ruhleder's (1996) argue that that one infrastructure might become another's barrier. In other words, there may be connections that are not immediately obvious and that are difficult to grasp. It is important to be cautious when aiming to change existing work practices into something that reflects ideal and seamless workflow models. Rather, one must be aware that heterogeneous artefacts are related and intertwined in many different ways.

To increase the understanding of a socio-technical network, the information infrastructure perspective (Hanseth and Lyytinen, 2004; Star and Ruhleder, 1996; Bowker and Star, 1999) is a promising framework. Such a framework may emphasize better how heterogeneous elements are interconnected.

In Article 2, I have illustrated how I consider the dynamics of network connections should be affected by the integration process. By dividing the integration process into smaller parts, one can figure out which parts of the heterogeneous components may best fit together. This implies that one needs to look at integration as a spectrum of many intertwined heterogeneous elements, which relate to each other in different ways. Here, I have suggested that one should devote most resources to integrating those parts with the most frequent interaction between the practices (an expression of the degree of necessity to integrate). This may result in higher motivation of users, as the purpose of the integration should be clearer to them.

7.1.3 Users as heterogeneous engineers in integration projects

In the theory section, it was claimed that users are important participants in the projects and that system designers and suppliers regard users as important contributors in the development process. However, users have traditionally had a passive role in such projects because they are often separated from the designers. This phenomenon has been criticized, for instance by Suchman (2002). Much of the basis for the criticism is that users are regarded as information providers who specify requirements through interviews, questionnaires and other surveys, rather than being included in the design process as equal partners (Berg, 1998: Hess et al., 2008; Millerand and Baker, 2010). Thus, the users' role is to provide information, while the system designers still define the terms for the systems.

However, such a traditional approach is not a fruitful strategy for increasing integration in the healthcare sector. This will only maintain the "gap" between designers and users (Hess et al., 2008; Suchman, 2002; Lyytinen et al, 2006), since those who make the systems might have far less knowledge about the context of the system than the users have. One must therefore ask whether it is fruitful for future IS design and integration projects that only the traditional "system designers" serve in the system design role.

To improve reciprocity, users should increase their influence in ICT projects. In this sense, users should have far greater opportunity to participate in creating the conditions for the systems. This can reduce the distance between designers and users (see articles 1 and 4). Another indication that users need to gain greater influence in the design process is described in Article 4. As Law (1987:117) explains, it is a key challenge for system designers to know:

> "...how to juxtapose and relate heterogeneous elements together such that they stay in place and are not dissociated by other actors in the environment in the course of the inevitable struggles – whether these are social or physical or some mix of the two"

This means that it is not possible for one group – such as a vendor – to have an overview of the long-term organizational consequences of its ICT systems (Wears and Berg, 2005).

Even though vendors may want to sell their products to as many customers as possible, one solution might not be suitable everywhere. While goals and strategies are often based on standardization, the actual *process of standardizing* is difficult. What usually happens are conflicts between strategy and use, since the plans do not take into account the heterogeneity in the network as well as the dynamics between the different stakeholders. Article 1 shows how many socio-technical factors are mutually interdependent. Article 2 and Article 3 illustrate this further and elaborate on how the hospital management wanted to create seamlessness in a heterogeneous context, which was indeed problematic.

Article 4 sheds light on how users can contribute in handling complexity in the design, implementation and deployment of an ICT project by illustrating that users have a role as *heterogeneous engineers.* When users coordinate heterogeneous aspects of a project, they are actually supplementing the design process with a role that traditional system designers and project managers are not able to fulfil.

By conceptualizing users as *heterogeneous engineers*, I have not only demonstrated that users help to improve the design and functionality of the systems, but also that the user role contributes to wider adoption of the systems. Even though ICT projects may encounter many obstacles in the development processes, users help to ensure that integration initiatives move forward through their efforts to mobilize and coordinate the various actors towards a common goal.

7.2 Implications for practice

7.2.1 Implications for designers and vendors

Due to the large distance between goals and results in many ICT-based health care projects, it is imperative for system designers to *learn more* about the complex interplay between the new technology and future users. It might therefore be useful for vendors to spend some time in the practices where a new system is to be implemented in order to increase their understanding of how the work is conducted, artefacts in use, and how and in which ways the workers interact with each other. In Article 1, I have not only illustrated a complex and heterogeneous infrastructure in the initial phases of the project, but also illustrated some of the goals of Well Interactor and how the vendor expected it to be used. By studying the current work situations in the laboratories, we see an emerging gap between the technology and the practices. This gap is increasingly difficult to close.

For vendors to gain a better understanding of how their systems affect the installed base, they must be aware that implementing innovative ICT systems is a complicated, unpredictable and challenging task. In addition, it is not certain that innovative and apparently sensible and effective solutions are the best for the existing practice, as the success of complex solutions may well depend on major changes in work practice. Complex technology may therefore presuppose a need for major modifications of related technological systems (produced by other vendors). This may easily result in escalating challenges, as all vendors do not necessarily pursue similar strategies (see Article 3). As illustrated in the theory chapter, a complex installed base cannot easily be changed or replaced. Rather, attempts to implement new technology in already complex settings may well result in a cascade of unintended consequences (Article 2). It is therefore important to sharpen the focus on the reciprocity between different technical solutions and reciprocity between the technology and organizations.

I therefore suggest that system designers and suppliers should be careful not to create systems that a) require major changes implemented by other vendors or b) require substantial organizational changes for the users. Designers and vendors should therefore aim to integrate new systems with current work procedures and existing systems rather than aiming for a complete replacement of existing ICT portfolios (the installed base). To achieve better systems, it is thus necessary to increase knowledge about practices.

7.2.2 Implications for users

Users need to undertake an active role in integration projects. Articles 3 and 4 illustrate that users influence the development of the system in that they take responsibility for key roles that influence other players to work towards a common goal. The users of the systems may therefore bring in new ideas and suggestions for improvements that have not previously been discussed (see Article 3). Instead of relying on a requirement specification, ICT projects should be seen as an ongoing process where results are created by negotiating interests between users and suppliers. In this sense, user involvement represents an ongoing process where users define change requirements along the way. Therefore, the communication between different actors is a dynamic process where designers configure users but users also configure designer (Mackay et al, 2000). The direction of this configuration must be considered in conjunction with the existing installed base and the need for change.

Because of a close relationship between designers and users, it is fruitful to use the information infrastructure perspective to map different roles as well as how they are interwoven with each other. Because the communication process is not unidirectional, in my opinion it is not easy to define the user/designer roles completely. Consider Article 4, where it is shown that users of the hospital were users in relation to the vendor while the laboratory staffs in the hospital were designers in relation to the users at the GP practices. Although there was little direct contact between the vendor and the GP practices, users still conveyed important information to the vendor when they regularly contacted the users at the doctor's office.

Since the example above explains that the development of Well Interactor resulted from the collaboration between different users and the vendor where all groups had the opportunity to influence the design of the product (see Article 4), the knowledge of the users is essential. In addition, since the context largely determines the user / designer role, where the distinction is dynamic within a complex structure, it is appropriate to motivate users to look at themselves as important contributors in the design process.

7.2.3 Implications for project leaders and decision makers

In order to establish a better match between goals and results, project leaders and decision makers should be more aware that it takes time to establish good ICT solutions in health care. As previously described, there are many players and some sort of coordination is required (see articles 3 and 4). Typically, these players have various sets of interests, motivations and expectations about what ICT systems can do for them. In the GiLab project, this was illustrated by the varying needs and differences between laboratories. For example, the plan to transfer series of laboratory numbers to the GP practices gained higher acceptance from the Microbiology laboratory than from the Medical Biochemistry laboratory. In contrast, establishing a pre-analytical unit was far more acceptable for the Medical Biochemistry laboratory than for the Microbiology and the Pathology laboratories.

First, an important question is to identify who benefits and who must bear the disadvantages of introducing ICT systems. This should therefore be a key task for project managers. However, this might not be immediately clear in the initial phases of a project where the stakeholders generally tend to agree. The difficulties typically emerge later as the stakeholders start to discuss how to do things and when the influential role of the installed base and the organizational consequences of the system became clearer.

Second, it is important for project managers to see ICT implementation as a prolonged incremental process, where different parts stabilize and align over time. While the promises of large-scale organizational change may be tempting – for example, Business Process Reengineering (see Hammer, 1990; Hammer and Champy, 1993) – there is still a need to allow the organization to transform more carefully (McNulty and Ferlie, 2002). Incremental changes are important to merge new strategies with the existing installed base. By focusing on alignments and improved cooperation between management and organization, one can better understand how to obtain a successful system in the long term.

Third, the GiLab project has illustrated that users are able to influence ICT development in many positive ways. A lesson for project leaders and decision makers is therefore to allow users more freedom and participation in the decision processes as well as utilizing their feedback and engagement. First of all, users possess rich knowledge about how work structures are built and how they work together. In this sense, users are able to describe what the terms of the systems should be. Consequently, I believe that by giving users more leeway and influence as well as by considering user feedback, project managers will be in a better position to anticipate the consequences of their projects.

As a fourth argument, it is important that project managers establish some strategies for managing the many unforeseen events that typically occur during implementation of ICT systems. Since an installed base is increasingly complex, it makes sense to suggest that project managers should explore surrounding issues in greater depth rather than considering single projects in isolation. In the GiLab project, for instance, there were many unforeseen events caused by factors that were not regarded as part of the project. For example, it was not expected that the bid for tender would delay the project and it was not easy to predict why it was so difficult to standardize the work processes in the pre-unit. A strategy to deal with the unexpected outcomes of integration may then be continuous assessment of specific integration strategies in terms of the components and practices to be integrated. As articles 2 and 3 illustrate, relationships among the different parts may be dynamic, where some factors affect the integration strategies more than others do. To make more sense out of integration projects, project leaders must then consider more thoroughly how and why interactions among the different parts of an infrastructural system may act as “major sources of unintended consequences" (Harrison et al, 2007:544).

7.3 Methodological implications

7.3.1 A broad methodological scope

As there are large variations between what is done in different contexts in integrated portfolios, and different actors often have different opinions about what solutions are appropriate, it is important to explore the differences between each setting. It is therefore crucial to apply a broad methodological approach. By studying the different contexts, we see not only that they are different, but also what those differences are, how they are expressed, and what the potential conflicts controversies may be.

What is important methodologically, then, is to take into account the different opinions and needs of everyone involved in using the infrastructure. I therefore recommend that project teams and system developers should utilize interpretive research better; perhaps they should even learn more about how and why this research contributes to a better understanding of users' needs, and of what happens in practice. Klein and Myers (1999) compare this to different witness accounts by explaining the need to be sensitive to possible differences in interpretations among various participants. Through the description of the "Principle of Multiple Interpretations" (ibid:72), the authors show that there are many different explanations, even in the same sequence of events.

7.3.2 Integration projects need to be studied over time

This study has emphasized that the results of integration projects are created over time and that they do not always match what was anticipated during the initial planning phase. First, it took much longer than anticipated to accomplish the project due to the many unforeseen events and issues that emerged. Second, it was very difficult to apply a strategy that fitted in with all the laboratories' demands, as the work practices varied hugely across the laboratories. The GiLab initiatives were so tightly connected that failure of one component had consequences for other components. Hence, what seemed to be a good solution in one place became a problem somewhere else. As the GiLab case has illustrated, the pre-unit, the PMS and the common laboratory number initiatives failed to materialize in the way they were initially planned.

The thesis shows that ICT projects change extensively over time, and this makes it crucial to study integration projects accordingly - over time - in order to identify what has really happened as well as how and why these things happened. Through studying large-scale projects over several years, one can understand how and why the projects progress the way they do. This may then serve as a foundation for identifying some lessons learned from such projects, from which similar projects might benefit.

7.3.3 Living in the "cross fire" between different stakeholders

Studying integration projects implies that the PhD researcher has to relate to many different stakeholders with different interests. This also reflects the relationship to the PhD researcher who needs access to the field in the related practices. When users, vendors, or project managers admit a PhD candidate to conduct research in a given practice or in a project, it is not unusual for these stakeholders to want something in return, for instance concrete design implications, suggestions, etc. However, since there are also many varying and conflicting opinions to address, it is not easy for a PhD candidate to offer improvement that fits everybody, so that some toes are occasionally stepped on. In this sense, PhD candidates are in the line of fire between the different stakeholders' interests.

While such a situation is not particularly advantageous, it is in a way "everyday life" for PhD students because current PhD projects are not conducted in isolation, but rather as part of a "real" ensemble of industry, research and users. This implies that many PhD projects increasingly reflect a "real world" setting rather than being conducted as a part of a "laboratory" study. It might be useful for businesses to draw on the services of PhD students, who in any case will spend considerable time in collecting field data, to try to grasp what is going on in complex settings.

8.0 CONCLUSION

In this thesis, I have discussed the challenges of integrating ICT systems in complex organizations and illustrated how a socio-technical perspective on ICT implementation and integration can be important in initiatives to address these challenges. To increase insight into socio-technical interactions, two promising theories have been applied: the *Actor-Network-Theory* and *information infrastructure*. These theories have been important for a better understanding of complexity issues in integration projects in health care.

As I have pointed out in the thesis, it is not a simple task to integrate ICT systems in health care organizations. A history of many mistakes and wasted spending is an illustration of this. One must accept that integrating ICT systems as well as implementing them in practice takes time, and time is therefore a foundation for any successful implementation process. A prerequisite for improving integration is a better understanding of technical and organizational interdependencies as well as of what actually occurs in day-to-day work. First, understanding interdependencies is important because successful use is closely rooted in the practice. Second, new ICT systems are also a new experience for organizations, which means that project leaders and participants should be careful to take into account how the new systems influence the various situations of use. Third, complex health care organizations are highly dependent on what is done elsewhere, so that work and ICT are interdependent, sometimes in unpredictable ways. Because unforeseen consequences may result from complex interdependencies, one cannot fully rely on well-planned goals and defined ambitions. Instead, one must map the complexity of the current practices and then try to form a picture of how new ICT systems and organizations interact.

One important reason for mapping existing practices and interdependencies rather than simply following “external” plans is that ambitions and goals seem to change during implementation, due to the unpredicted influences of unforeseen events, which may result in an escalation of complexity. Even though this escalation means that plans and ambitions may not be realized as defined, it does not mean that ambitions are not relevant. However, in order to realize such ambitions, one needs to accept that plans may need to be changed along the way. In this sense, it might be a good idea to focus on changes made through incremental steps rather than rigidly following the initial plan.

To contribute to better outcomes in the future, to reduce complexity, and to deal with existing heterogeneity, it makes sense to study existing practices and technologies – the installed base – in detail prior to any implementation attempt. Therefore, I have recommended investing the resources where they are most needed and where the possibility of achieving integration is best. This might reduce complexity to a manageable level. In addition, by repeating this process, for example by utilizing the concepts of information infrastructure and an ANT perspective, I believe complexity might be handled better.

However, as ICT projects involve many stakeholders with different interests and points of view, one might ask if it is ever possible to achieve complete agreement, or if it might not be better just to make a decision rather than asking what everyone wants. As is pointed out in this thesis, such a strategy is not particularly fruitful. Implementing ICT in health care is more of a collective achievement than a single manager's decision. Users are indeed an important resource to coordinate the different activities and practices. As pointed out, users not only juxtapose heterogeneous elements, but also see how heterogeneous elements relate to each other, enabling them to identify the weak links in an integration process.

This thesis also suggests that vendors should cooperate better with their competitors in order to deal with heterogeneities. Vendors need to make agreements that are good for the whole rather than creating solutions that are good for individual players. In this sense, vendors need to consider in greater depth how their systems affect other surrounding systems. In addition, vendors of ICT systems should increase their understanding of current work processes and become more aware of how they can create systems that support complex work processes, rather than focusing on innovative solutions that require large-scale changes within an already complex installed base. I also recommend that project managers pay attention to the concepts of information infrastructure, as this can increase insight into the complexity issues in ICT implementations. What is definitely clear is that it is difficult to guarantee that an ICT system will be used as expected. Hence, in order to reduce the typical user-design gap, I also suggest that users are given more influence in ICT projects.

9.0 REFERENCES

Aanestad, M. (2003): The Camera as an Actor: Design-in-Use of Telemedicine Infrastructure in Surgery, Computer Supported Cooperative Work 12: pp. 1-20, 2003.

Adler-Millstein, J, McAfee, A. P. Bates, D. W. and Ashish, K. J. (2007): The State of Regional Health Information Organizations: Current Activities and Financing. Health Affairs, 27, no.1 (2008): pp. 60-69.

Ahmad, S., and Schroeder, R. G. (2001): The impact of electronic data interchange on delivery performance. Production and Operations Management, Vol. 10, No 1, pp. 16-30.

Ahrens, T., and Dent, J. F. (1998): Accounting and Organizations: Realizing the Richness of Field Research. Journal of Management Accounting Research, 10, pp. 1-39.

Akrich, M. (1992): The De-Scription of Technical Objects. In Bijker, Wiebe E. and Law, J. (eds.) *Shaping Technology / Building Society. Studies in Sociotechnical Change*. The MIT Press, Cambridge, Massachusetts, pp. 205-225.

Amundsen, O. J. (2011): Meningsløs kort tidsfrist og for stor kompleksitet. Fagtidsskriftet HMT Helse/ Medisin/ Teknikk, No. 2 – 2011. ADD media AS http://project.vbook.no/project.asp?version_id=796&page=43#zp3

Anderson, J. G. (1997): Clearing the Way for Physicians' Use of Clinical Information Systems, Communications of the ACM, August 1997/Vol. 40, No. 8, pp. 83-90.

Appleby, J., Crawdord, R. and Emmerson, C. (2009): How cold will it be? Prospects for NHS funding: 2011 -17. The king's Fund, 2009, 1-28.

Ash, J. S., Berg, M. and Coiera, E. (2004): Some Unintended Consequences of Information Technology in Health Care: The Nature of Patient Care Information System-related Errors. J Am Med Inform Assoc. 2004, 11, pp. 104-112.

Atkinson, P. (1995): Medical talk and medical work. Sage Publications Ltd, London.

Avison, D. and Young, T. (2007): Time to Rethink Health Care and ICT, *COMMUNICATIONS OF THE* ACM, June 2007, Vol. 50, No. 6, pp. 69-74.

Bartlett, S. C. and Ghoshal, S. (2000): Transnational Management: Text, Cases and Readings in Cross-Border Management, Irwin McGraw Hill, Boston.

BBC NEWS (2006): Services back after NHS IT crash. Tuesday, 1 August, 2006. *http://news.bbc.co.uk/2/hi/health/5233604.stm*

Berg, M. (1998): The Politics of Technology: On Bringing Social Theory into Technological Design. *Science Technology Human Values*, 1998 23: Sage publications, pp. 456-490.

Berg M. (1999): Patient care information systems and health care work: a socio-technical approach. *International Journal of Medical Informatics 55*, pp. 87-101.

Berg M. and Goorman E. (1999): The contextual nature of medical information, International *Journal of Medical Informatics 56*, pp. 51-60.

Berg M., Langenberg, C., Berg, I.v.d, and Kwakkernaat, J. (1998): Considerations for sociotechnical design: experiences with an electronic patient record in a clinical context. *International Journal of Medical Informatics 52*, pp. 243-251.

Berg M., Aarts, J. and van der Lei, J. (2003): ICT in Health Care: Sociotechnical Approaches *Methods Inf Med 2003; 42*, pp. 297-301.

Berg, M. and Timmermans, S. (2000): Orders and Their Others: On the Constitution of Universalities in Medical Work. *Configurations*, Vol. 8, No. 1, pp. 31-61

Berg, O. (2006). Fra politikk til økonomikk - den norske helsepolitikks utvikling det siste sekel. *Den norske lægeforening, tidsskriftets skriftserie. Kap. 4,* Oslo.

Bernstein P. A. and Haas L. M. (2008): Information Integration in the Enterprise *COMMUNICATIONS OF THE ACM*, September 2008, Vol. 51, No. 9, pp. 72-79.

Bidgood, W. D. JR., Horii, S.C., Prior F.W., and Van Syckle, D.E. (1997): Understanding and Using DICOM, the Data Interchange Standard for Biomedical Imaging. *Journal of the American Medical Informatics Association*, Vol. 4, No. 3, pp. 199-212.

Bjerknes, G. and Bratteteig, T. (1995): User Participation and Democracy: A Discussion of Scandinavian Research on System Development. *Scandinavian Journal of Information Systems*, Vol. 7.No. 1, pp 73-98.

Boland, R. J. Jr. (1985): Phenomenology: A Preferred Approach to Research in Information Systems. In Mumford, E., Hirschheim, R, Fitzgerald, G. et Wood-Harper, T. (eds.). *Research Methods in Information Systems*. North- Holland. Amsterdam. pp. 193-202.

Boland, R. J. Jr. (1991): Information System Use as a Hermeneutic Process. In H. E. Nissen, H. K. Klein, and R. Hirschheim (Eds.), *Information Systems Research: Contemporary Approaches and Emergent Traditions*, Amsterdam, The Netherlands: North-Holland-Elsevier Science Publishers, pp. 439-464.

Boochever, S. S. (2004): HIS/RIS/PACS Integration: Getting to the Gold Standard. *Radiology Management* (26:3), May-June 2004, pp. 16-24.

Boudreau, M. C., & Robey, D. (2005): Enacting Integrated Information Technology: A Human Agency Perspective. *Organization Science*, Vol. 16, No 1, pp. 3-18.

Bowker, G. C., and Star, S. L. (1999): *Sorting Things Out - Classification And Its Consequences.* The MIT Press, Cambridge, Massachusetts Institute of Technology.

Buckhout, S., Frey, E. and Nemec, J. (1999): Making ERP Succeed: Turning Fear into Promise. *Journal of Strategy and Business*, Vol. 17, No. 2, 1999, pp. 60-72.

Bødker, S. and Iversen O. S. (2002): Staging a Professional Participatory Design Practice - Moving PD beyond the Initial Fascination of User Involvement. *NordiCHI*, October 19-23, 2002, pp. 11-18.

Callon, M. (1986): Some elements of a sociology of translation: Domestication of the scallops and fishermen of St. Brieuc Bay, in Law, J., (Eds.), *Power, action and belief: a new sociology of knowledge?* Routledge, London, pp. 196-233.

Callon, M. (1991): Techno-Economic Networks and Irreversibility. In J. Law (ed.): *A Sociology of Monsters. Essays on Power, Technology, and Domination*. London: Routledge, pp. 132-161.

Ciborra, C. U. and Hanseth, O. (1998): From tool to *Gestell* Agendas for managing the information Infrastructure. *Information Technology & People*, Vol. 11, No. 4, pp. 305-327.

Crabtree, A., Rodden, T, Tolmie, P. and Button, G. (2009): Ethnography Considered Harmful, *CHI 2009 – The Status of Ethnography in systems Design*, April 7th – Boston, MA, USA, pp. 879-888.

Cross, M. (2006): *Information Technology* Will Connecting for Health deliver its promises? *BMJ,* Vol. 332, 11 March 2006, pp. 599-601.

Cruz-Correia, R. J., Vieira-Marques, P. M., Ferreira, A. M., Almeida, F. C., Wyatt, J. C. and Costa-Pereira, A. M. (2007): Reviewing the integration of patient data: how systems are evolving in practice to meet patient needs, B*MC Medical Informatics and Decision Making* 2007, 7:14.

Curtis, P. (2011): Government urged to abandon NHS IT programme, guardian.co.uk, Wednesday 18 May 2011 12.03 BST. *http://www.guardian.co.uk/society/2011/may/18/government-urged-to-abandon-nhs-it-programme*

Darke, P., Shanks, G. and Broadbent, M. (1998): Successfully completing case study research: combining rigour, relevance and pragmatism. *Info Systems J*, 8, pp. 273-289.

Davenport, T. (1998): Putting the Enterprise into the Enterprise System. *Harvard Business Review*, Vol. 76, Issue 4, pp. 121-131.

Denzin, N. K. (2001): Interpretive interactionism. Second Edition, Applied Social Research Method Series, Volume 16, Sage Publications, Inc, 2001, California

Dogac, A., Laleci, G. B., Kirbas, S., Kabak, Y., Sinir, S. S., Yildiz, A. and Gurcan, Y. (2006): Artemis: Deploying semantically enriched Web services in the health care domain. *Information Systems 31* (2006), pp. 321-339.

Dyer, W. G. JR. and Wilkins, A. L. (1991): Better Stories, Not Better Constructs, To Generate Better Theory: A Rejoinder to Eisenhardt. *Academy of Management Review*, Vol. 16, No. 3, pp. 613–619.

Eisenhardt, K. M. (1989): Building Theories from Case Study Research. *Academy of Management Review*, Vol. 14, No 4, pp. 532–550.

Ellingsen, G. and Monteiro, E. (2003): A Patchwork Planet: Integration and Cooperation in Hospitals. *Computer Supported Cooperative Work (CSCW)*, Vol. 12, No. 1, pp. 71–95.

Ellingsen, G. and Monteiro, E. (2005): The Slight Surprise of Integration. IFIP International Federation for Information Processing, Vol. 185/2005, pp. 261-274.

Ellingsen, G. and Monteiro, E. (2006): Seamless Integration: Standardisation across Multiple Local Settings. *Computer Supported Cooperative Work (CSCW)*, 15, pp. 443–466.

Ellingsen, G. and Monteiro, E. (2008): The organizing vision of integrated health information systems. *Health Informatics Journal*, 14, pp. 223–236.

Ellingsen, G., Monteiro, E. and Munkvold, G. (2007): Standardization of Work: co-constructive practice. The Information Society, Vol. 23, No. 5, pp. 309–326.

Ferlie, E. B. and Shortell, S. M. (2001): Improving the quality of Health Care in the United Kingdom and the United States: A Framework for Change. *The Milbank Quarterly*, Vol. 79, No. 2, pp. 281–315.

Finansministeriet (2010): *Professionalisering af arbejdet med it-projeckter i staten - Afrapportering fra arbejdsgruppen vedrørende bedre statslige it-projekter*. Maj 2010, Rosendahls - Schultz Grafisk, pp. 1-116.

Fleck, J. (1994): Learning by trying: the implementation of configurational technology. *Research Policy*, 23(6), pp. 637-652.

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

Fox, R., Sahay, R. and Hauswirth, M. (2009): PPEPR for Enterprise Healthcare Integration. *D. Weerasinghe (Ed.): eHealth 2008*, LNICST 1, pp. 130–137. © ICST Institute for Computer Sciences, Social Informatics and Telecommunications Engineering 2009

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

Gasser L (1986): The Integration of Computing and Routine Work. *ACM Transactions on Office Information Systems*, Vol. 4, No. 3, pp. 205-225.

Geertz, C. (1973): *The Interpretation of Cultures*. Basic Books, New York.

Giuse, D. A. and Kuhn, K. A. (2003): Health information system challenges: the Heidelberg conference and the future. *International Journal of Medical Informatics 69,* pp. 105- 114.

Glouberman, S. and Mintzberg, H. (2001): Managing the Care of Health and the Cure of Disease-Part II: Integration. *Health Care Management Review*, Vol. 26, Issue 1, pp. 70-84.

Goodhue, D. L., Kirsch, L. J., Quillard, J. A. and Wybo, M. D. (1992): Strategic Data Planning: Lessons from the Field. *MIS Quarterly*, Vol. 16, No. 1, pp. 11–34.

Goorman E. and Berg M. (2000): Modelling nursing activities: electronic patient records and their discontents. *Nursing Inquiry*, 7(1). pp. 3-9.

Grant, D., Hall, R., Wailes, N. and Wright, C. (2006): The false promise of technological determinism: the case of enterprise resource planning systems. *New Technology, Work and Employment,* 21:1, pp. 2–15.

Grimson, J. (2001): Delivering the electronic healthcare record for the 21st century. *International Journal of Medical Informatics 64,* pp. 111–127.

Gripsrud, S. (2002) Fastlegeordningen gir mer makt til pasientene, 29. oktober 2002. *http://www.forskning.no/Artikler/2002/oktober/1034338934.74*

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

Hammer, M. and Champy, J. (1993): *Reengineering The Corporation, A Manifesto For Business Revolution*, Summaries.com, Internet Delivered Business Book Summaries.

Hanseth, O. (1996): Information Infrastructure Development: Cultivating the Installed Base. *Studies in the Use of Information Technologies*, No. 16. Department of Informatics, Göteborg University.

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", unpublished article, available at: *http://heim.ifi.uio.no/oleha/Publications/ib_ISR_3rd_resubm2.html*

Hanseth, O. and Aanestad, M. (2003): Design as Bootstrapping. On the Evolution of ICT Networks in Health Care, *Methods Inf Med* 2003; 42, pp. 385-391.

Hanseth, O. and Braa, K. (1998): Technology as Traitor: Emergent SAP Infrastructure in a Global Organization. *Proceedings of the International Conference on Information Systems 98*, pp. 184-196.

Hanseth, O. and Braa, K. (2001): Hunting for the Treasure at the end of the Rainbow: Standardizing Corporate IT Infrastructure. *Computer Supported Cooperative Work,* 10, pp. 261-292.

Hanseth, O. and Ciborra, C. (2007): *Risk, Complexities and ICT.* Edward Elgar Publishing, Massachusetts, USA.

Hanseth, O. and Lundberg, N. (2001): Designing Work Oriented Infrastructures. *Computer Supported Cooperative Work,* 10, pp. 347–372.

Hanseth, O., and Lyytinen, K. (2004): Theorizing about the Design of Information Infrastructures: Design Kernel Theories and Principles. *Sprouts: Working Papers on Information Environments, Systems and Organizations*, Vol. 4, Issue 4, pp. 207-241.

Hanseth, O. and Monteiro, E. (1997): Inscribing behaviour in information infrastructure standards. *Accounting, Management & Information Technology,* Vol. 7, No. 4, pp. 183-211.

Hanseth, O. and Monteiro, E. (1998): Understanding Information Infrastructure. Manuscript 27. Aug., 1998. *http://heim.ifi.uio.no/oleha/Publications/bok.pdf*

Hanseth, O. Jacucci, E., Grison, M. and Aanestad, M. (2006): Reflexive standardization: Side-Effects and Complexity in Standard-Making. *MISQuarterly*, Special Issue, Vol. 30, pp. 563-581.

Harrison, M. I., Koppel, R., and Bar-Lev, S. (2007): Unintended Consequences of Information Technologies in Health Care — An Interactive Sociotechnical Analysis. *J Am Med Inform Assoc.,* 14, pp. 542-549.

Hartswood, M., Procter, R., Rouncefield, M. and Sharpe, M. (2000): Being there and doing IT in the workplace: a case study of a co-development approach in healthcare, Participatory Design Conference 2000.

Hartswood, M., R. Procter, M. Rouncefield and R. Slack (2003): Making a Case in Medical Work: Implications for the Electronic Medical Record. Computer Supported Cooperative Work (CSCW), Vol. 12, No. 3, pp. 241-266.

Health Direct (2011): NHS £12 billion IT system is waste of money NAO still finds. National Audit Office, May 19, 2011. *http://www.healthdirect.co.uk/2011/05/nhs-12-billion-it-system-is-waste-of-money-nao-still-finds.html*

Heeks, R. (2006): Health information systems: Failure, success and improvisation. *International Journal of Medical Informatics* 75, pp. 125-137.

Heeks, R., Mundy, D., and Salazar A. (1999): Why Health Care Information Systems Succeed or Fail. *Manchester School of Environment and Development*, Working Paper 9, Manchester, U.K., 1999.

Heffler, S., Smith, S., Keehan, S., Borger, C., Clemens, M. K., and Truffer, C. (2005): Trends U.S. Health Spending Projections For 2004–2014. *Project HOPE–The People-to-People Health Foundation, Inc.*

Helse Nord RHF (2009): Organisering av Helse Nord. *http://www.helsenord.no/organisering/category19904.html*

Hess, J., Offenberg, S. and Pipek, V. (2008): Community Driven Development as Participation? - Involving User Communities in a Software Design Process. *Proceedings Participatory Design Conference*. Trustees of Indiana University, 2008, pp. 31–40.

HOD (1997): NOU 1997:18, Prioritering på ny gjennomgang av retningslinjer for prioriteringer innen norsk helsetjeneste. Helse og omsorgsdepartementet. *http://www.regjeringen.no/nb/dep/hod/dok/nouer/1997/nou-1997-18/5.html?id=140961*

HOD (2008): A new health sector reform - The Coordination Reform. Presented by Bjarne Håkon Hanssen, Minister of Health and Care Services, 24. September 2008. *http://www.regjeringen.no/upload/HOD/Vedlegg/BHH%20ppt%20Trondheim%20en%2024%2009%2008.pdf*

HOD (2009): St.meld. nr. 47 (2008–2009) - Samhandlingsreformen Rett behandling – på rett sted – til rett tid. Det Kongelige Helse og Omsorgsdepartementet, Trykk: 07 Gruppen AS – 06/2009.

Hubbard, W. H. (2006): Essay Review, Public Health in Norway 1603 – 2003. *Med Hist. Volume 50, Number 1, January 2006,* pp. 113-117.

Hughes, T. P. (1987): The Evolution of Large Technical Systems. In Bijker, W.E., Hughes T. P., and Pinch, T., (eds.), *The Social Construction of Technological Systems*, *New Directions in the Sociology and History og Technology*, The MIT Press, Cambridge, Massachusetts, pp. 51–82.

Hutchison, A., Kaiserswerth, M., Moser, M., and Schade, A. (1996): Electronic Data Interchange for Health Care. *IEEE Communication Magazine*, July 1996, pp. 28–34.

Jones, T., Dobrev, A., Stroetmann, K., A., Cameron, J. and Morris, L. (2008): Report on the socio economic impact of NHS Scotland's Emergency Care Summary - Final Draft. Europeian *Commision Information Society and Media*, 10, pp. 1–53.

Kaplan, B. and Harris-Salamone, K. D., (2009): Health IT Success and Failure: Recommendations from Literature and an AMIA Workshop. *Journal of the American Medical Informatics Association,* Vol. 16, No. 3, pp. 291–299.

Kaplan, B. and Maxwell, J. A. (2005): Qualitative Research Methods for Evaluating Computer Information systems. In Anderson, J. G. and Aydin, C. E. (Eds.), *Evaluating the Organizational Impact of Healthcare Information systems.* Second Edition, 2005, Springer, Baltimore, USA, pp. 30–55.

Kensing, F. and Blomberg, J. (1998): Participatory Design: Issues and Concerns. *Computer Supported Cooperative Work,* 7, pp. 167–185.

KITH (2004): Elektronisk resept. Informasjonsmodell og meldingsbeskrivelse XML. *KITH Rapport R12/04*, pp. 1–33. Versjon 0.9.

KITH (2008): ELIN-K Prosjektet. Elektronisk informasjonsutveksling i pleie og omsorgstjenesten i kommunene. Sammen skaper vi en enklere og tryggere hverdag for helsearbeidere og pasienter. *KITH rapport 06/08*, pp. 1 – 32, 2 July 2008.

KITH (2009): KITH-standarder for meldinger, 28.04.2009, *http://www.kith.no/templates/kith_WebPage____1444.aspx*

Klein, H. K. and Kleinman, D. L. (2002): The Social Construction of Technology, Structural Considerations. *Science, Technology and Human Values*, Vol. 27, No. 1, pp. 28–52.

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.

Kush, R. D., Helton, E., Rockhold, F. W. and Hardison, C. D. (2008): Electronic Health Records, Medical Research, and the Tower of Babel. The New England Journal of Medicine, 358; 16, pp. 1738-1740

Larsen, E. and Ellingsen, G. (2010): Facing the Lernaean Hydra: The Nature of Large-Scale Integration Projects in Healthcare. *K. Kautz and P.A. Nielsen (Eds.): SCIS 2010*, LNBIP 60, pp. 93–110.

Latour, B. (1987): *Science in Action.* Harvard University Press. Cambridge, Massachusetts.

Latour, B. (1991): Technology is society made durable, in Law, J., (Eds.), *A sociology of monsters: essays on power, technology and domination.* Routledge, London, pp. 103-131.

Latour, B. (2005): *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Law, J. (1987): Technology and Heterogeneous Engineering: The Case of Portuguese Expansion. In Bijker, W.E., Hughes T. P., and Pinch, T., (eds.), *The Social Construction of Technological Systems*, *New Directions in the Sociology and History og Technology*, The MIT Press, Cambridge, Massachusetts, pp. 111–134.

Law, J. (1992): Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity. *Systems Practice*, Vol. 5, No. 4, pp. 379-393.

Law, J. (1999): After ANT: complexity, naming and topology. In Law, J. and Hassard, J., (Eds.), *Actor Network Theory and After*, Blackwell Publishers / The Sociological Review, Oxford, pp. 1-14.

Lee A. S. and Baskerville R. L. (2003): Generalizing Generalizability in Information Systems Research. *Information Systems Research,* Vol. 14, No. 3, pp. 221–243.

Leonard-Barton, D. (1988): Implementation as mutual adaptation of technology and organization. *Research Policy*, 17, pp. 251-267.

Lipkin, M., Engle, R. L. JR., Davis, B. J., Zworykin, V. K., Ebald, R., Sendrow, M. and Berkley, C. (1961): Digital computer as an aid to differential diagnosis – Use in Hematologic Diseases. *Arch Intern Med. ,*Vol. 108, No. 1, pp. 56-72.

Littlejohns, P., Wyatt J. C. and Garvican, L. (2003): Information in practice. Evaluating computerised health information systems: hard lessons still to be learnt, *BMJ*, Vol. 326, pp. 860–863.

Liu, C-T., Long, A-G., Li, Y-C., Tsai, K-C. and Kuo, H-S. (2001): Sharing patient care records over the World Wide Web. *International Journal of Medical Informatics* 61, pp. 189–205

Lovdata (2009): FOR 2000-04-14 nr 328: Forskrift om fastlegeordning i kommunene. *http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-20000414-0328.html*

Lundh, F. (2008): Hansen: - Svære IKT – utfordringer i helse Norge - Røntgen sendes fortsatt i posten og med taxi. VG nett, 25.09.2008. http://www.vg.no/helse/artikkel.php?artid=526679

Lyytinen, K., Bergman, M. and King, M. J. L. (2006): Large Scale Requirements Analysis as Heterogeneous Engineering*. Enterprise Information Systems,* VI, pp. 9–23.

Maciaszek, L. (2007): *Requirement analysis and system design*. Pearson Education Limited, Edinburgh Gate, England.

Mackay, H., Carne, C., Beynon-Davies, P. and Tudhope, D. (2000): Reconfiguring the User: Using Rapid Application Development. *Social Studies of Science,* 30/5, pp. 737-757.

Maykut P. and Morehouse R (1994): *Beginning Qualitative Research – A Philosophic and Practical Guide.* The Falmer Press, London.

McNulty, T. and Ferlie, E. (2002): Reengineering Health Care, The complexities of organizational transformation, Oxford University Press, 2002, Oxford, New York.

Miles, M. (1979): Qualitative Data as an Attractive Nuisance: The Problem of Analysis. *Administrative Science Quarterly*, Vol. 24, No. 4, pp. 590- 601.

Miles, M. B. and Huberman, A. M. (1994): *Qualitative Data Analysis: An Expanded Sourcebook*, SAGE Publications.

Millerand, F. and Baker, K. S. (2010): Who are the users? Who are the developers? Webs of users and developers in the development process of a technical standard. *Info Systems J.,* 20, pp. 137-161.

Moe, I. (2011): Stopper dataprosjekt – risikerer milliontap. Aftenposten.no, 15.05.2011, *http://www.aftenposten.no/nyheter/iriks/article4121836.ece*

Monteiro, E. (2000): Actor-Network Theory and Information Infrastructure. In E. A. Ciborra (Ed.), *From Control to Drift: The Dynamics of Corporate Information Infrastructures,* Oxford: Oxford University Press, pp. 71-83.

Mumford, E. (1983): *Designing Human Systems for New Technology*. Manchester Business School, Manchester**.**

Mumford, E. (1994): New treatments or old remedies: is business process reengineering really socio-technical design? *Journal of Strategic Information Systems*, 3(4), pp. 313-326.

Mykkänen, J., Porrasmaa, J., Rannanheimo, J. and Korpela M. (2003): A Process for Specifying Integration for Multi-Tier Applications in Healthcare. *International Journal of Medical Informatics* 70, pp. 173-182.

Narayanan, S., Marucheck, A. S., and Handfield, R. B. (2009): Electronic Data Interchange: Research Review and Future Directions. *Decision Sciences*, Vol. 40, No. 1, pp. 121–163.

Nasjonal IKT (2010): Strategiplan 2010 og 2011, De regionale helseforetakenes felles IKT-strategi. Felles satsningsområder og tiltak. *Nasjonal IKT*, Versjon: 1.0, Dato: 4. mai 2010, pp. 1–29.

NAV (2011): Fastleger per 30. juni 2007, etter legens kjønn og alder. *http://www.nav.no/805355631.cms*

Norges Forskningsråd (2007): Resultatevaluering av sykehusreformen - Tilgjengelighet, prioritering, effektivitet, brukermedvirkning og medbestemmelse. *Norges forskningsråd 2007*, Oslo.

Norwegian Directory of Health (2009): Norway and Health an introduction *http://www.helsedirektoratet.no/vp/multimedia/archive/00232/Norway_and_Health___232259a.pdf*

Omar, W. M. and Taleb-Bendiab, A. (2006): E-Health Support Services Based on Service-Oriented Architecture. *IEEE Computer Society*, pp. 35–41.

Orlikowski, W. J. (1992): The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science*, Vol. 3, No. 3, Focused Issue: Management of Technology, pp. 398-427.

Orlikowski, W. J. (2002): Knowing in Practice: Enacting a Collective Capability in Distributed Organizing. *Organization Science*, Vol. 13, No. 3, pp. 249-273.

Orlikowski, W. J. (2007): Sociomaterial Practices: Exploring Technology at Work. *Organization Studies,* 28(09), pp. 1435–1448.

Orlikowski, W. J. (2008): Using Technology and Constituting Structures: A practice Lens for Studying Technologies in Organizations. In Ackerman, M. S., Halverson, C. A., Erickson, T. And Kellogg, W. A. (eds.) *Resources, Co-Evolution and Artifacts, Theroy in CSCW*. Springer-Verlag, London, pp. 256-305.

Orlikowski, W. J. and Baroudi, J. J. (1991): Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research,* 2: 1, pp. 1– 28.

Orlikowski, W. J., & Iacono, C. S. (2001): Research Commentary: Desperately Seeking the 'IT' in IT Research - A Call to Theorizing the IT Artifact. *Information Systems Research*, Vol. 12, No. 2, pp. 121-134.

Orton, J. D. and Weick, K. E. (1990): Loosely Coupled Systems: A Reconceptualization. *The Academy of Management Review*, Vol. 15, No. 2, pp. 203-223.

OUS (2009): Project report for common clinical information platform. *Oslo University Hospital*. June 12. 2009.

Page-Jones, M. (1980): *The Practical Guide to Structured Systems Design*. Yourdon Press, New York.

Pare, G. and Elam, J. J. (1998): Introducing Information Technology in the Clinical Setting - Lessons Learned in a Trauma Center. *International Journal of technology Assessment in Health Care*, 14(2), pp. 331–343.

Pascal, W. (2000): Health Care of the Future: Vision 2020 Leads the Way – Part 2. In *Healthcare Information Management & Communications Canada*, Vol. XIV, No. 3, 3rd Quarter, pp. 22–24.

Pedersen, R., Ellingsen, G. and Monteiro, E. (2011): The standardized Nurse: Mission Impossible? *IFIP Advances in Information and Communication Technology*, Vol. 356, pp. 163-178.

Perrow, C. (1984): *Normal Accidents: Living with High-risk Technologies*. Basic Books, New York.

Pinch, T. J. and Bijker, W. E. (1984): The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology might Benefit Each Other. *Social Studies of Science*, Vol. 14, No. 3, pp. 399-441.

Plsek, P. E. and Greenhalgh, T. (2001): Complexity science - The challenge of complexity in health care. *BMJ* Vol. 323, pp. 625–628.

Pollock, N., Williams, R., and D'Adderio, L. (2007): Global Software and its Provenance: Generification Work in the Production of Organizational Software Packages. *Social Studies of Science*, 37(2), pp. 254-280.

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

Rozich J. D., Howard R. J., Justeson J. M., Macken P. D., Lindsay M. F. and Resar R. K. (2004): Standardization as a Mechanism to Improve Safety in Health Care. *Joint Commission Journal on Quality and Patient Safety*, Vol. 30, No. 1, pp. 5-14.

Rønnebeck, L. Holmstrøm, J. and Hanseth, O. (2007): IT-adaptation challenges in the process industry: an exploratory case study. *Industrial Management & Data Systems,* Vol. 107, No. 9, pp. 1276-1289.

Sahay, S. (2003): Global software alliances: the challenge of 'standardization'. Scandinavian Journal of Information Systems, 15, pp. 3–21.

Sahay, S., Monteiro, E., and Aanestad, M. (2007): Towards a Political Perspective of Integration in IS Research: The Case of Health Information Systems in India. Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries, São Paulo, Brazil, May 2007.

Sahay, R., Akhtar, W. and Fox, R. (2008): PPEPR: Plug and Play Electronic Patient Records. *SAC' 08 March 16 - 20, 2008, Fortaleza, Cear´a, Brazil*, pp. 2298–2304. Copyright 2008 ACM 9781595937537/08/0003

Schreurs, N. (2011): Slakter bruken av pasientjournaler, Computerworld, 07.06.2011, *http://www.idg.no/computerworld/helse/article210193.ece*

Schuler, D. and Namioka, A. (1993): *Participatory Design: Principles and Practices.* Lawrence Erlbaum Associates, Hillsdale, New Jersey.

Schultze, U. (2000): A Confessional Account Of An Ethnography About Knowledge Work. *MIS Quarterly*, Vol. 24, No. 1, pp. 3-41.

Singer, E. (2009): A Digital Health-Care Revolution: Twenty billion dollars might finally turn the U.S. health-care system digital. *http://www.technologyreview.com/biomedicine/22026/*

Slack, W. V. Hicks, G. P., Reed, C. E. and Van Cura, L. J. (1966): A Computer-Based Medical History System. *New Engl. J. Med.*, 274, pp. 194–198.

SHD (1996): *Mer Helse for Hver bIT – Informasjonsteknologi for en bedre helsetjeneste – Handlingsplan 1997 – 2000.* Helse og omsorgsdepartementet, 30.10.1996.

SHD (2001a): *Elektronisk samhandling i helse og sosialsektoren, "Si@!". Statlig tiltaksplan 2001 – 2003*. Sosial og helsedepartementet, Oslo.

SHD (2001b): Ot.prp. nr. 66 (2000-2001) - Om lov om helseforetak m.m. (helseforetaksloven). *Det Kongelige Sosial- og Helsedepartement*, 6. April 2001, pp. 1–285.

SHD (2005): Te@mwork 2007, Electronic Interaction in the Health and Social Sector, The Ministry of Health and The Ministry of Social Affairs, Government Administration Services P.O. Box 8169 Dep, 0034 Oslo.

SHD (2008) Teamwork 2.0, Nasjonal strategi for elektronisk samhandling i helse og omsorgssektoren 2008 – 2013, Strategiplan. I-1135, Oslo: Helse og Omsorgsdepartementet.

Shen, W., Hao, G., Wang, S., Li, Y. and Ghenniwac, H. (2007): An agent - based service-oriented integration architecture for collaborative intelligent manufacturing. *Robotics and Computer - Integrated Manufacturing* 23, pp. 315–325.

Smith, B. and Ceusters, W. (2006): HL7 RIM: An Incoherent Standard. *Studies in Health Technology and Informatics*, 124, pp. 133–138.

Spear, S. J. (2005): Fixing Healthcare from the Inside, Today. *Harward Business Review*, September 2005, pp. 1–15.

SSB (2011a): Befolkningsstatistikk. Befolkningsendringer i kommunene. 1951-2011. *Statistisk sentralbyrå, http://www.ssb.no/emner/02/02/folkendrhist/tabeller/tab/00.html*

SSB (2011b): Helseregnskap, 1997-2009- Helseutgiftene fortsetter å øke. *Statistisk sentralbyrå, http://www.ssb.no/helsesat/*

SSB (2011c): Helseutgifter, nøkkeltall. 1997-2009. *Statistisk sentralbyrå http://www.ssb.no/helsesat/tab-2011-05-19-01.html*

Star, S. L. and Ruhleder, K. (1996): Steps toward and Ecology of Infrastructure: Design and Access for Large Information Spaces. *Information Systems Research*, Vol. 7, No. 1, pp. 63-92.

Stoop, A.P. and 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. 458-462.

Suchman, L. A. (1987): *Plans and Situated Actions*, *The problem of human machine communication*. Cambridge University Press, New York.

Suchman, L. A. (2002): Practice-Based Design of Information Systems: Notes from the Hyperdeveloped World. *The Information Society*, 18, 2, pp. 139–144.

Tatnall, A. and Gilding, A. (1999): Actor-Network Theory and Information Systems Research. Proceeding 10th Australasian Conference on Information Systems, pp. 955–966.

Timmermans, S. and Berg, M. (1997): Standardization in Action: Achieving Local Universality through Medical Protocols. *Social Studies of Science,* 27, pp. 111–134.

Trauth, E. M. (1997): Achieving the Research Goal with Qualitative Methods: Lessons Learned along the Way. In, Lee, A. S., Liebenau, J. and DeGross, J. I. (eds.), *Information Systems and Qualitative Research*, Chapman and Hall, London, 1997, pp. 225–245.

Trunick, P. (1999): ERP: Promise or Pipedream? *Transport and Distribution*, Vol. 40, No. 1, pp. 1–39.

Tsiknakis, M., Katehakis, D. G., and Orphanoudakis, S. C. (2002): An Open, component-based infrastructure for integrated health information networks. *International Journal of Medical Informatics*, 68, pp. 3-26.

UNN (2009): A driving force in Health expertise, University hospital of North Norway. http://www.unn.no/getfile.php/UNN-Internett/OmUNN/Dokumenter/Wallview_eng.pdf

Van Maanen, J. (1979): The Fact of Fiction in Organizational Ethnography. *Administrative Science Quarterly*, Vol. 24, pp. 539–550.

Vasilescu, E. and Mun, S. K. (2006): Service Oriented Architecture (SOA) Implication for Large Scale Distributed Health Care Enterprises. *Proceeding of the 1st Distributed Diagnoses and Home Health Care (D2H2) Conference,* Arlington, Virginia, USA, April 2-4, 2006, pp. 91–94.

Volkoff, O, Strong, D. M. and Elmes, M. B. (2007): Technological Embeddedness and Organizational Change. *Organization Science*, 18 (5), pp. 832-848.

Vossberg, M., Tolxdorff, T. and Krefting, D. (2008): DICOM Image Communication in Globus-Based Medical Grids. *IEEE Transactions on Information Technology in Biomedicine*, Vol. 12, No. 2, pp. 145–153.

Wakefield, D. S., Mehr, D., Keplinger, L., Canfield, S., Gopidi, R., Wakefield, B. J., Koopman, R. J., Belden, J. L., Kruse, R. and Kochendorfer, K. M. (2010): Issues and questions to consider in implementing secure electronic patient–provider web portal communications systems. *International Journal of Medical Informatics*, 7 9, pp. 469–477.

Walsham, G. (1993): *Interpreting Information Systems in Organizations*. Wiley, Chichester.

Walsham, G. (1995a): Interpretive case studies in IS research: nature and method. *European Journal of Information Systems*, 4, pp. 74–81.

Walsham, G. (1995b): The Emergence of Interpretive in IS Research. *Information System Research*, 6:4, pp. 376–394.

Walsham, G. (1997): Actor-Network Theory and IS Research: Current Status and Future prospect. In Lee, A. S., Liebenau, J. and Degross, J. I. (1997), *Information Systems and Qualitative Research*, Chapman and Hall. London, pp. 466–480.

Walsham, G. (2006): Doing interpretive research. *European Journal of Information Systems*, 15, pp. 320–330.

Wears, R. L. and Berg, M. (2005): Computer Technology and Clinical Work - Still Waiting for Godot. *JAMA*, Vol 293, No. 10, pp. 1261–1263.

Weingart, S. N., Rind, D., Tofias, Z. and Sands, D. Z. (2006): Who Uses the Patient Internet Portal? The PatientSite Experience. *Journal of the American Medical Informatics Association*, Vol. 13, No. 1, pp. 91–95.

Williams, R. and D. Edge (1996): The Social Shaping of Technology. *Research Policy,* 25, pp. 865–899.

Xiao, Y. (2005): Artifacts and collaborative work in healthcare: methodological, theoretical, and technological implications of the tangible. *Journal of Biomedical Informatics,* 38, pp. 26–33.

ARTICLE 1

"Slow organizations and fast technologies"

How existing practices and systems shape integration projects in health care

ARTICLE 2

INTEGRATION AS ESCALATION OF COMPLEXITY

ARTICLE 3

The Role of Integration in Health – Based Infrastructures

ARTICLE 4

Users as Heterogeneous Engineers -

The Challenge of Designing Sustainable Information Systems in Health Care

Declarations describing the independent research contribution of the candidate

Required enclosure when requesting that a thesis be considered for a doctoral degree

Declaration describing the independent research contribution of the candidate

In addition to the thesis, there should for each article constituting the thesis be enclosed a declaration describing the independent research contribution of the candidate (problem formulation, method, data collection, analysis, interpretation, writing etc.)

For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 1
Authors: Kristoffer Røed
Title: "Slow organizations and fast technologies" How existing practices and systems shape integration projects in health care

---

The independent contribution of the candidate:

In this article, I managed the whole process of problem formulation, theory, the selection of method, carried out the data collection, and conducted the analysis and interpretation of the article as well as performing the writing process.

Kristoffer Røed Signature of the candidate Name (bold letters): Kristoffer Røed	Kristoffer Røed Signature of co-author 1 Name (bold letters): Kristoffer Røed
Any Comments:	.... Signature of co-author 2 Name (bold letters):
	.... Signature of co-author 3 Name (bold letters):
	.... Signature of co-author 4 Name (bold letters):

Required enclosure when requesting that a thesis be considered for a doctoral degree

Declaration describing the independent research contribution of the candidate

In addition to the thesis, there should for each article constituting the thesis be enclosed a declaration describing the independent research contribution of the candidate (problem formulation, method, data collection, analysis, interpretation, writing etc.)

For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 2
Authors: Kristoffer Røed, Eric Monteiro and Gunnar Ellingsen
Title: Integration as Escalation of Complexity

The independent contribution of the candidate:

In this article, I coordinated the process of problem formulation, theory, the selection of method, carried out the data collection, and conducted the analysis and interpretation of the article as well as performing the writing process.

The second and third author took part in discussions with me on how to frame the paper theoretically. They also provided suggestions on which analytical points to focus on.

All authors read and approved the final version of the article.

Kristoffer Røed .... Signature of the candidate Name (bold letters): Kristoffer Røed	Kristoffer Røed .... Signature of co-author 1 Name (bold letters): Kristoffer Røed
Any Comments:	Eric Monteiro .... Signature of co-author 2 Name (bold letters): Eric Monteiro
	Gunnar Ellingsen .... Signature of co-author 3 Name (bold letters): Gunnar Ellingsen
	.... Signature of co-author 4 Name (bold letters):

Required enclosure when requesting that a thesis be considered for a doctoral degree

Declaration describing the independent research contribution of the candidate

In addition to the thesis, there should for each article constituting the thesis be enclosed a declaration describing the independent research contribution of the candidate (problem formulation, method, data collection, analysis, interpretation, writing etc.)

For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 3
Authors: Gunnar Ellingsen and Kristoffer Røed
Title: The Role of Integration in Health-Based Information Infrastructures

---

The independent contribution of the candidate:

The writing of this article was conducted in collaboration with my supervisor (the first author). The first author undertook slightly more responsibility of the interpretation and writing of the paper.

Still, I took fully part of problem formulation, theory, the selection of method. I carried out most the data collection, and took part of the analysis and interpretation of the article as well as took considerable part in the writing process.

Both authors read and approved the final version of the article.

Kristoffer Røed .... Signature of the candidate Name (bold letters): Kristoffer Røed	.... Signature of co-author 1 Name (bold letters): Gunnar Ellingsen
Any Comments:	Kristoffer Røed .... Signature of co-author 2 Name (bold letters): Kristoffer Røed
	.... Signature of co-author 3 Name (bold letters):
	.... Signature of co-author 4 Name (bold letters):

Required enclosure when requesting that a thesis be considered for a doctoral degree

Declaration describing the independent research contribution of the candidate

In addition to the thesis, there should for each article constituting the thesis be enclosed a declaration describing the independent research contribution of the candidate (problem formulation, method, data collection, analysis, interpretation, writing etc.)

For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 4
Authors: Kristoffer Røed and Gunnar Ellingsen
Title: Users as Heterogeneous Engineers - The Challenge of Designing Sustainable Information Systems in Health Care

---

The independent contribution of the candidate:

In this article, I coordinated the process of problem formulation, theory, the selection of method, carried out the data collection, and conducted the analysis and interpretation of the article as well as performing the writing process.

The second author took part in discussions with me on how to frame the paper theoretically and contributed with some writing.

Both authors read and approved the final version of the article.

Kristoffer Røed .... Signature of the candidate Name (bold letters): Kristoffer Røed	Kristoffer Røed .... Signature of co-author 1 Name (bold letters): Kristoffer Røed
Any Comments:	Gunnar Ellingsen .... Signature of co-author 2 Name (bold letters): Gunnar Ellingsen
	.... Signature of co-author 3 Name (bold letters):
	.... Signature of co-author 4 Name (bold letters):

ISBN xxx-xx-xxxx-xxx-x