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Lightweight methods, heavyweight organisations.

Transforming a small tailored product to a large integrated healthcare information system

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ABSTRACT

This thesis aims to provide some detailed empirical insights as well as expand on conceptual perspectives of processes related to expanding small local information systems (IS) into large scale integrated IS. The empirical insights were drawn from the case of developing a product named Interactor which is a system that makes it possible for GPs to order laboratory services from the hospital. This thesis includes six papers published or submitted to conference proceedings and peer-reviewed journals. The following research questions have been addressed:

1. How do the making and scaling of large scale integrated information systems in public healthcare play out in practice?
2. What is the nature of a large-scale integrated IS in terms of use and change flexibility within the information system itself?
3. Who is involved in the making and scaling of a large scale information system, and what are the roles, motivations and strategies of these actors?
4. What strategies can vendors apply when attempting to take a local tailored product into a larger market?

The contribution of this thesis is related to empirical insights, expansion of theoretical concepts and methodological reflections. The empirical material demonstrated how the making and scaling of such a large scale integrated IS in public healthcare in different phases were a process of evolution and large steps. The first phase was characterised by a small step and iterative approach with users participating actively in the development process and according to the users immediate needs. The second phase was characterised by a large procurement process where the regional healthcare authority wanted to buy a system for laboratory ordering. The Interactor product was chosen and further development and implementation was done in large steps based on a detailed tender specification. In the transition from evolution to large steps the conditions for development changed dramatically. For instance the vendor lost full control of the product, the cooperation between users and vendor changed, and the cooperation between the vendor and vendors of integrated products also changed.

The empirical details also contribute to the understanding of the user groups, vendors and public authorities involved, and roles, strategies, motivations and relations of these actors. The making and scaling of such large scale IS is not just the result of a technological momentum, it takes work and negotiations among the human actors involved. This thesis have categorised these actors into users, vendors and public healthcare authorities, each with a set of motivations and strategies. However the roles were blurry and changing. For vendors the process of taking a product from a local setting and into a larger market requires work and strategies.

The basic theoretical approach for this thesis is drawn from literature on IS and information infrastructure which incorporates the complex, heterogeneous and integrational aspects of the healthcare domain. The Interactor product can be conceptualised as such an information infrastructure. By introducing the concept of generativity this thesis seeks to contribute to the theoretical discussions on flexibility of information infrastructures. While the existing literature mostly suggests technical solutions to this challenge, the generativity concept directs us towards a socio-technical understanding of flexibility that includes both use and change flexibility. The

Interactor case suggests that in a highly integrated environment generativity in the system itself is not enough, the systems to be integrated with also needs to be generative. Further, generativity is not purely a technical issue about the possibility of making changes; it is often an issue about willingness to change. The downside of generativity is the possibility for hostile access and changes, thus a high degree of generativity in healthcare IS is not always desirable. The thesis also contributes to the information infrastructure theory by suggesting to expand on the concept of infrastructuring. Firstly, infrastructuring has been portrayed as work done by end users, however this thesis argues that also ICT staffs are users of IS and their work to change the system is also infrastructuring. Secondly, infrastructuring implicates a co-constructed view of design which also encompasses the design of work practices. Infrastructuring from the vendor's perspective can be conceptualised as a process of generification, i.e. strategies to take a tailored product made for one customer into a larger market. In the Interactor case this included aligning users, making the parts of the software tailorable and developing strategies towards the vendors of systems to integrate with. In addition the vendor had to manoeuvre in the market.

This thesis adheres to an interpretive research approach. Empirical data was primarily collected through participant observation, interviews and document studies during the period from December 2007 to June 2011. The data analysis is based on a hermeneutic approach which underscores the interdependability between the issue to be interpreted, preconceptions and context, where the different sources of field data are all taken into consideration. The method includes detailed case write-ups. Methodologically this thesis contributes with some insights of being an insider related to how joint research can be conducted to both enhance research quality and to increase the contribution of the research to the company.

FOREWORD

One of the first theories that I was introduced to in my PhD-project was Actor Network Theory (ANT) and this theory has been in my back bone ever since, inspiring and guiding my research. ANT is about how things come into being as a result of ongoing negotiations between human and non-human actors. In retrospect I can see my whole PhD-process as an actor network consisting of: The thesis and my papers, my computer which is my writing and storing device for all kinds of information, the internet for digging up knowledge, theory courses, journals proving obligatory passage points with their publishing opportunities, colleagues at DIPS that have been both a source of data and source for social relaxation, friends and family that kept me busy and trained my social competence, my employer DIPS, my fellow PhD students Eli, Torbjørg, Rune, Monika and Kristoffer who have provided social support and inspiring discussions, my supervisors Gunnar who really pushed me to a kick start and Deede with her intriguing questions, my co-authors Gunnar, Deede, Eli, Ann Therese and Aud whose contributions were decisive for the actual content of my PhD, and my DIPS colleague Martin who has tediously gone through the whole thesis searching for spelling and formatting mistakes. All these heterogeneous actors with their different agencies and motivations contributed to a process which hasn't been straightforward or predictable, but rather a process of constant translations, negotiations, change of directions and alignment of interests. Thank you all for making it possible to finally make this PhD-actor network stable.

Being a PhD-student is often described as a lifestyle, but in my PhD-life my thesis has most of the time felt like a minor occupation. My main occupation has as always been the daily family-life with all the practicalities that involves. During the PhD-project the family got the opportunity to stay in Barcelona for half a year. This stay was a challenging, but most of all, a memorable experience for the whole family: Thanks to TTL for financing the stay. Someone once said to me that having children must be good for your mental wellbeing, because children are good at getting your attention away from work and secure that you keep contact with the ground. Seen from a PhD point of view having children seldom allows you to elaborate on theories, research questions and data gathering in your spare time: Thank you Idunn and Henning for being exactly *you* and always remind me of the important things in life. Finally, I think we all need companionship and support from someone that are particularly close: Thank you my dearest Harald for being there for me, sharing tasks as well as thoughts, and always expressing faith in me and my project.

ABBREVIATIONS

Ahus: University Hospital of Akershus

ANT: Actor Network Theory

CSCW: Computer Supported Cooperative Work

EPR: Electronic Patient Record

GP: General Practitioner

II: Information Infrastructure(s)

IS: Information System(s)

PD: Participatory Design

UNN: University Hospital of North Norway

Well: Well Diagnostics

PAPERS

Johannessen LK and Ellingsen G. Lightweight methods in heavyweight organizations. Proceedings of Participatory Design Conference 2008. Bloomington, Indiana: 11-20[1].

Johannessen LK and Ellingsen G. Integration and Generification—Agile Software Development in the Healthcare Market. Computer Supported Cooperative Work (CSCW), Volume 18, Numbers 5-6 / December, 2009: 607-634.

Johannessen LK and Gammon D. Pilot Users and Developers in Agile Development Processes: Mutual Configuration and Motivation. Health Technol Inform. 2010;157:47-52.

Johannessen LK, Ellingsen G and Gammon D. Users as designers of information infrastructures and the role of generativity, accepted, AIS Transactions on Human-Computer Interaction

Johannessen LK and Larsen E. Top-down or bottom-up? Building information systems for healthcare, Submitted to Scandinavian Journal of Information Systems

Johannessen LK, Obstfelder A and Lotherington AT. Scaling of an information system in a public healthcare market – infrastructuring and generification, submitted to Special issue International Journal Medical Informatics (IJMI): Infrastructures in Healthcare: Global Health

[1] This paper is further developed into the following paper: Johannessen, LK and Ellingsen, G. "Lightweight Design Methods in Integrated Practices", accepted for publication in "Design Issues"

CONTENT

1 INTRODUCTION

1.1 PROBLEM SETTING AND MOTIVATION

The theme of this thesis is the making and scaling of information systems (IS). The establishment of large scale and integrated healthcare IS is a contemporary issue in Norwegian healthcare today with the national systems for ePrescription and core health records as the most recent examples (NDH 2008). These are both examples of projects initiated and run by national healthcare authorities that are planned and established on a large scale from the start. But there are examples of another approach where IS start out on a local scale, tailored to the local needs, and then scaled into a larger system with broader scope and more users. The case that will be presented in this thesis is an example of the latter. The thesis will describe the process of making and scaling such a system and research the roles, relations and strategies of those involved in the process. In particular the thesis will take the perspective of the vendors of such system.

1.1.1 MAKING AND SCALING OF INFORMATION SYSTEMS

IS are socio-technical systems that include software, hardware, data, people, and work processes (Berg 1999). IS could be seen as a special case of technological systems as defined by Hughes (1989) consisting of different types of components: Physical artefacts, organizations (firms etc.), scientific components (books, articles, and research programs), legislative artefacts and natural resources. These components are closely related and change in one component will result in change in other components accordingly. Hughes (2000) claims that the making and changing of technological systems is a process where technology and society shape each other, but where technology with time (as it gains momentum) is less shaped by, and more a shaper of its environment. The making and scaling of such a technological system, that started out as a small scale product and was to be transformed into a larger system, could be seen as a process of innovation and diffusion of the innovation. Innovation is the making of a new artefact or a new service, and includes the reinvention or adaption to another context or location (Hartley 2005), while the diffusion could be viewed as the spread of an innovation within a social system and where the spread denotes flow or movements from a source to an adopter (Wejnert 2002).

The drivers of innovation in public healthcare IS are to achieve improvements in public healthcare services performance, including efficiencies, in order to increase public value (Hartley 2005). Norwegian healthcare authorities pursue coordinated implementation and national governance of healthcare IS (NDH 2008). The building making and scaling of healthcare IS are supposed to be done in close collaboration with the vendors of the technical components, but the Norwegian healthcare authorities view this as a challenging mission for both parties:

> "*Most requirements for changes or new functionalities must be directed to the vendors. The Norwegian market is limited and the pressure on the vendors to deliver updates is significant. The vendors are often viewed as a bottleneck in this situation. The vendor industry has varying expertise on the needs and complexity of the sector. The sector on the other hand, can gain much on better ordering skills and better requirement descriptions*" (NDH 2008).

The technological components of healthcare IS are often delivered by vendors either as tailored or packaged software (Pollock 2010). From the vendor's perspective innovation and diffusion or scaling is primarily by competitive advantage (Hartley 2005) and hence capturing a larger part of a market. When an IS starts up as a small local product tailored to a few customers, selling the product to more customers is a possibility for the vendor to increase the payback for the product. In the transition from local healthcare IS to a packaged solution for a larger market the vendor needs to make decisions on issues related to the scope of the product as well as to market issues. This might seem like a straightforward process at first, but as described by Akrich et al. (2002a), making the right decisions is not an easy task for the vendors:

> "*There's no need to complicate matters: if an innovation succeeds, it is because it satisfies a demand, whether of a factory manager, a supermarket customer or an aeroplane manufacturer. The price matters little: follow the market, follow the users and you will win. As we will see, such a suggestion is true, banally so, but of little use. Easier said than done! How to identify the users, how to follow a market when you are setting up an innovation which runs counter to existing markets? By undertaking market research? By listening to the customer? Once again, no single technique can claim to guarantee that a decision is correct*" (ibid).

1.1.2 THE INTERACTOR CASE

The case in this thesis deals with the process of taking a small tailored healthcare IS into a larger market. It describes the establishment and growth of a product called Interactor and those who built it. The system makes it possible for general practitioners (GP) to choose and order laboratory services on their computer and send them electronically to the hospital. The development process started in 2006 when the University Hospital of North Norway (UNN) and the vendor Well Diagnostics (Well) established a two year collaboration project aimed at developing a system that would enable GPs to send laboratory orders electronically to UNN's laboratories. This was based in UNN's experience of high error rates and double work load with paper-based orders from primary care, and their anticipation that electronic laboratory orders would improve the situation. The project received financial support from Innovation Norway. The system was developed, integrated and implemented in a stepwise way using agile development methods. Representatives for the end users in UNN and general practice had an active role and were involved in all steps of the development process putting large amounts of work and effort into it. The system integrates the laboratory ordering process in general practices with the order receiving and analysis process in the hospital laboratory. This implicates an integration of autonomous organizations as well as the people working in these organizations. A fundamental idea for its architecture has been to utilize as much of the existing infrastructure in general practice, in the hospital and nationally as possible, and integrate Interactor to these systems as tightly as possible. In general practice an Interactor component is bundled with the GP's electronic patient record (EPR) system. The system uses the national healthcare network for sending orders and it uses the national standards for laboratory orders. The sample tubes are sent using regular mail service or a delivery service to the hospital laboratory. Here, the bar code is scanned and information from the order is transferred directly onto the laboratory IS.The tight integration with systems in general practice and in the laboratories made it necessary to include the vendors of these systems in the project. After the project phase the system became a

commercial product taken by Well into the market and the system was sold to nine hospitals and used by 60 GP offices in the Northern and South-Eastern parts of Norway, and for a long time it was the only such system in the Norwegian market.

The establishment project was a success seen from both the vendors' and the hospitals' point of view. Therefore the demand for the system increased and the vendor and the regional healthcare authorities decided to expand the system to more hospitals and GPs. The regional healthcare authorities initiated large procurement processes. Due to these processes further deployment of the system was stopped for one and a half year. International tender competitions were launched and detailed pre-specifications were made for a system for electronic laboratory orders. The vendor of Interactor participated in these competitions, and won in the northern healthcare region, but lost in the south-eastern region.

1.2 AIMS AND RESEARCH QUESTIONS

The making and scaling of an integrated IS is a process that takes time and involves many phases; hence such research requires large timescales. Pollock and Williams (2010) therefore urge for research approaches that encompass both the short-term dynamics of selection, implementation and embedding components, and the longer-term evolution of work practices and technologies. Following the different phases of the establishment and further scaling of the Interactor product into becoming part of a larger integrated IS, the main aim of this thesis is to provide detailed empirical insight as well as to expand on conceptual perspectives of processes related to expanding small local IS into large scale integrated IS.

The discussion above about market and public services represents a macro perspective on the making and scaling of healthcare IS. The micro perspective on making and scaling deals with changing of the technological components and, as the short description of the Interactor case above indicated, the use and work practices of the users. A different angle of approach is to look at the nature of an IS related to making and scaling process. Hughes (1989) suggests that technological systems evolve in small steps through different phases that overlap and backtrack. Recent examples in Norwegian healthcare, for instance the E-prescription project (Larsen and Ellingsen 2010), show a different approach where comprehensive new IS has been made and introduced to large user groups in large step processes. These different perspectives combined with the unpredictability of such processes (Akrich et al. 2002a) indicate that these are complex processes, which this thesis will explore further in light of the scaling process of Interactor. This leads to the first research question: How do the making and scaling of large scale integrated information systems in public healthcare play out in practice?

The changing and scaling of a system requires change flexibility, and many technological solutions have been proposed (Hanseth and Lyytinen 2004; Yoo 2010). Star and Bowker (2002) argue that making and changing IS requires a modifiable infrastructure on an individual and social level. These arguments indicate that there are both technical and social characteristics of the technology itself determining the possibility for making changes to an IS. This leads up to the second research question: What is the nature of a large-scale integrated IS in terms of use and change flexibility within the information system itself?

Technological systems are socially constructed artefacts because they are built by system builders. These builders may be different people that take on different responsibilities (Hughes 1989). The builders of large scale integrated IS may be categorised in many ways. Hughes (ibid) used the different phases of the evolution process to make distinctions between the builders: Inventors, manufacturers, managers etc. However this distinction only focuses on the vendor roles in an IS. Another way to categorise the actors are into demand and supply side in the IS (Hanseth and Lyytinen 2004). But this would only be an artificial or analytical distinction as the builders may have multiple roles: Suppliers can supply parts of the IS while they are users of other parts of the same IS. The same can be said about healthcare authorities: They may supply standards and physical infrastructures, but be users of other components. A call for more research that follows the actors of the making and scaling process, and that explicitly analyses the role, influences and actions of these has been launched (Nielsen 2006). In line with this the third research question is: Who is involved in the making and scaling of a large scale information system, and what are the roles, motivations and strategies of these actors?

Given this scaling process and the identified actors, we finally return to the vendors' perspective and inquire more into how the vendor manage the process of going from a small tailored product to a large scale integrated system. I therefore ask the fourth research question: What strategies can vendors apply when attempting to take a local tailored product into a larger market?

Main aim	To provide detailed empirical insight as well as expand on conceptual perspectives of processes related to expanding small local information systems into large scale integrated information systems.
Research question 1	How do the making and scaling of large scale integrated information systems in public healthcare play out in practice?
Research question 2	What is the nature of a large-scale integrated IS in terms of use and change flexibility within the information system itself?
Research question 3	Who is involved in the making and scaling of a large scale information system, and what are the roles, motivations and strategies of these actors?
Research question 4	What strategies can vendors apply when attempting to take a local tailored product into a larger market?

TABLE 1 MAIN AIM AND RESEARCH QUESTIONS

1.3 RESULTS

This thesis includes six papers published or submitted to conference proceedings and peer-reviewed journals. All papers contribute empirical and theoretical insights to the main aim of the paper. The papers and their relation to the research questions are listed below in *Table 2 Papers and research questions*. The colouring of the cells indicates to which degree the different papers answer the research questions of this thesis. Dark grey indicates full match between paper and research question, grey means partial match and white means no match between paper and research question.

Paper	RQ1	RQ2	RQ3	RQ4
Lightweight methods in heavyweight organizations				
Integration and Generification—Agile Software Development in the Healthcare Market				
Pilot Users and Developers in Agile Development Processes: Mutual Configuration and Motivation				
Users as designers of information infrastructures and the role of generativity				
Top-down or bottom-up? Building information systems for healthcare				
Scaling of an information system in a public healthcare market – infrastructuring and generification				

TABLE 2 PAPERS AND RESEARCH QUESTIONS

1.4 OVERVIEW OF THEORETICAL PERSPECTIVE

The basic theoretical approach for this thesis is drawn from literature on IS, and in particular on information infrastructure (II). This is complemented by theory from Actor Network Theory (ANT), and literature from the Participatory Design (PD) and Computer Supported Collaborative Work (CSCW) fields, Cyber Law and social sciences. This section will outline how the different theoretical perspectives gives insight to my research, but also the deficiencies of the literature and how this thesis can contribute to fill this gap.

1.4.1 HEALTHCARE IS CONCEPTUALIZED AS INFORMATION INFRASTRUCTURES

IS for healthcare of today, following the general IS trend, show an increase in the scope and complexity of the systems: "*In many 'IS' projects today, it is difficult to differentiate the system from the other aspects of an IT-based business intervention, such as process redesign, physical layouts of the workplace, changes in job design and compensation, or development of IT infrastructure*" (Markus and Mao 2004). This means that healthcare IS are increasingly part of an integrated portfolio of systems supporting many different cross-organizational practices in hospitals, general practice and healthcare authorities, and thus have a heterogeneous array of users. The notion of II has been used as a framework for analysing such large-scale systems. II are heterogeneous networks consisting of a wide range of physical artefacts, information, software, standards and people. An II shapes and is shaped by work practices, and an infrastructure can be said to exist when local practices are enabled by larger scale technology (Star and Ruhleder 1995). Small scale and local IS come into contact with others systems through standards and become part of larger II (Pollock 2010). In this sense the Interactor product integrating technical systems and heterogeneous work practices can be viewed as a component or part of an II already from the establishment.

I have chosen to use the II framework because it focuses on relevant relational aspects: Users - contexts relations, micro - macro aspects, present – past relations. Much research on II is influenced by ANT. ANT is a critical sociological approach for studying how actors, relations, knowledge and reality come into existence through networks of relations between heterogeneous materials. As a backdrop to II the ANT framework offers a vocabulary to describe how, where and to which extent technology influences human behaviour.

1.4.2 *MAKING AND SCALING OF INFORMATION INFRASTRUCTURES*

II is always in the process of design and have an evolving nature (Star and Ruhleder 1995). The verb 'to infrastructure' (Star and Bowker 2002) denotes the activities and processes of integrating materials, tools, methods and practices that make up and change an infrastructure. These processes are incremental, iterative and long term (Karasti et al. 2010). This implies that II will never evolve from scratch and new components or changes will always have to be integrated into existing systems or work practices (Hanseth and Braa 2000). Openness and heterogeneity of use are in many cases viewed as an asset that enhance growth (Zittrain 2006) and evolution. However it is not always an aim to encourage new and different local practices and open growth for other IS, like for instance healthcare IS. Rather, these systems or parts of them are often a result of a few actors that are able to make substantial changes to them (Nielsen 2006) and hence deviating from the evolutionary understanding. This implicates that making and scaling of II could be both small-step evolution, and large-step approaches, or the combination of these. The studies of large step approaches have been limited. Nielsen (2006) studied the making of a system for mobile content in a private market. A public healthcare IS does not operate in a free and open market, and healthcare authorities are major players in this market, hence an investigation of the nature of making and scaling of such IS is appropriate.

Changing a system requires change flexibility, and technological solutions have been suggested (Hanseth and Nielsen). Star and Bowker (2002) argue that making and changing infrastructures require a modifiable infrastructure on an individual and social level, hence indicating that there are both technical and social characteristics of the technology itself determining the possibility for making changes to an IS. II theory lacks a good framework for assessing the flexibility for making changes and adding components to an IS. In this respect the concept of generativity seems promising, offering a framework for assessing both technical and social characteristics related to the possibility for flexibility. The term generativity can be understood as the ability to create something in a system, and depends on both technical design and social behaviour, and where the degree of generativity characterizes a technology's capacity to produce unanticipated change: "*Generativity denotes a technology's overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences*" (Zittrain 2006). A generative system has characteristics related to how it leverages tasks, ease of adoption and adaption, accessibility and transferability.

1.4.3 *THE BUILDERS OF LARGE SCALE HEALTHCARE INFORMATION SYSTEMS*

One of the major critics of ANT is how it treats humans and non-humans in the same way and the lack of interest in the characteristics of the actors and how the different actors are enrolled in the in the network (Amsterdamska 1990). As much of the II literature is based on ANT it has also inherited these weaknesses. II research has in practice positioned itself close to technological determinism, portraying technology as autonomous and leaving developers simply with the ability to cultivate (Nielsen 2006). The relational definition of II as coined by Star and Ruhleder (1995) and the infrastructuring concept (Karasti and Syrjänen 2004) however give the users a central role in the making and scaling of II. The verb 'to infrastructure' (Star and Bowker 2002) denotes the activities and processes of integrating materials, tools, methods and practices that make up and change an

infrastructure. These processes are incremental, iterative and long term processes (Karasti et al. 2010). The focusing on infrastructuring makes it natural to discuss the users' role in the making and scaling of II more thoroughly. Despite much research on the user role in systems development, the user role is still viewed as quite blurry (Millerand and Baker 2010). To complement the II literature, this thesis has used insights from the research fields of PD and IS, in addition to more general literature on motivation, to study the user notion and roles, user contribution in development processes and factors that foster motivation for users to participate in the making and scaling of IS.

Infrastructuring is portrayed as the appropriation, use and changes made by the end users and thereby ignore the contribution of other actors and users. For vendors large scale IS are markets in which they can sell their product (Hanseth and Lyytinen 2004), and infrastructuring from the perspective of the vendor is often about how a system, carefully designed for one local context, can be moved to new users and new contexts. The notion of generification is "*the supplier's strategy of taking a technology that have worked in one place and attempting to make it work 'everywhere' "* (Pollock and Williams 2008). I find this concept useful to expand the infrastructuring concept with the vendors' perspective. Closely related to the generification strategy is also the vendor's strategies related to development methodology. An evolutionary approach to making and scaling of II requires an iterative and incremental development process. Iterative and incremental development approaches are named Agile (Beck 2000) and these are in-bureaucratic and receptive of changes in the environment. In an agile approach customer contribution is seen as very important for obtaining good functionality; however the methodology does not give any clues on how to involve the end users in the development. The research field of PD might give some insights to vendors with its long tradition to maintain and increase user participation (Bjerknes and Bratteteig 1995) and the tools and techniques that have been developed.

Infrastructuring from the healthcare authorities' perspective can be a multitude of activities: Establishing legislation, managing large projects, establishing standards and classifications, and purchasing technology produced by private companies. Public healthcare authorities strive to manage the large healthcare II, and they attempt to do this through better planning and control (see for instance Broadbent and Weill (1997)). To better understand the healthcare authorities' strategies as actors in the making of healthcare II I have used insights from social sciences describing the political philosophy in Western states today as neo-liberal (Dean 1999). This is an indirect form of governing with free and autonomous individuals and organizations and a strong private sector with only limited interference by the state in society. The consequences of this governance approach are that governments give away substantial traditional power, authority and control, but the price to pay for this is an increased demand for documentation and reporting.

1.5 EXPECTED CONTRIBUTIONS TO THE IS FIELD

Theoretically this thesis draws on, but also contributes to the IS field in general and the II field in particular. By analysing the empirical findings from a real-life process, this thesis seeks to contribute with some empirical insight as well as expand on some conceptual views to better understand the making and scaling of large scale IS and those who have been involved in this process.

By using a biography (Pollock 2010) inspired approach this thesis will contribute with some empirical insights of how the making and scaling of large scale integrated IS in public healthcare was both

evolving and a large steps process in different phases. In the transition from evolution to large steps the conditions for development changed dramatically. For instance the vendor lost full control of the product, the cooperation between users and vendor changed, and the cooperation between vendor and other vendors also changed. The empirical details also contribute to the understanding of the user groups, vendors and public authorities involved, and roles, strategies, motivations and relations of these actors.

By introducing the concept of generativity (Zittrain 2006) this thesis seeks to contribute to the theoretical discussions on flexibility of II. While the existing literature mostly suggests technical solutions to this challenge, the generativity concept directs us towards a socio-technical understanding of flexibility that includes both use and change flexibility. The Interactor case suggests that in a highly integrated environment like II, generativity in the system itself is not enough, also the installed base, i.e. the systems to be integrated with, needs to be generative. Further, generativity is not purely a technical issue about the possibility of makeing changes; it is often an issue about the willingness to change. The downside of generativity is the potential for access and changes made by hostile (or just unlucky) actors jeopardising the security of the system, thus a high degree of generativity in healthcare II is not always desirable. The thesis also contributes to the II theory by suggesting to expand on the concept of infrastructuring. Firstly, infrastructuring have been portrayed as work done by end users, however this thesis demonstrates that also ICT staff are users of II and their work to change the system is also infrastructuring. Secondly, infrastructuring implicates a co-constructed view of design which also encompasses the design of work practices. Infrastructuring from the vendor's perspective can be conceptualised as a process of generification, i.e. strategies to take a tailored product made for one customer into a larger market. In the Interactor case this included aligning users, making the parts of the software tailorable and developing strategies towards the vendors of systems to integrate with. In addition the vendor had to manoeuvre in the market.

Methodologically this thesis contributes with some insights of being an insider related to how joint research can be conducted to both enhance research quality and to increase the contribution of the research to the company.

In addition to the contribution to the IS and II fields, this thesis also seeks to contribute to the research fields of PD and CSCW. Although the research on users and user participation in development projects has given rich insights there are some clear limitations. There has been a recurrent tendency in both the PD and CSCW community to report on small-scale experimental projects, and participation in commercial product development has had little focus (Kensing and Blomberg 1998; Oostveen and van den Besselar 2004; Schmidt and Bannon 1992). To these fields the thesis will give insights about the challenges of implementing large-scale II for health care related to user participation, and vendor and authority strategies.

1.6 THE EMPIRICAL BASIS AND METHODS FOR ANALYSIS

This thesis adheres to an interpretive research approach (Klein and Myers 1999; Walsham 1995). Empirical data was primarily collected through participant observation, interviews and document studies during the period from December 2007 to June 2011. The data analysis is based on a hermeneutic approach which underscores the interdependability between the issue to be

interpreted, preconceptions and context, where the different sources of field data are all taken into consideration. The method includes detailed case write-ups.

1.7 FURTHER ORGANIZATION OF THIS THESIS

The rest of the thesis is organized as follows: Chapter 2 describes the theoretical perspectives. This is followed by an overview of philosophy of science and methodological approaches in chapter 3. The case presented as the biography of Interactor is in chapter 4. However the details of the case are to be found in the different papers (appendixes 1-6). A summary of each paper and findings are included in chapter 5. Chapter 6 elaborates on implications and in chapter 7 concluding remarks, contribution and future research direction are presented.

2 THEORY AND RELATED RESEARCH

This thesis is about the making and scaling of large scale healthcare information systems (IS). In particular it deals with how small local IS may be expanded into large scale integrated systems, and about those who take part in these transformation processes. This section discusses the theoretical inspirations and approaches which are used as a lens (Gregor 2006) to view these complex processes. Large scale integrated IS that are deeply embedded in work practices may be conceptualized as information infrastructures (II) (Bowker and Star 1999; Hanseth and Lyytinen 2004). II have been the overarching theoretical approach in my papers, and is also used to frame this thesis. This theory section will give an overview on II theory and research and other related or relevant theory that can complement the II theory. However, I will start by discussing Actor Network Theory (ANT) which is another lens that can be used to understand such systems and which has served as an underlying inspiration for the research in this PhD-project, and also for much of the theory on II.

2.1 INSPIRATION FROM ACTOR NETWORK THEORY AND PERFORMATIVITY

In this study of the making and scaling of large scale healthcare IS the technical artefact, as well as those participating in the development process, are in focus. In a healthcare setting information technology is deeply entangled with other tools, routines, documents and people which together make up the healthcare practices (Berg 1999). These elements of the practice are not discrete and easily delineated and the studies of such practices should reflect that:

> "*One should not attempt to pry it apart in a 'social' and a 'technical' system. 'Technology' and 'organization' do not occupy separate domains or operate according to separate logics; nor does their relationship develop in some unilinear way (the former 'causing change' in the latter or vice versa)*" (ibid).

Yet, in studies of development and use this separation of the technical artefact and the organization has been evident. One example is the techno-centric perspective which assumes technology to be exogenous, predictable and stable, and which indicates deterministic relationships between technology and organisation. In the opposite perspective, the human centred view, the technology vanishes from the social processes. To better comply with the heterogeneous nature of healthcare organisations and practices there is a need for a perspective that relates the material and the social in a better way (Orlikowski 2010). One such perspective is ANT:

> *"These concepts [among them ANT] challenge and transcend conventional distinctions between the social and the material. What is particularly valuable about such developments is their insistence on speaking of the social and the material in the same register, and of not reverting to a limiting dualism that treats them as separate (even if interacting) phenomena*" (ibid).

ANT is a critical sociological approach (Latour 2005) originating from the interdisciplinary field of Science and Technology Studies, which is based on the observation that social sciences have ignored the issues on how science is actually carried out and technical artefacts are actually shaped. ANT studies how actors, relations, knowledge and reality come into existence through networks of relations between heterogeneous materials, and it offers a framework and a vocabulary to describe how, where and to which extent technology influences human behaviour. In this thesis and the papers ANT has served as an inspiration and a way of thinking about how the system for electronic laboratory orders came into being, and about the actors that have been involved throughout the

process. The flexibility of ANT has been useful because it has allowed me to zoom in and out on the case:

> "*Sometimes a comprehensive set of interconnected modules and systems is collapsed into one node, sometimes you want to focus on the relative contribution of each of the modules and sometimes you want to dig into the design and details of one, specific module. This kind of flexibility is indispensable in any analysis of information infrastructure*" (Monteiro 2000).

2.1.1 THE MAKING OF AN IS: AN ACTOR-NETWORK PROCESS OF TRANSLATION

IS are made up of artefacts, routines, people and standards. In an ANT vocabulary this would be conceptualised as actors tied together in heterogeneous dynamic networks. An actor is anything that modifies a state of affairs by making a difference (Latour 2005). This 'anything' could be both human and non-human, each with a set of characteristics such as goals, interests, identities and scripts. This means that in an IS the technology is also an actor if it is capable of changing things such that it makes a difference.

The building process of an IS is made up of relations and actions (Latour 2005). For such a process to start and for changes to be made an actor needs to enrol other actors by capturing their interest and to make them see that they have a common interest (Latour 1983). Changing the system can be described as translations, which in ANT terms means both to displace or move, and to interpret. The different actors may interpret things differently and hence what they do with it will differ. Translations lead to changes such as a relation or action that did not exist before, and that make a difference to the actors:

> "*The notion of translation emphasizes the continuity of the displacements and transformations which occur in this story: displacements of goals and interests, and also, displacements of human beings, devices,..[..] Because of a series of unpredictable displacements, all the processes can be described as a translation which leads all the actors concerned as a result of various metamorphoses and transformations...*" (Callon 1999).

However, in the building process the enrolment of other actors into the process is not necessarily straightforward. Actors may have diverse interests, and their ability to translate these interests through negotiations and align them with the network will determine if the network will stabilize. Negotiations takes place between all types of actors and will continue until the system has reached a state of stability. Still the outcome of the making and scaling process is uncertain:

> "*Since the outcome of a project depends on the alliances which it allows for and the interests which it mobilises, no criteria, no algorithm, can ensure success a priori. Rather than speak of the rationality of decisions, we need to speak of the aggregation of interests which decisions are capable or incapable of producing. Innovation is the art of interesting an increasing number of allies who will make you stronger and stronger*" (Akrich et al. 2002b).

Healthcare practices are about how healthcare workers use technology. This use is to a variable extent being influenced of the inscribed properties of the artefact, i.e. how anticipated patterns of use are embodied in an artefact through design (Latour 1991). This does not mean that users are not allowed to use the technology completely as they like, but it somehow urges them to use it in a particular way. But an artefact is not static and appropriated as is; it is changed in the use situation: "*To adopt an innovation is to adapt it*" (Akrich et al. 2002b), hence the use and the change of the technology is closely related, and this is a process that has an unpredictable outcome.

2.1.2 PERFORMATIVE AND MULTIPLE NETWORKS

The uncertainty of making and scaling of IS can be further analysed using the concepts of performativity and multiplicity. Performativity (sometimes the word enactment is used) of building an IS means that the different parts are performed in, by, and through the relations in which they are located, for instance roles and power of the actors is not a given; it is performed or enacted: "*What each actor does also depends on its co-actors, on whether they allow it to act and on what they allow it to do, on rules and regulations. But this is not to say that an actor-enacted is determined by its surroundings. It has its own stubbornness and specificities: it is full of surprises*" (Law and Mol 2008). Enactment means that both actors and processes are done. But this is a process full of tensions that need to be handled (Mol and Law 2004). The notions of performativity or enactment have been used to describe a wide range of phenomena. One example is social scientific models in general, and how these are not just descriptions of a phenomenon or guiding principles of what can be done but how they actually make changes to the phenomenon they describe: "*The idea that they don't just represent reality out there; but that they are also performative*" (Law 2010). Technology is designed based on some expectations, however it may be used in unexpected ways and this may again change the expectations towards the technology and in this way the technology and the expectations have a performative relation.

An IS as described in a research project may be just one of several networks as seen from other perspectives. Traditional ANT has been criticised for only telling the story of the strongest actor, those actors who were able to enrol other actors into their network (Star 1991). However, a stable and durable network is just one of the possible outcomes. These different outcomes may be complex, non-coherent, uncertain and in interference with each other. With the concept of multiplicity one acknowledges that there are more than one network and that different realities, different logics and different practices coexist. One example from medicine is the story of hypoglycaemia (Mol and Law 2004). From a medical point of view it is the state of the blood when the blood glucose level is below a certain level. In the life of people with diabetes hypoglycaemia is feeling of shivering and sweating, or it is something that is done and counteracted through self-measuring and self-awareness. An example demonstrating multiple market practices are how buyers comply with Public Procurement Acts when letting vendors that they have pre-existing relations with design the call for tender, while they act differently towards other vendors (Kjellberg and Helgesson 2006). This multiplicity gives rise to another form of investigation:

> "*Smooth narratives that seek to bring coherence will miss the point. If the tragic aspects of living-in-tension and intervening-for-the-best are to be described, jagged story-lines are needed. And they should be told by a variety of narrators whose voices may be drawn together and/or clash.(..) The overall aim of a multi-voiced form of investigative story telling need not necessarily be to come to a conclusion. Its strength might very well be in the way it opens questions up*" (Mol and Law 2004).

As researchers we should therefore be aware that there are different realities, and hence a wide range of stories to be told.

2.2 Making and scaling of large scale integrated IS conceptualized as Information Infrastructures

The concept of II is the main theoretical framework used in this thesis. The II term may have different interpretations and is widely used in everyday language. In this thesis I use it as a theoretical framework and not as a physical infrastructure in IS. I have chosen the II framework because it focuses on how different users and context are related, how micro aspects (for example work practices) are related to macro aspects (for example large scale technology), how the present relates to the past (for example how designers have to take into account existing systems and practices) and the integrational aspects (how all components depend on each other). In my use of II literature I mostly draw from the works of Hanseth, Lyytinen, Monteiro, Star, Bowker and Ruhleder. However, the presentation beneath will reveal some gaps in this literature that this thesis attempts to fill. This relates to the flexibility in the II, where this thesis suggests using the concept of generativity to get a broader socio-technical perspective on flexibility. This thesis will also focus more on those making and scaling the II than what have traditionally been done in the II literature. In particular the concept of infrastructuring is discussed, and this thesis suggests including the work and strategies of healthcare authorities and vendors in this concept. In particular the concept of generification which is the vendors scaling strategies is suggested as a complement to the II literature.

2.2.1 Definition of Information Infrastructures

IS for healthcare today are increasingly part of an integrated portfolio of IS supporting many different cross-organizational practices, and thus a heterogeneous array of users. Such IS can be classified as business sector infrastructures (Hanseth and Lyytinen 2004). They are shared among institutions including their employees, their customers (for instance in primary care), healthcare authorities or partners and suppliers. The integrational aspects are central: An "*infrastructure has reach beyond a single event or on-site practice*" (Bowker and Star 2000). It has several characteristics distinguishing it from a general IS. The following characteristics were described by Hanseth and Monteiro (1998):

- II have a supporting or enabling function.
- An II is shared by a larger community (or collection of users and user groups).
- II are open.
- II are more than pure technology; they are socio-technical networks.
- II are connected and interrelated, constituting *ecologies of networks.*
- II develop through extending and improving the existing system, called the installed base.

Star and Ruhleder (1995) offer a socio-technical and relational understanding of II linking the technology to the involved work practices, and pose that an II only exist in relation to someone's practice. It is in the tension between local, customized, intimate and flexible use on the one hand, and the need for standards and continuity on the other, that the infrastructure is shaped: "*An infrastructure occurs when the tension between local and global is resolved*" (ibid). Hence an II exists when local practices are afforded by larger scale (global) technology.

The II has a heterogeneous nature and is made up of a multiplicity of competing and overlapping sub-infrastructures, standards and service providers. There is always an installed base that consists of all current integrated services, their users and developers, and the practices they are supporting and embedding (Hanseth and Lyytinen 2004). But, the heterogeneity of an healthcare II does not only

relate to the diversity of artefacts and actors, but also the diversity of relations that groups of human actors have to the technology and other actors: Users do not only use IS, through appropriation and adaption they change components and work practices; vendors do build components of II, but they are also users of other components, standards and perhaps also the technical infrastructure; public authorities are users, but also providers of parts of the infrastructure. These actors have different and often competing preferences, aims and agendas (Nielsen 2006), and the heterogeneity implicates that the "*information infrastructure is composed of components developed independently by different actors with different aims, interests, and agendas, symbolizing multiple and contradictory political strategies*" (Aanestad et al. 2005). These differences imply that the outcome of making and scaling processes will always be unpredictable.

2.2.2 THE EVOLUTIONARY NATURE OF INFORMATION INFRASTRUCTURES

The II changes and grows when new types of information are exchanged among the users and by involving more organizations, and when new components are integrated. The most common view is that this is a continuous process that implies that II are always in the process of design or evolution: "*The emergence of the infrastructure [..] is thus an 'organic' one, evolving in response to the community evolution and adoption of infrastructure as natural, involving new forms and conventions that we cannot yet imagine*" (Star and Ruhleder 1995). Modifications to the II are made continuously and in this way one could say that scaling and changing of an II is cultivation. Related to II this is a soft and less interruptive way of changing infrastructures: "*Cultivation is a conservative belief in power of natural systems to outstand design*" (Bergqvist and Dahlberg 1999). By growing an II by cultivation the organisation is viewed as a living organism, constantly changing and evolving where technology, organization and work practices are changed a little at a time.

To change an II will always be to further develop something that already exists, for instance exchange paper-based information with electronic communication. This means that an II for health care will never evolve from scratch and new components will always have to be integrated with the installed base (Hanseth and Braa 2000). Integrating new components or changing parts of the II might be difficult due to rigid work practices, technological lock-ins and large number of users which makes the installed base conservative and carries a huge inertia. New parts will have to struggle with this, and will also inherit strengths and limitations from it (Star and Ruhleder 1995). From a market perspective the conservative installed base represents a competitive advantage that makes it hard for new vendors to enter the II. This implies that new products or features have to fit the existing portfolio of technology and old practices and users, and these factors need to be taken into account when designing new systems.

In much of the existing literature on II users are viewed as important for the evolution of the II. The relational aspects as posed by Star and Ruhleder (1995) states that it is what the users do to the II that actually makes it grow. This is taken further in the infrastructuring (Karasti and Syrjänen 2004) concept. The verb 'to infrastructure' (Star and Bowker 2002) denotes the activities and processes of integrating materials, tools, methods and practices that make up and change an II. In the literature infrastructuring is portrayed as activities done by users (Karasti et al. 2010; Karasti and Syrjänen 2004; Pipek and Wolf 2009).

2.2.3 *Large steps approach to making and scaling*

The evolutionary approach to building II is presented both as the nature of II and as a guiding principle for II design (Hanseth and Lyytinen 2004), where all development is supposed to be accomplished in small steps and where it is only possible for the actors to do minor changes, i.e. to cultivate the installed base (Nielsen 2006). Openness and heterogeneity of use are viewed as assets that enhance growth (Zittrain 2006) and evolution. While this fits certain types of II, healthcare II are different. Due to security issues or a wish to standardize work practices it is not always an aim to encourage new and different local practices or open growth in such II. There are empirical examples of II or large components of II that was made using large step approaches and where few, but influential actors made large contribution to this building process. One example was the building of an infrastructure for mobile content services in Norway which was a process with few influential actors that were able to make dramatic changes to the II (Nielsen 2006). Another example was the Norwegian E-prescription project (Larsen and Ellingsen 2010) where new components was introduced to, and implied substantial changes in, existing work practices for large users groups. These examples show an approach that deviates from the evolutionary understanding and implicates that making and scaling of healthcare II could also be large-step processes.

2.2.4 *Generativity as prerequisite for change*

Both evolutionary and large step approaches to making and changing requires the necessary flexibility to facilitate change. Many technological solutions to enhance such flexibility have been suggested. Modularisation by decomposing systems into loosely coupled modules is one example (Hanseth and Lyytinen 2004), while layering (Yoo 2010) is another. Star and Bowker (2002) argue that making and changing II require a modifiable infrastructure on an individual and social level. These arguments indicate that there are both technical and social characteristics of the technology itself that determines the possibility for making changes to an II. However I argue that the II literature has not been specific about the non-technical aspects of flexibility and lacks a good framework for assessing the flexibility for making changes and adding components to an II.

The concept of generativity as coined by Zittrain (2006) seems promising in this regard, offering a framework for assessing and describing both technical and social aspects related to change and use flexibility, and I suggest that this concept may be a valuable addition to the theory of growing and scaling II. The concept of generativity originates from the field of cyber-law, and was first used by Jonathan Zittrain in an paper called *The generative internet* (2006) and the book *The future of the Internet and how to stop it* (2008). In this book he described the history of the Internet and argued that the generative aspects of the Internet are the reasons for its success. The term generativity can generally be understood as the ability or power to create something. In a pure technological context it has been used about automatic generation of code (Czarnecki and Eisenecker 1999) and it has been used to describe how information technology has the power to enable changes in work practices (Berg 1999). Zittrain took the concept further by giving it a wider socio-technical definition stating that the ability to create something in a system depends on both technical design and social behaviour, and where the degree of generativity characterizes a technology's capacity to produce unanticipated change: "*Generativity denotes a technology's overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences*" (Zittrain 2008). This means that there are some characteristics of a digital artefact that allows people other than the original builders of the

technology to create new forms of products and services that were not the original purpose of the technology. Generativity therefore encompasses innovational aspects. The concept of generativity has been applied to many different technologies in addition to the Internet: The traditional PC and the Wikipedia (Zittrain 2008), mobile phones (Nielsen and Hanseth 2010), mobile internet (Hanseth and Nielsen) and social media (Tham 2009). Also research on II has applied the generativity concept (Andersen and Aanestad 2008; Nielsen and Hanseth 2010).

Five factors will, to a varying degree, be present in a generative system:

- How the system leverages possible tasks by making them easier. The more the system can do the more change it may produce.
- How the system can be adapted to a range of tasks that were not anticipated at the time of development.
- How easily new contributors or audiences can master both adoption and adaption.
- How accessible, in terms of barriers etc., it is to those able to build on it.
- To what extent any changes can be transferred to other users (Zittrain 2006).

These factors indicate that change is a result of both use and change flexibility, and the generativity concept is a way to see how the properties of a technology relate to the users:

> "*A tool with leverage enables users to do a task more effectively, while an adaptable tool can be used for a wide range of tasks. The easier it is for a new user to learn, the more generative the tool; it's also more generative if it's available to more potential users. Moreover, a truly generative tool isn't just personally useful: It lets users transfer their improvements to others*" (Grimmelmann and Ohm 2010).

Nielsen and Hanseth (2010) argue that there is a contradiction between usability and generativity:

> "*Despite their differences, both the usability and the generativity arguments are about the properties of technology and how technology relates to their users. Where the usability argument is founded on end-user needs, generativity considers the end-users only indirectly by seeing innovation as creating value for the users*" (ibid).

I argue in this thesis that the generativity concept is just as much about the use aspects and that these aspects are important for the growing of large scale IS.

For Zittrain generativity is a good thing, and there are two types of benefits: Unanticipated change which is the output of innovation and inclusion of large and varied audiences where participation is viewed as benefits in its own right (Post 2010). However, not all innovation is for the good, and generative technology is also open for hostile software like spyware and viruses making it instable and insecure (Grimmelmann and Ohm 2010). This is the dilemma of generativity, and in a healthcare setting I find this dilemma particularly relevant because of the dependency on stability in the system and the sensitivity of the information.

In this regard I find the amendments as posed by two other cyber-law scholars, Grimmelmann and Ohm (2010) useful. They largely agree with Zittrain's generativity concept; however they argue that it is missing some nuances and that the ambiguities as mentioned above are downplayed by Zittrain. They have therefore proposed three amendments to Zittrain's theory that I think apply to II and healthcare II in particular: First, they see generativity as only one virtue among many: "*Working with generativity in the real world means engaging with these tensions, both between generativity and other values, and within generativity itself*" (Grimmelmann and Ohm 2010). Designers will face the trade-offs between restricting some kinds of generativity and encouraging generativity of other

kinds. In their second amendment they state that generativity is never absolute, that the perfect generative system is not possible. Generative systems are always non-generative in many ways, and they propose that we only want a system that is generative enough to enable broadly generative production. Third, they state that generativity is a system-wide property, and that it can be counterproductive to maximize generativity at one layer, on one device, or at one time. Instead, we should seek to create a sustainable ecosystem of generativity. For an II this means that generativity in a component is not enough or meaningful, but that we would need to consider generativity in the wider context: The integrated components and the installed base.

2.3 THE MAKERS OF LARGE SCALE INFORMATION SYSTEMS

So far the nature of IS conceptualized as II and generativity as a prerequisite for changing an IS have been discussed. I will now focus more on those that are involved in the making and scaling of large scale healthcare IS. With the infrastructuring concept, as well as the relational perspective on II proposed by Star and Ruhleder (1995) attention has been given to the end users. Yet, much of the II literature is based on ANT and in my opinion this implies that it has also inherited some of its weaknesses. One of the major objections towards ANT is how it treats humans and non-humans in the same way insisting on agency also for non-humans. For ANT it is unimportant to examine the characteristics of the nodes or the nature of the alliances or how the different actors are enrolled in the network (Amsterdamska 1990). In this way ANT can be seen to flatten the view on human actors: "*ANT has a flat view of human agents, reducing them to effects and denying the embodied, emotional nature of human existence. This existence is still flatter, however, when it comes to social relations*" (Mutch 2002). The same kind of critic can be raised towards some of the II research. II research has in practice positioned itself close to technological determinism, portraying technology as autonomous and leaving developers simply with the ability to cultivate (Nielsen 2006). The agencies and interrelationships between the multiplicity of developers and institutions in the shaping of II have been under-theorized. In an attempt to enrich the II literature and give a more nuanced perspective on those that engage in the making and scaling of II, this section draws on a variety of theory and literature from other fields.

The builders of IS may be categorized in many ways: By the different phases of the evolution process (Hughes 1989), by users and developers (Grudin 1991) or by the demand and supply side (Hanseth and Lyytinen 2004). However, all distinctions show blurry categories and actors may belong to several categories at the same time. I have therefore for the sake of simplicity chosen a rather pragmatic distinction: Users, vendors and governments. Users are to be understood as all end-users of a system, vendors are those developing and selling a particular part of the system and governments are public bodies at different organizational levels.

2.3.1 USERS: INFRASTRUCTURING BY END USERS

The relational definition of II as coined by Star and Ruhleder (1995) and the infrastructuring concept (Karasti and Syrjänen 2004) give the users a central role in the making and scaling of II. This focus makes it natural to discuss the users and their roles more thoroughly. To complement the II and IS

literature it has been natural for me to draw on the research field of Participatory Design (PD) and some general literature on motivation.

2.3.1.1 Users' roles and their contribution

Before I go into the users' role and motivational aspects I will elaborate on what we mean by *user*. In recent years we have seen a wide range of design processes where end users play a major role as user-designers, actual developers or actors who take all the responsibility of use, design, development and other activities within their everyday setting. Examples are Lay Participatory Design (Syrjänen 2007) and End User Development (Lieberman et al. 2006). Despite this, the traditional dichotomy that users and designers are two different groups, where designers develop systems and users provide input to this process, thereby giving the developer the most prominent role in the design process, prevails (Pipek and Wolf 2009). The traditional roles attributed to users in design have been based on functional roles or interest groups (Lamb and Kling 2003), while developers are usually assumed to be those belonging to a development team (Grudin 1991). Implicit to such discussions is a clear distinction between those who develop a system and those who use it. Infrastructuring and arguments for blurring the boundaries between design and use call for a new view on the user – designer concepts. Mackay et al. (2000) view the boundary between users and developers as being fuzzy, the users and developers having equal influence on each other. They argue that design is not a one-way process and that the boundary between designers and users is fluid, negotiated, constructed, managed and configured. Millerand and Baker (2010) extend this view by defining design processes as a web of users and designers in which the roles tend to evolve and the users do tasks traditionally assigned to developers. This web is defined as dynamic ensembles of interrelations between users and developers, and they emphasized the fluidity of such webs: "*Users and developers are not stable entities; they tend to adopt multiple roles that are constantly evolving throughout information system development processes*" (ibid).

Having acknowledged that users do more than just use systems, and that the distinction between users and designers is somewhat artificial I will now turn the attention to the users' contribution in the building of IS. The notion of infrastructuring denotes how changing both work practice and new technologies shapes and changes the II. By using an artefact users develop knowledge and understanding about the artefact itself, as well as its potential use from the use situation. This knowledge of how the technology affects and is affected by the work practice must also be reflected in the development processes (Orlikowski 1995). Changing the system in new and unexpected ways require that the users appropriate or take possession of the technology. When appropriating the technology, they will reshape the features of it and use it in unanticipated ways, as well as shape their own practices according to the technology. In this way, the users can be said to finish the design process through their appropriation of a technology (Carroll 2004). The Technology Appropriation Cycle suggests that design is the combination of two processes: The design process that is completed during appropriation, and the appropriation process that is the basis of design. In this way, Carroll (ibid), draws attention to the way in which technologies should be redesigned, based on experiences from the technology in use, and how these two processes of use and redesign should continue. While Carroll suggests an iterative process, Suchman (2002) goes even further by arguing that these should not be discrete phases, but: "*Complex, densely structured courses of articulation work, without clearly distinguishable boundaries between them*." In blurring the boundaries between use and design, the users' perspectives on use, tailoring, training, modification, reuse and design can be taken

into account, and this allows for the continued development of the core activities while the technology development takes place (Karasti and Syrjänen 2004).

2.3.1.2 User motivation

Being an active user contributing to design requires much time and effort and interruptions of daily work (Hirschheim 1989). As their contribution is highly needed and wanted attention has to be paid to factors to foster motivation for participation.

The general factors motivating any human behaviour is often described using Maslow's hierarchy of human needs which describes motivation as the drive of behaviour to satisfy human needs. These needs are classified in a hierarchy where the most basic physiological needs are at the bottom, and higher level needs like social and self-actualization needs only become motivators when the lower levels are satisfied (Maslow 1943). People have a need for high evaluation of themselves, for self-respect and for the esteem of others. Motivational factors can be characterised as either extrinsic or intrinsic. Extrinsic motivation is the drive to behave in order to achieve specific goals or rewards while intrinsic motivation relates to perceptions of pleasure and satisfaction from performing the behaviour itself (Venkatesh 2000). Much research points to the importance of intrinsic motivation in the work place sphere. Hertzberg (1987) introduced the notion of motivator and hygiene factors for work place motivation. Hygiene factors are those that have to be present to avoid demotivation. These are extrinsic factors like money, physical work conditions etc. Extrinsic factors can make people do their job, but will not create the passion necessary to foster creativity (Amabile 1998). Motivators on the other hand are intrinsic factors like recognition, the work itself, personal achievement and growth, and Hertzberg (1987) introduces the idea of job enrichment for psychological growth as a way to make the most out of the personnel. The obvious motivation for users to participate in the development of IS to be used in their own work practice is the expectation of getting an improved or new working solution fast (Büscher et al. 2002; Wilson et al. 1997). But intrinsic motivational factors have also shown to be prominent in studies of motivation of participation. Psychological ownership, i.e. feeling an object as theirs and getting emotionally attached to it, is one motivational factor fostering responsibility, contribution and commitment (Hirschheim 1989; van Rijn and Stappers 2008). The joy of working with ICT activities may for some be a motivational factor in itself (Carroll and Rosson 2007). While for other participation in development processes fosters job enrichment and recognition (Lieberman et al. 2006).

Benkler and Nissenbaum (2006) offer another approach that I also find appropriate. They explain the drive of the contributors to a particular sort of development processes, the commons-based peer production. Examples of such systems are Wikipedia and open source software. Although the Interactor system is not commons owned, but owned by a company, it is used by a community, and the findings may explain the motivation to participate in this development process. According to Benkler and Nissenbaum (2006) people choose to contribute to such systems out of virtue or a moral belief in doing something good. This means that those contributing are just not producing something, but they do it with the right attitude. These virtues can be both self-regarding like autonomy, independence and liberation, creativity, productivity, industry and other-regarding, for example characterized as benevolence, charity, generosity, altruism, sociability, camaraderie, friendship, cooperation and civic virtue. This means that by participation out of virtue one have chosen freely to use one's capabilities for something useful and made something in cooperation with others which

will be of value to all: "*The act of creating for oneself and one's fellows is an act both of self-reliance and of fellowship*" (ibid).

2.3.2 *VENDORS: MAKING AND SCALING A LARGE SCALE INFORMATION SYSTEMS FROM THE VENDORS PERSPECTIVE*

While the literature on infrastructuring (see for instance Karasti et al. (2004) or Pipek and Wolf (2009)) describes situations where the users had in-house developers at their disposal to make the necessary changes, much of the technology in healthcare II are delivered by vendors as tailored or packaged software (Pollock and Williams 2010). For these vendors II are markets in which they can sell their product (Hanseth and Lyytinen 2004), and infrastructuring from the perspective of the vendor is often about how a system, carefully designed for one local context, can be moved to another. For a tailored product there is often one customer who has paid for the product to get it the way they want it, but for the packaged solution on the other hand there is no longer one single paying customer. Still, expanding a product is often of great concern to vendors and designers who have invested substantial funding and resources in developing a local system, where the effort and resources invested in the first version of a product often exceed the payment from the customer. Particularly for small vendors of IS, taking a product made for one customer into a broader market may be a question of survival. However, as many socio-technical studies have informed us, this is not an easy task. For instance, Marc Berg (1999) claims that many systems in healthcare are failures because they were not transportable out of the local context. Contrary to this research Pollock and Williams (2008) argue that they have observed that many systems are transported across organisational boundaries and are implemented in many organizations, but that this requires work and careful considerations from the vendor.

When the tailored product is taken to a larger market it is the supplier which bears the risk and must decide which features to include and how to do this (Pollock and Williams 2008). The vendors' strategies to do this are processes of generification which is "*the supplier's strategy of taking a technology that have worked in one place and attempting to make it work 'everywhere'* " (ibid). The notion encompasses both the process of taking a product from one sector to another, and when a tailored product travels from a few customers to a market. The trade-off between particularisation and generification is central in a generification process. The need for particularisation comes from the situatedness of work practices and organisations. Particularly within healthcare there is strong professional autonomy and a high degree of professional and departmental specialisation. This makes healthcare IS different from manufacturing systems and other public services systems, and this urges more particular solutions (Pollock and Williams 2010). From the vendor's perspective a generic product is easier to maintain, but also from the user's perspective the standardisation that a generic product implies might be desirable for certain actors (Ellingsen and Monteiro 2006). The work involved in attempting to find the balance between the generic and the particular typically include: Identify particular requirements from a few customers, identify general requirements, and assess the options of building diversity into the system or leaving customisation to the customer. In addition to identifying requirements the vendors will try to align the diversity of user requirements by making and managing communities of users by public forums, users witnessing etc. (Pollock et al. 2007). In this process some kind of proximity with users might be lost on the way.

The generification concept as described above give valuable insights about how a vendor have to handle user requests and how this changes as the product expands. In this way it is a way to see infrastructuring from another angle. However I find the concept too narrow the way it is used in the literature so far because for a vendor there are also other challenges that come to the fore in this generification process. For an integrated product in an II going from a small product to a larger context there are challenges related to integration and in particular towards the vendors of the products to be integrated with, and these challenges grow and need to be handled as the product is scaled. There are also challenges that need to be handled related to market access and market expansion particular in a public healthcare market which functions differently than an open market. These are issues that the empirical analysis in this thesis will explore further.

2.3.2.1 Development approaches

For vendors it is important to choose a development methodology that is suitable for the making and expansion strategies the vendor has chosen. The traditional methods for development are the so-called Waterfall models, also called the System Development Life Cycle model. These are top-down and sequential models of development activities starting with requirements analysis to design, coding, testing and, finally, to delivery. The perceived benefits of this model are the emphasis on predictability, stability, and control of the development process (Lyytinen 1987). The argument is that time spent early in the process making sure requirements and design are correct will save time and effort later. It also provides an understandable structure and a linear approach which provides milestones and a predictable financial situation. The model was first described in the seventies (Royce 1970), but is still in widely use and often referred to as the traditional model of software development. However the success of the model presupposes a stable environment and that there will be no need for changing requirements and many criticize it for being too mechanistic and inflexible neglecting the ambiguous context of design processes (Lyytinen 1987).

An evolving and iterative scaling process requires a small step development approach. As a reaction towards these heavyweight methods agile methods have evolved (Beck 2000). Where traditional waterfall methods are seen as bureaucratic and slow agile methods are seen as the opposite. The idea is that short iterations make the methods receptive of changes in the environment. The basis for agile methods is The Agile Manifesto (Beck et al. 2002): "*Individuals and interactions over processes and tools, Working software over comprehensive documentation, Customer collaboration over contract negotiation*". An agile approach implies that the developer gives high priority to satisfy the customer through early and continuous delivery of valuable software where changes of requirements are welcomed. Development is based on user stories that are two to three sentence informal descriptions of feature requests or desired working situations written by the customer (Rittenbruch et al. 2002). The user stories are written and prioritized by the customer or a customer proxy in the development team. Each iteration starts with the planning game where customer and developers estimate, select and prioritize the user stories to be implemented in that particular iteration, and user contribution is seen as very important for obtaining good functionality (Rittenbruch et al. 2002).

2.3.2.2 User participation

Although the agile methods have a strong focus on the customers they do not help vendors to find ways to involve the end users in the design. However the research field of PD have for several decades (Bjerknes and Bratteteig 1995) researched and collected experience in the field that might provide insights to vendors. PD is an approach to the assessment, design, and development of

technological and organizational systems that places a premium on the active involvement of workplace practitioners (usually potential or current users of the system) in design and decision-making processes.

The participation can take many forms and be conducted in many contexts. In development projects users have been represented in project groups and steering committees and have taken active parts in analysis, design, evaluation, and implementation. Kensing and Blomberg (1998) have made a list of five basic requirements for participation:

- Access to relevant information
- The possibility for taking an independent position on the problems
- Participation in decision making
- The availability of appropriate participatory development methods
- Room for alternative technical and/or organizational arrangements.

The development of tools and techniques has been a key focus for the PD field in order to promote good practices for participation. The tools and techniques include features to learn about users' work and include methods such as prototyping, visualization, mock-ups, storyboarding, metaphorical design, and future workshops which all aim to offer users a sense of how a proposed system will work (Asaro 2000).

Historically PD emerged from a Scandinavian approach which looked upon user participation as an instrument for maintaining and increasing the workplace democracy (Bjerknes and Bratteteig 1995), and a British approach focusing on autonomy in work group organization through socio-technical systems design (Asaro 2000).After the first political motivation for PD other reasons for conducting the approach has emerged. Joan Greenbaum (1993) has summarized these motivations into three groups:

- Pragmatic- The motivation is based in the need for improving systems design by involving designers with day-to-day work experience early when the basic design choices are made.
- Theoretical- This is motivated by the assumption that designers and users have different experiences, thus limiting their understanding of each other. By applying different PD approaches users can be provided with hands-on experience in a work-like setting.
- Political – Motivated by people's rights, in a democracy, to influence their own work place, including the use and development of computer technology.

Although the research on users and user participation in development projects has given rich insights there are some clear limitations. Firstly, there has been a recurrent tendency in the PD community to report on small-scale experimental and prototype-based projects with limited scope and duration (Kensing and Blomberg 1998; Oostveen and van der Besselaar 2004). Although these approaches give valuable insights, they do not reflect the challenges that face implementing large-scale II for health care. For instance, small-scale PD projects do not pay attention to the full organizational complexity of establishing robust and sustainable systems (Kensing and Blomberg 1998) in an integrated setting. Altogether this calls for a broader focus for the research on users and user participation to intensify its research efforts on large-scale integrated systems in complex organizational settings.

2.3.3 GOVERNMENTS: PUBLIC AUTHORITIES AS PURCHASERS, FACILITATORS AND BUILDERS

Although the vendors make and sell components of large scale IS in healthcare, there is another group of actors that strive to control these IS: The public healthcare authorities. For them information technology is a tool for achieving an efficient healthcare system, and in Norwegian healthcare authorities take an active role in the building and managing of healthcare II (NDH 2008). In Norway healthcare is a public responsibility, however the healthcare sector is under constant pressure, healthcare expenses are increasing and accounted for 11% of the gross national product in 2009 (NDH 2010). Approximately 85% of healthcare is publicly financed and a large proportion of the healthcare services are offered by public healthcare organisations (Holmøy and Oestreich Nielsen 2008). Healthcare's large impact on the national economy makes it crucial for the Norwegian healthcare authorities to manage the sector in an efficient way to get the most out of the resources. Today governmental large-scale IS projects face an increased critical attitude and the attention is drawn towards what governments fail to do. Hence the main objective for public bodies become to avoid mistakes (Dean 1999) and not to waste tax payers' money on failed system implementations (Griffin and Dempsey 2008).

To better understand the healthcare authorities' strategies I have used insights from political science describing neo-liberal government. Neo-liberal government is by some viewed as the dominating political philosophy in Western states today (Dean 1999), among them Norway. It stems from a realisation that the domain to be governed is complex and unpredictable which makes it impossible for the state to regulate all aspects alone. Central in neo-liberal politics is therefore decentralisation of power to free and autonomous individuals and organizations, also public entities, and a strong private sector. This implies only limited interference by the state in society. The role of public management is to construct frameworks in such a way that the autonomous organizations have to find ways to deliver services which are in line with the overall political aim. Public bodies are encouraged to join with private companies to develop good solutions and competence, and in that way also contribute to innovation and economic growth in the business sector (MGA 2006). However, the increased critical attitude towards public sector and the risks of tax payers have to be governed, so the price to pay for the increased autonomy and delegation is an increased demand for documentation, auditing and report (Dean 1999). In light of this it is important to:

> "*Render governmental institutions and mechanisms, including those of the social itself, efficient, accountable, transparent and democratic by the employment of technologies of performance such as the various forms of auditing and the financial instruments of accounting, by the devolution of budgets, and by the establishment of calculating individuals and calculable spaces*" (ibid).

The strong focus on budget and control is reflected in governmental plans and strategies for healthcare IS (NDH 2008), which to a large degree adhere to management literature stating that the mess and improvisations in IS should be abandoned through better planning and control (see for instance Broadbent and Weill (1997)). Governing of II is an issue that is widely debated in the II research community and the management literature's view has been criticised by many (Ciborra and Hanseth 1998; Hepsø et al. 2009). The heterogeneity of actors in an II implicates that the possibility for control for one of these actors is limited, and those seeking to manage it can only control parts of the II (Ciborra and Hanseth 1998). Instead managers just have to live with the paradox of control versus cultivating local practices (Hepsø et al. 2009).

3 PHILOSOPHY OF SCIENCE AND METHODS

3.1 INTERPRETIVE RESEARCH APPROACH

This thesis adheres to an interpretive research approach. This paradigm (Kuhn 1962) has guided the choices I have made throughout this thesis regarding research questions, theory, methods and conclusions. The choice of paradigm is something we as researchers have to make, and have to communicate to our readers in order for them to do any reflective scientific inquiry into our research (Van de Ven 2007). The interpretive research approach is a paradigm used in social-sciences that contains "*the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed".* The interpretive approach includes epistemology, which refers to how one gets to know about the world, ontology, which is about how one sees the nature of reality, and finally methodology, which is about the best means for gaining knowledge of the world (Denzin and Lincoln 2003).There are many possible ways to categorize the paradigms in social-sciences. Orlikowski and Baroudi (2002) have suggested three paradigms for research within IS: Positivist, interpretivist and critical. The positivist philosophy poses that there is a fixed relationship within phenomena that may be studied by an objective researcher and where findings may be generalised across context and time. The aim is to make propositions and test theories by empirical findings. In a review of IS research Orlikowski and Baroudi (2002) found that the positivist philosophy is by number the largest paradigm underlying the studies and argue that this has limited what phenomena have been studied as well as how they have been studied. They therefore encourage a broader perspective in IS research, including the interpretive paradigm. Using an interpretive approach in IS as may contribute to "*producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context*" (Walsham 2002). The interpretive paradigm is not a coherent perspective. It is rather a general term for different philosophical positions that resembles each other in many ways. Examples are critical realism, phenomenology and hermeneutics (Walsham 2006). The philosophical position underlying this thesis is the hermeneutic philosophy where a complex whole is understood ''*from preconceptions about the meanings of its parts and their interrelationships*'' (Klein and Myers 1999). More detailed descriptions on how these principles are applied in this thesis are in the subsection *3.4. Data analysis*.

The interpretive perspective is influenced by the German intellectual tradition of hermeneutics (which originally stems from the ancient Greeks) and the *Verstehen* tradition in sociology, from phenomenology and from critiques of positivism in the social sciences (Gregor 2006). The ontological underpinning of the interpretive paradigms is that the social reality is produced through the actions of humans. These humans produce and reproduce their social world through their subjective meanings, social-political and symbolic actions. It also assumes that social reality cannot be discovered; only interpreted. The interpretivists believe in orderly interaction due to shared norms, beliefs and interests that bind humans together. As the meanings that make up the reality may change over time the interpretations will also be circumstantial (Schwandt 2003).

The intention with interpretive research is to understand the deeper structures of society and understand why people, through their participation in social processes, enact their realities and thereby act the way they do (Orlikowski and Baroudi 2002). As researchers we can get knowledge of

this reality through social constructions such a language, consciousness, shared meanings, documents, tools, and other artefacts (Klein and Myers 1999).

Methodologically an interpretive approach implies that the individual is the starting point and basic unit of analysis and the research object is individuals' experience of their reality (Sandberg 2005). The research seeks to understand action through its meaning. One example could be the action of raising a hand that can mean different things, for instance voting, hailing a taxi, ask to speak etc. (Orlikowski and Baroudi 2002). Interpretivists reject objectivity in research, and they do not attempt to predefine variables, but emphasizes context (Schwandt 2003). The use of theory is important in interpretive research (Klein and Myers 1999), but not just any kind of theory. Interpretivists argue for a type of theory that doesn't aim to generalize, but to seek to explain phenomena:

> "*This type of theory explains primarily how and why some phenomena occur. These theories are formulated in such a way, however, that making testable predictions about the future is not of primary concern. Explanations of how, when, where, and why events occurred may be presented, giving rise to process-type theory. This class could well be labelled theory for understanding, as these theories often have an emphasis on showing others how the world may be viewed in a certain way, with the aim of bringing about an altered understanding of how things are or why they are as they are*" (Gregor 2006).

In interpretive research the context of research is also important and research formulations, choice of observational sites and persons interviewed, analytic frame and writing all influence the outcome of the research (Yanow 2003).

3.2 QUALITATIVE RESEARCH STRATEGIES AND METHODS

The interpretive research approach requires qualitative research methods. Qualitative research methods are developed in the social sciences to enable researchers to study social and cultural phenomena and to help us understand people and the social and cultural contexts within which they live (Myers and Avison 2002). The researcher use different tools, methods and techniques that are available and add to the puzzle. Seeking answers to *how* questions, the research will include different voices, different perspective and points of view, and shifts between personal, political, local, historical and cultural aspects. The research is value-laden, in contrast to quantitative that claims to be value-free (Denzin and Lincoln 2003). The research strategy for this thesis is mainly case study which is complemented by other research strategies. These are all described below.

3.2.1 CASE STUDY STRATEGY

This thesis is mainly based on a single case study strategy. The case study approach is a study design which "*examines a phenomenon in its natural settings"* (Benbasat et al. 2002), implying that no experimental control or manipulation is used and by using a variety of data sources: "*This ensures that the issue is not explored through one lens, but rather a variety of lenses which allows for multiple facets of the phenomenon to be revealed and understood"* (Baxter and Jack 2008). The boundaries between the phenomenon to be studied and its context are not clear and both phenomenon and context may change over time. Unlike other research strategies this complexity is tolerated by case studies (Yin 1999). An invaluable feature of iterative case research is the possibility to discover in the

process of research, hence leading to new or revised research questions. This means that everything does not have to be pre-specified.

Case study design is viewed to be particularly useful to answer *how* and *why* questions (Walsham 1995), to capture knowledge from practitioners (Benbasat et al. 2002), and when the experience of the actors and the context is critical (Myers and Avison 2002). Particularly the thick descriptions that often accompany case studies are important to actually understand what is happening in complex IS (Walsham 1995). There is however a discussion on what type of conclusions that can be drawn from case studies and the issue of generalizability has been widely discussed. Walsham (1995) describes four types of generalisations that can be drawn from case studies: Development of concepts, generation of theory, drawing on specific implications and contribution of rich insight.

There are many ways to characterize case studies. The cases in thesis could be described as *descriptive* (Baxter and Jack 2008) because they are used to describe a phenomena and the real-life context in which it occurs. It may also be characterized as *instrumental* because it is an instrument to provide insight or help to refine a theory. The cases play supportive roles to understand the larger issue of making and scaling IS, as opposed to an *intrinsic* case where the aim is to understand the case itself (ibid).

Case studies resemble fieldwork for ethnography. What really distinguishes case studies from ethnography is the time spent in the field. Fieldwork for ethnography requires a lengthy stay (Van Maanen 1988) while fieldwork for case studies can be shorter. In an ethnographic approach fieldwork means living with and living like those who are studied and the written ethnography is the result of the fieldwork (ibid). The written report must be rich enough and detailed enough to make the observed behaviour understandable (Harper 2000). Van Maanen (1988) uses the term tale for what a case study would call case description or narrative. My case descriptions are realist tales which are told in a third person voice:

> "*The voice assumed throughout the tale is that of a third-party scribe reporting directly on the life of the observed. The tone suggests anonymity, a characteristic of science writing, where the fieldworker is self-cast as a busy but unseen little fellow who is confident that the world as represented in the writing is the real one*" (ibid).

Van Maanen (1988) characterizes case descriptions as formal tales because the ethnography is made not primarily for its own sake, but to build, test, generalize, and otherwise exhibit theory. In formal tales representations of persons, places and activities are often just to provide a context for the data.

3.2.2 Actor Network Theory used methodologically

In addition to the case approach the papers have been methodologically influenced and inspired by Actor Network Theory (ANT) (Callon 1999; Latour 2005). Although the name Actor Network *Theory,* ANT is not seen as a theory in the traditional sense because it does not explain phenomena: "*..it is better understood as a toolkit for telling interesting stories about, and interfering in, thoserelations*" (Law 2007).

Methodologically ANT urges us to follow the actor, and by doing this relations and actions will unfold (Latour 2005). This implies that the observer shall not make a priori distinctions between social,

technical or natural events, and further that the boundaries of the involved actors and events to study will be the result of the analysis and not the point of departure:

> "*Instead of imposing a pre-established grid of analysis upon these, the observer follows the actors in order to identify the manner in which these define and associate the different elements by which they build and explain their world, whether it be social or natural*" (Callon 1999).

This also implies that the observer must apply the *symmetry principle* (Law 2007) by attempting to stay impartial to all arguments and use the same repertoire of concepts and vocabulary when moving from technical to the social aspects of the study. In an ANT description the main actors or mediators are shown. This implicates that the written account is by no means the total and complete picture, but will show only the actors and the translations that lead to changes (Latour 2005). ANT account studies and documents the only observables possible. These are the traces left by objects, arguments, skills, and tokens in the network. This also means that social relations are not possible to observe (Callon and Latour 1992).

I have sought to use ANT methodically as guiding principles in the research. In the overall choice of research issues to pursue this has lead me from micro issues in the first papers to macro issues on large scale strategies and including healthcare authorities as actors in the last papers. Being in the field where the actual action was taking place I have also sought to follow and describe the different actors in the development process: Users, developers and technology, as well as the health care authorities, based on what these actors were actually doing and not based on a particular theory or predetermined understanding of their roles and relations.

3.2.3 BIOGRAPHY

This thesis follows the Interactor product in several phases, looking into how the technology as well as how social relations evolve around the product. The biography of software concept has inspired this approach. The biography approach could be seen as a particularly tailored case strategy, or what Pollock and Williams (2008) call a "*strategic ethnography*".

The biography concept was coined by Pollock et al. (2003) after criticizing that the research community to a large degree had based their research on 'snap-shots', privileging of the local and focusing on short time periods or single aspects of a products life-cycle. They argue that this approach does not capture how a product evolves, how it matures and what happens to it when crossing borders of the initial setting. They therefore urge for research that: "*Theorize longer-term processes and the influence of the broader historical and institutional context which pattern and structure these local processes*" (Pollock and Williams 2010). This is particularly relevant for research on II which emerge and evolve over a long time. These are typically founded on earlier development and implementation, and small II may come in contact with each other incurring difficulties in aligning the differences between systems. These tensions and discrepancies may lead to adjustments and redevelopments. The need for such research on healthcare II also stems from the long duration of the information within healthcare IS, the large scale and complexity of these systems and implementation difficulties (ibid). By using the biography approach on such systems it is possible to understand how new systems emerge over time (Brady et al. 1993).

The biography approach follows the accumulated history of an artefact: "*Biographies of things can make salient what might otherwise remain obscure*" (Kopytoff 1986). The approach focuses on socio-technical processes in innovation and shows how it affects structures and practices of users of the product, and which transformations and translations a product goes through as it is changed and redefined. It may also show how technological fields and markets are constituted and organised and how a product may be moved from one market to another (Pollock and Williams 2010). As a product move from one setting to another, relationships and meanings from the first setting are inscribed in the product, and this will influence other settings and other actors (Pollock et al. 2003). The research must therefore include different localities and different temporalities to view development as a process of reworking existing components and integration with new components, how users address technology and work over time and to broaden the view of development activities to include system configuration, integration and testing activities (Pollock and Williams 2010).

The strategic ethnography implies that the research addresses multiple sites which are selected according to previous knowledge. Unlike ANT the biography approach does not reject theory. Instead it welcomes a multiplicity of concepts as well as methods adequate to the issue and phenomena at hand.

> *"The biographical approach focuses upon social (or rather socio-technical) processes involved in innovation and how these are shaped by their context and history. [..] Multiple methods may be required, knitting together different kinds of evidence including historical studies, ethnographic research, qualitative studies of local and broader development and the use of larger-scale research instruments and quantitative data"* (Pollock and Williams 2008).

In this way the approach aims at building a comprehensive understanding of the evolution of a technology and encompasses both design and use seeing the phases together and thereby integrate historical and contemporary instances. The paper "Integration and generification – Agile software development in the healthcare market" used the biography approach explicitly to study how the Interactor product evolved in a period of a few years and how the vendors strategies and relationships with other actors influenced the product.

3.2.4 Methods for Data collection

Case studies may employ multiple methods of data collection, both qualitative as well as quantitative data. My data sources, which will be explained in detail below, were qualitative and included documents, interviews, physical artefacts, and participant-observation (Walsham 2006). Participant observation embodies an intensive involvement with people in their natural environment. Hence, participant observation is not a technique, but a mode of being-in-the world for the researcher (Atkinson and Hammersley 1998). The method does not guaranty a correct account of everything that happens, it rather applies a tacit 'significance filter', by which some events in a setting are noted while others are not (Tjora 2006).

Interviews may be structured, unstructured, semi-structured and group interviews (Myers and Newman 2007). Unstructured or semi-structured interview is performed by the researcher himself with an incomplete script with a few prepared questions, and where the rest is improvisation (Klein and Myers 1999). The distinction between unstructured and semi-structured interviews might seem a bit artificial (DiCicco-Bloom and Crabtree 2006). I tried to get a diversity of voices represented

(Myers and Newman 2007), and interviewed different personnel from different professions in healthcare as well as chief designers and developers at the vendor. Myers and Newman (2007) warns against elite bias in the research by interviewing only the 'stars', and therefore risking to fail to gain an understanding of the broader situation. Qualitative interviews might be viewed as a dialogic conversation where information is transformed into shared experience (Denzin and Lincoln 2003). This means that it is not just the interviewer who learns from the session, but also the interviewees interpret and construct knowledge:

> "*In response to an interviewer, interviewees construct their stories – they are reflecting on issues that they may have never considered so explicitly before. Interviewees usually want to appear knowledgeable and rational, hence the need to construct a story that is logical and consistent*" (Myers and Newman 2007).

Using a multitude of methods is seen as giving more weight to the evidence: *"In using multiple sources of evidence, the goal during the data collection process is to amass converging evidence and to triangulate over a given fact*" (Yin 1999). This approach makes it possible to explore the nature of a phenomenon and interpretation of meanings and functions of human action (Atkinson and Hammersley 1998) and thereby produce an in-depth understanding of real-world social processes (Forsythe 1999).

3.3 DATA COLLECTION

The data collection period for this thesis was from December 2007 to June 2011, however the most intensive period for data gathering was during the first two years. The paper "Top-down or bottom-up? Building information infrastructures for healthcare" also included a case description of the national ePrescription project. Data gathering for this case was done by my co-author Eli Larsen in the period 2004-2010, and included interviews, non-participant observation and document studies. More detailed description of the data gathering for this case is found in the paper.

3.3.1 PARTICIPANT OBSERVATION

The major part of the data collection consisted of participant observation. As an employee of Well/DIPS I have had my desk in an open office space together with the rest of the Tromsø department of Well/DIPS. Most of the time I had a desk in the Interactor team room. As part of my PhD position I was supposed to use 25% of my working time on tasks for Well/DIPS. In the first two years during these 25% I was recognized as a team member and spent my time on miscellaneous work for the development team of Interactor. This physical proximity and close relationship made it possible for me to get a thorough insight into the progress of the development process, situations and rationales. As a member of the development team I participated in all kind of meetings: Internal team meetings, meetings with other collaborating vendors, meetings with users and formal project meetings. These meetings were located on Well's/DIPS' premises, in the hospital, in general practice, and as telephone meetings. I also accompanied the developers when they did work place visits to the users or testing in the users systems. As a team member I was also on the team's mailing list getting all written information that circulated. Being located in the team also gave me a unique possibility to observe and take part in informal discussions between team members and also between team members and other personnel in the company. In the team I performed different tasks like testing of

the system and writing of user guides or documentation of the Interactor system. This gave me an even better knowledge of the system as well as of the users.

Two years into my PhD period I deputized for the product responsible person for six months working full time in that position. My responsibilities in this position were to make priorities and plan the development of the whole product portfolio of the development team including the Interactor product. In this position I was also part of the product department participating in the total prioritizing process of the company. This gave valuable insight into the overall strategies and thinking of DIPS. I was also responsible for external contacts with other collaborating vendors, customers and users. This gave me the opportunity to get to know many of the actors portrayed in this thesis from another position. The task I spent most time on in this period was the bid for tenders for electronic orders and referrals. I had the responsibility of writing the product specific input to the bids for both South-Eastern Norway Regional Health Authority and Northern Norway Regional Health Authority. This gave a detailed knowledge of the tender specifications of the customers and the response from DIPS as well as the competition strategies for DIPS. For the last year of my PhD I was part of the quality department of DIPS and preformed a few tasks related to documentation of the Interactor product.

In addition I participated as DIPS' representative in two projects of relevance for this thesis. One was the EttStopp-project that was the extension of Interactor to referrals. I joined the project late and was responsible for making users documentation, and I was also responsible for the contact with the project manager at UNN in the implementation phase. The other project was GiAlt, another collaboration project between DIPS and UNN. This was a project to explore needs and attitudes of a general system for ordering processes in health care including patients. The project was a continuation of electronic laboratory orders and was closely related to the EttStopp-project. I was responsible for data collection and wrote much of the project report. The method for data collection was mainly interviews and many of the subjects were already users of Interactor for electronic laboratory orders. Their experience with Interactor was touched upon in several of the interviews giving me valuable insight about their experience and attitude towards the system.

I also did observations in the microbiology department at UNN. I had free access to the laboratory and could show up and make observations at any time. In addition I was invited to attend a couple of internal meetings in the department. During my observations I was guided around the department and could follow the logistics of the samples and orders from when they arrived at the hospital and until they were analysed. The work practice observations took place in one bacteriology laboratory at a time were that particular laboratory was in the transition from paper based orders to electronic orders. These observations gave valuable knowledge about the organization of the work in the laboratory, the logistics of the referrals and samples, the challenges of going from paper based to electronic orders as well as the work practices of analysing the samples. In that way I did not only get to understand how the orders were handled in the laboratory, but also the content of the orders and the rationale behind the content.

During the observations field notes were taken in a kind of diary. The field notes were a mix of short minutes from the internal meetings I participated in. For instance the development team had a daily ten minutes 'stand-up' (an up-date meeting where each team member talks about their tasks and how it is going). The development team also worked on other products than Interactor and only things that I reckoned to be of interest for Interactor was noted. Interesting things that occurred

during the day were also noted in the diary. E-mails that I viewed as part of my participant observation have been archived.

3.3.2 INTERVIEWS

In addition to the observations, I was particularly interested in the history of the project, from the time before I became involved, and also the reflections and ideas of some of the key people involved in the process. To capture this information mainly semi-structured interviews were performed. But also unstructured and group interviews were conducted. My semi-structured interviews were all scheduled and planned in advance and the script was a list of overall questions and issues to discuss. The script was used quite flexible and served mostly as a memo. The two unstructured interviews were not planned in advance, but I got the opportunity after two different meetings that I observed. The questions I asked was never put on paper, but was based on improvisation and the questions I had asked in semi-structured interviews earlier. Also the group interview was semi-structured. It was never intended as a group interview, but when I arrived for the interview all the GPs in the office showed up, not only the GP I had made an appointment with. So I grabbed this opportunity to get a wider spectre of views, however this also made it a less in-debt interview. *Table 3 Overview of interviews* below gives an overview of the informants, length and themes of the interviews.

Type of interview	**Subjects**	**Number of interviews**	**Duration**	**Locations**	**Issues**
Semi-structured	Project leader UNN	1	105 min	UNN	History of project
	Developers, product owner	5	30-70 min	Well/DIPS	Issues related to product and design
	Biomedical scientists, secretary	5	35-55 min	UNN, Ahus, GP office, café	Issues related to design, use and pilot testing
	Vendor of system to integrated with	1	30 min	Telephone	Cooperation, development of product
Unstructured	Biomedical scientists, physician	2	20-45 min	UNN	Development and use
Group	GPs	1	35 min	GP office	Expectations of system

TABLE 3 OVERVIEW OF INTERVIEWS

In the selection of interviewees I tried to get a diversity of voices represented (Myers and Newman 2007), and interviewed different personnel from different professions in healthcare as well as chief designers and developers at the vendor. I tried to avoid elite bias however, in my cases the number of people involved in the actual development of the system was limited, and I interviewed most of

them, but this did not give me knowledge of how the system was actually appreciated by other users. All interviews except for the group interview were conducted after I had got acquainted with the interviewees through participant observation. This means that for them I was not a complete stranger and they knew quite well already what my interests were. This will be reflected on in more detail in the section on reflection on methods. To minimize any social dissonance (ibid) I asked the interviewees to choose location for the interviews, and all interviews except for one were conducted in their own work place. The one exception was conducted at a local café. All interviewees gave me permission to tape record and use the data for my research. I tried to make the interview situation into a dialog where both interviewer and interviewee could gain new knowledge, yet it was not easy for me to know how much the interviewees gained from the sessions, but on two instances the interviewees thanked me for the discussion because they felt they had gained new reflections and insights.

All interviews were taped and transcribed in entirety by the researcher. I chose to do it myself because the writing gave me the opportunity to reflect on it while writing. The transcripts did to a limited extent also include non-linguistic observations (McLellan et al. 2003) like 'laughs', 'said humorously' etc. in order to express contextual information that might be necessary to understand and interpret the information.

3.3.3 DOCUMENT STUDIES

In addition to participant observations and interviews a large amount of documents were studied and used as empirical data. These were political strategy documents, historical documents of the GiLab project, including technical system and project descriptions, project minutes and written information sent to users. In the late phases of the PhD project documents related to the tender competitions were also studied. All these documents added to the general knowledge of the issues related to the making and scaling of Interactor.

3.4 DATA ANALYSIS

Data collection and analysis have not been separate activities, but continuous parallel processes. My main instrument for the analysis was the writing of the detailed case descriptions (see for instance Eisenhardt, (1989)). In this writing process the analysing was based on the principle of the hermeneutic circle (Klein and Myers 1999). This is a principle of human understanding in general and suggests that understanding is an iterative process of altering between the parts and the complex whole: Between the issues to be interpreted and the context. For me this implicated that this was a process back and forth between case writing, use of related theory and literature and data collection to gain new insight.

The writing process of both case and interviews were important for the analysis because the writing made me think about data in new and different ways. The transcription of interviews was important mostly because the slow speed made it possible to think it through while writing, and also because the writing itself made me remember things better. During the write-up of the case I had to think about how to represent the data and this made me think about the meanings of the data, it raised new questions and problems that I sought to find the answer to in either the data or in theory.

Theory plays a crucial role in interpretive research and it is used as a "*sensitizing device*" (Klein and Myers 1999) to view the world. The principle of dialogical reasoning (ibid) requires the researcher to confront the theory that guided the original research design (i.e., the original lenses) with the data that emerge through the research process. This was an iterative process where theory informed my initial choice of research problems and data collection, but also changed the data collection throughout the process and the questions originally being asked (DiCicco-Bloom and Crabtree 2006).

Using the hermeneutic circle implied that the different sources of data were all taken into consideration in the interpretation process, and the analysis of these data were done in different ways. In the analysis involved in writing the paper "Top-down or bottom-up? Building information infrastructures for healthcare" two separate case descriptions were made initially, and then these were condensed into a table comparing the cases on different themes. These themes were resulting from a tedious reading of the cases for analytic points. In the instances where one of the cases lacked information on a theme further data collection would be incurred. A similar approached was used in the paper "Users as designers of information infrastructures and the role of generativity" where generativity in different levels of the system and its environment was compared. However, also less formal analysing procedures have been used for analysing data. Particularly during interviews and transcription themes, questions and problems were identified. Sometimes this was followed up by new ad-hoc questions to the interviewee at the same time or by e-mail or informal face-to-face follow up at a later time. These themes also guided the preparation for new interviews. However, this was also done the other way around; when interesting themes came up during an interview I would go back and search older interviews, observation notes and other documents for related issues and themes to complement the picture.

This iterative process of going back and forth between case description, theory and data collection continued until I had a rich description of events, meaning and action involved in the process of making and scaling Interactor. After writing a detailed case description the case was examined for potential analytical themes that could be further developed into a paper, which yet incurred new iterations writing a case description that could fit into a paper format.

Central in the principle of the hermeneutic circle is the concept of preconceptions, i.e. preunderstandings, and how these preconceptions are a necessity for understanding. Understanding emerges from the interaction between the issues to be studied and the preconceptions (Klein and Myers 1999). Such preconceptions consist of prejudices, traditions or other socio-historical inherited biases. My preconceptions have been related to my socio-technical education, my experience from healthcare ICT as well as my emerging closer relation and knowledge about my cases. For me the experience and influence from my Well/DIPS colleagues and my own work with the product is definitely a preconception: "*Things that are familiar are extremely difficult to see clearly because of their very familiarity*" (Randall et al. 2007). Being so close might have narrowed my views and I might have lost sight of the total picture or nuances. The benefit of being an insider for the analysing process is the thorough knowledge of the field site that for instance makes it possible for the researcher to be better aware of body language and jargons within the cultural norms of the organisation or the group (Edwards 2002). Also related to preconceptions is the risk of becoming socialized to the views of the people in the field, and the deep knowledge of everyday work may be a challenge because the researcher may assume too much, be ignorant of situations and not be able to reframe their knowledge in light of new information (Coghlan and Casey 2001).

Thorough discussions of findings and data with my co-authors have been central in my analysing process. My co-authors have different fields of expertise either from their experience from studies of innovation and IS in healthcare or from their theoretical knowledge, and together we have been able to reach an understanding based on our dialog.

3.5 Reflections on methodology

3.5.1 ANT and Interpretivism: An impossible combination?

Through the generalised symmetry principle ANT takes a rather unconventional philosophical position by treating non-human actors and human actors the same and it is the view of actors and agency that have created the largest controversies on ANT (Amsterdamska 1990; Mutch 2002). Normally action is understood as an act by a human based on a rational choice, while agency is used to describe the capacity of something to act in a world (Gilje and Grimen 1993). ANT goes beyond this dualistic thinking: Human versus non-human actors, human action versus natural processes. Non-human actors, like technology, are part of networks and may contribute to action by allowing, permitting, influencing, hindering etc. something to happen, and intentionality is not a presumption for agency.

ANT allows for different interpretations and ways of application of this theory. I do accept the part that states that both human and non-human actors are capable of action, and that action is the result of the joint forces in the network. But for me this does not imply any strange form of granting intentionality, thinking or speaking to things. I accept that human actors have a set of characteristics that are unique for human beings such as for instance intentionality and moral. I also agree with the critics that ANT to a certain extent flattens the human actors (Mutch 2002) and have sought to complement ANT with interpretive research to broaden the research particularly to find the meanings as seen from the human actors. This combination of ANT and the Interpretive paradigm have been widely used in IS (for examples see Walsham (2006)). However there is not a general agreement that this combination is philosophically possible. Cordella and Shaik (2006) criticise the combination of ANT and Interpretivism based on the point of view that constructivism is a prerequisite for interpretivism: "*Interpretivism considers reality not as an emergent phenomenon, as in the case of ANT, but as the outcome of the process of interpretation of people*." Latour (2005) argues that interpretative approaches violate the basic tenet of ANT by limiting themselves to only part of the reality, the human actors. Despite these objections I find the combination useful. For me it has been important to not only study action from an ANT perspective, but also uncover the prerequisites for action: Goals, interest, and programs and anti-programs of action to get a deeper understanding of the meanings of the actors as well.

3.5.2 Choice of case

The choice of cases for my PhD-project was a mix of convenience and theoretical sampling (Eisenhardt 1989). Already in the announcement of the PhD-position it was indicated that the Interactor product was to be the theme of the research. However, the further focus and delineation of the cases were up to me and the cases as they are described in this thesis and the papers are the result of several influences. First of all the cases were convenient. They were ready at hand, so to

speak, because I had easy access to data from the development process. After discussions with peers I also got the impression that my access to the vendor was viewed as unusual, which in itself could be an appropriate criterion for choice of case (Eisenhardt and Graebner 2007). Theory has a large role in interpretive case studies (Walsham 1995), and for me reading different theories and literature from the IS field made me see clearer the interesting aspects of my cases and in that way guided me to include new issues in the case descriptions. This may be conceptualised as theoretical sampling (Eisenhardt and Graebner 2007). Activity factors (Baxter and Jack 2008) were also decisive in the delineation of the cases. From the outset of my PhD- project it was not possible to foresee what would actually happen in the development process of the Interactor product. Because I followed the actors and the actual actions (Latour 2005) I had to let that decide what to include in the cases along the way. And finally the time restriction of the PhD-project was determining the end of the cases, although the development process still goes on.

3.5.3 BEING AN INSIDER

The position as a PhD student was announced by Well Diagnostics (Well) in 2007 as part of the research program Tromsø Telemedicine Laboratory where Well was one of the partners. The theme of the PhD-project was decided in advance to be 'something' concerning Interactor. I applied and received the position in Well, and this position was continued after the merge with DIPS ASA, and my employment was also supposed to continue after the PhD project. The research project was financed partly by Well/DIPS ASA and Tromsø Telemedicine Laboratory in a joint effort to integrate research and industry. During this four years project I split my time by working 75% with my PhD and 25% for Well/DIPS ASA. Having a position within the organisation that the researcher is studying is not new in the IS community. One of the most renowned projects was within the Xerox-company. The project lasted for 20 years, starting in the late seventies and consisted by a group of anthropologists and computer scientists. The group was led by Lucy Suchman and a large number of publications in the fields of IS, CSCW, PD and ethnography resulted from this project (see for instance Suchman (1999)). Although it is not a unique situation to be employed by the company that I am studying, I feel that it posed some challenges that I will elaborate on below.

Firstly, I have strived to be independent and as neutral as possible. However, the close relation with my research field has influenced the research in several ways. Yet, I feel obliged to declare that there is no conflict of interest related to both researching and being an employee in the company. Conflict of interest is usually understood as whether the validity of the research is influenced by financial gains, and I have no financial gains from this research other than my wages. But also other interests like the desire for recognition and the need to compete successfully for research funding can be seen as conflicts of interest and may strongly influence the research process (Bekelman et al. 2003). However I do not think that either of these factors has influenced my research in such a way that I would name it conflicting interests.

When I started I did not know the theme or my colleagues in Well, and I started out as an outsider. However very soon, and more and more so, I felt like an insider. This was of course because I got to know my colleagues better, but also because I took part in the development process performing tasks like testing, writing user documentation, making minutes from meetings with users and finally deputizing as product responsible for the Interactor product. In many aspects I felt like going native

(Harper 2000). Below I present my reflections and experience related to being an employee and an insider to the field that I am studying.

3.5.3.1 Access and collection of data

There are many advantages of being an insider. Walsham (2006) lists several: In-depth access to people, issues, and data, enables observation or participation in action, and field participants may see the researcher as trying to make a valid contribution to the field site itself. These advantages were evident in my situation. In the beginning I made interviews with several colleagues in Well/DIPS. Later on I stopped doing interviews with them. This was partly due to the direction the research took, but also because it felt increasingly awkward to make interviews with people that I was very well acquainted with. Instead I increasingly used more informal approaches like just posing informal questions or discussing opinions.

On the other hand I increasingly used data sources outside the development team. I could expect them to be unwilling and dishonest because of my relation with Well/DIPS because studies have shown that field subjects may be less open if they perceive the researcher to have an interest in the case (Walsham 2006). Instead I experienced the opposite. The users that had been part of the development process were all quite willing to be interviewed. They all had a positive attitude towards the system and the vendor, and I do think that my affiliation helped me to get easy access to these informants. At times when I participated in meetings with users as a Well/DIPS representative, information that was interesting also for my research came up. In such settings the information I got was added to my other knowledge and used in the cases, however I never used direct quotations from these meetings in my writing. But still, these sessions made me wonder if the participants of the meeting would have discussed things differently if I had been there as an 'objective' researcher and not as a Well/DIPS representative, and hence if this would have made any difference to my interpretation.

My formal affiliation with DIPS restricted my access to some external data sources. One example was the procurement process in the Northern Norway Regional Health Authority, where all their employees could have only limited contact with representatives from potential vendors, and on these occasions I was seen as a representative for the vendor. In other situations it did not feel appropriate, based on on-going processes between vendor and customers, to start asking questions within the customer organisation because this might have been interpreted as critique or interference.

Finally, my employment in Well/DIPS gave me full access to all internal documents in the company related to the system and the project, including e-mails to and from the development team. This of course made that kind of data collection very easy. However, this also gave me access to documents containing information that would be characterised as business secrets. Examples of such were strategies related to product, prising, prioritising etc. Although many of these were relevant for my research they were of course omitted, or the cases and research questions were moved in another direction to avoid such issues.

As described above a large portion of my data collection was based on participant observations. However, since I was in the development team most of the time, also doing other things than primarily observing, then everything that happened related to Interactor was data. The challenge for me related to this became to know when to document these data by making notes in my diary and

when not to. During long term observations interpretations might be included as descriptions when field notes are not taken at the same time as the actual observation, and need to be based on memory in larger extent (Tjora 2006). This might have happened in my situation, because I realised afterwards that the notes in the diary often was of little use for my case writing, while a lot of what was not written down, but that was remembered and interpreted was used in the cases. In this way the case descriptions were the actual documentation of data. And in line with the hermeneutic circle (Klein and Myers 1999) it was also during the case writing that the needs for further data collection emerged.

3.5.3.2 Scope of research and results

My affiliation with the vendor also influenced the scope of the research and what kind of research questions that would be appropriate to pose. For instance, in the beginning I experienced some expectations towards doing evaluation or assessment studies of the Interactor product. However I felt uneasy about this and was afraid of stumbling into too many difficulties because I was an insider, and hence could have problems getting legitimacy in the research community as well as in the practice field.

Qualitative research often seeks to problematize an issue. In my position I had to be careful that the problematisation was not felt as a critic towards anyone. I did not feel comfortable criticizing our own product, my colleagues or my employer, although I was free to do so. Still, it felt easier and more appropriate to be critical towards my company than to be critical towards external actors. Being a representative of Well/DIPS I was sensitive towards contributing to bad relations between my company and other actors. Because of this I did not feel that it was appropriate to raise critical questions towards our collaborating users (if that should have been applicable), our customers, collaborating vendors or the healthcare authorities. But I also experienced the opposite as a challenge: Being too positive in my own case descriptions and findings. I therefore had to strive finding the balance both in research aims, presentation of the cases and discussions, resulting in an effort to problematize internal as well as external issues.

3.5.3.3 The researcher's influence on the case

My position in Well/DIPS gave me the opportunity to influence the product and the development process formally and informally. Informally through my discussions with developers and the product responsible, and more formally in the period were I deputized as product responsible. As a product responsible I was in the formal position to formulate user stories and prioritize these for the development team. However the Interactor product was one out of several products that I and the development team were responsible for and in my deputizing period little was done with the product. So, I think that my degree of influence on the cases have been limited and difficult to pinpoint.

3.5.3.4 My own role as researcher and employee

I have never perceived my dual role as researcher and employee in Well/DIPS as problematic. However, in retrospect I realize that this issue has crossed my mind occasionally, and that being an insider has at times been confusing. Dwyer and Buckle (2009) wrote about their experience of studying a group in which they were members themselves, and I find my own experience coinciding with their reflections quite well:

> "*However, when I was conducting my data analysis, I found myself writing both 'we' and 'us', and 'they' and 'them'. Sometimes I wrote myself into my research, and other times I did not.*

> *On further reflection, I realized I sometimes shared experiences, opinions, and perspectives with my participants, and at other times I did not. It is not that I sometimes saw myself as an outsider instead of an insider".*

They go on by discussing whether it is possible to be a pure insider or outsider, and argues that the researcher is somewhere between:

> "*We may be closer to the insider position or closer to the outsider position, but because our perspective is shaped by our position as a researcher (which includes having read much literature on the research topic), we cannot fully occupy one or the other of those positions*" (Dwyer and Buckle 2009).

The insider role was not evident in my writings. The case descriptions were written as a realist tale (Van Maanen 1988) in a third person voice and were I, the author, am absent from the text. In retrospect this feels a little awkward since I was part of the process, although to different degrees, throughout the period.

Several authors have reported on how insiders that are also employees of the organisations they are researching also have additional challenges. One is how researchers having both a formal role in the organisation and a researcher role might experience this as a conflict implicating loyalty tugs, behavioural claims and identification dilemmas (Coghlan and Casey 2001). Others have reported how the research findings of unpleasant issues for the company, such as unattractive organisational features or betrayal of confidence, may even danger the insider's future career within the organisation (Edwards 2002). Although these are issues that have been on my mind occasionally, I cannot say that they have been a problem.

4 RESEARCH SITE AND CASE: THE BIOGRAPHY OF THE INTERACTOR PRODUCT

This chapter describes the research sites and the case for this thesis. The case description is inspired by the biography of an artefact approach (Pollock and Williams 2010).

4.1 RESEARCH SITES

The research was mainly carried out at three sites: The vendor Well Diagnostics (Well)/DIPS ASA, the University Hospital of North Norway (UNN) and the Sentrum general practice.

The first phase of development of the system was carried out by the company Well in Tromsø. Well was a small company with 14 employees specializing in systems for communication and interaction across organizational borders in Norwegian healthcare. The product portfolio included products for secure and interactive communication between patients and healthcare organisations, and between different organizations within healthcare. Well had a tight cooperation with other vendors of different IS for hospitals and primary care with which the products of Well had to be integrated. Well was originally a spin-off from the telemedicine department at UNN and had close relations and a history of cooperation with several departments at UNN. In 2008 Well merged with the larger vendor DIPS. DIPS is the largest vendor of hospital IS in the Norwegian market with about 75% of Norwegian hospitals using the system. After the merge the former Well's products were included in DIPS' product portfolio. DIPS has approximately 150 employees, of which about 50% are developers. The main office is in Bodø, Norway, while the former Well's employees together with some new employees make up the Tromsø office. Most of the research was carried out in the Tromsø office.

The UNN located in Tromsø is the largest hospital in the Northern Norway Regional Health Authority. It has approximately 5000 employees and 600 beds. The hospital has 7 laboratories: Clinical biochemistry, microbiology, pathology, clinical pharmacology, immunology, the blood bank and medical genetics, conducting approximately three million analyses per year from GPs as well as from internal ordering physicians. Staff in the laboratories has a history of active participation in development and testing of new systems in the laboratories, for instance they were central in the development of the laboratory IS that is used by most laboratories at UNN.
The Sentrum general practice is located in the city of Tromsø. It has 6 GPs and 5 secretaries. The office is an active piloting site for new systems for general practice, and the office has a long history of cooperation with both Well and UNN. One of the GPs most active in the development of the Interactor product also has a part-time position at UNN with the responsibility for facilitating cooperation between UNN and local GPs.

In addition to these three sites a site visit and an interview was carried out at the University Hospital of Akershus (Ahus) which is one of the largest hospitals in the South Eastern part of Norway with 4700 employers and about 400 beds. The paper "Top-down or bottom-up? Building information infrastructures for healthcare" was a comparison of the Interactor case and a case from the Norwegian ePrescription project. This case was built on research from a number of sites: Several GP offices, pharmacies and public organisations.

4.2 ESTABLISHING A PROJECT

In 2001 UNN studied the use of resources and error rates related to their own laboratory activities. This study revealed that the paper-based orders from primary care often contained errors, lacked clinical information or had a mismatch between the paper-based order and the sample tube. In addition, manual and repetitive work in receiving the samples was considered a waste of resources. To assure quality in the reception of orders and samples, UNN saw the potential for an electronic system for orders from the GPs. The idea was that the ordering physician should not need to know the internal organization of the laboratories in order to make correct orders. At the same time the vendor Well had an idea for a system for electronic orders that was fully integrated both with systems in general practice and in the hospitals.

As a result, UNN and Well established a project, GiLab, aimed at designing a system that would enable the interaction between general practice and the laboratories. By committing themselves to cooperation in the project, they received approximately 30% of the total budget from Innovation Norway, a national institution supporting industrial development. One of the main strategies of Innovation Norway is to support development of products made for one customer, aiming to eventually sell it to a larger market. This project was in accordance with the Norwegian politics on industrial development focusing on innovation in the public healthcare sector and small sized companies from rural areas. The project was perceived to have the necessary potential and was granted financial support accounting for approximately 30% of the calculated costs in the project. This was in line with the ambitions of Well who reckoned that selling the product to more customers would increase the payback for the product. Also for UNN this was beneficial in the sense that the system would be further developed and costs could be shared between several customers. The project was ready to start in the beginning of 2006.

A project group consisting of administrative personnel and managers from UNN and Well were established. In addition there was a reference group with members from general practice and UNN. This group was actively used by the project group as advisors in the design process. At UNN there was also an internal group in the laboratories organizing implementation, doing testing and so forth. The GiLab project phase lasted for approximately two years. When the initial project came to an end Interactor was taken further as a commercial product by Well.

4.2.1 MAKING THE FIRST LOCAL SOLUTION FOR UNN (2006)

Well has chosen to employ agile development methods throughout the company. When they started to build a system for electronic orders from scratch, they faced many unknown factors. Initially they had some ideas for the technological concept, but the developers did not know the work practice of the users well enough to be able to develop the system on their own. They had also experienced earlier that users were not usually able to formulate their needs and requirements well enough. Well therefore viewed an agile approach as a way to make up for these shortcomings. An important value pervading agile methodology is the close relations between developers and users or customers. An agile approach implies that the developer gives high priority to satisfy the customer through early and continuous delivery of valuable software where changes of requirements are welcomed. The

design process of the early versions of Interactor was a collaborative effort between Well and these users. The project kept the initial discussions as short as possible and four months into the project, and in line with agile philosophy, Well presented a simple, but working solution to the customer, which let the users start using it right away. The idea was that when the users started to use it they could see how it suited their daily work, and they could correct the developers and give feedback on how it should be and in that way they could shape the solution together. The developers worked in short iterations where the programming was based on user stories that were results of requests or feedback from the users, and these were prioritised according to the degree of urgency for users or vendor.

To give the necessary feedback for the development process the users implemented the system in their daily routines. Users also performed functional and technical testing of the system. Four GP offices in Tromsø were included in the first pilot implementation and approximately 1000 electronic orders were sent per month. After pilot usage for approximately a year, more GP offices started to use the system and it gradually evolved into regular use. The pilot user group included physicians, biomedical laboratory scientists and computer support personnel in the laboratories and GPs and secretaries in the GP offices. User experiences with the new work practices and routines were reported back to and discussed with the developers and changes, fixes and new functionalities of the system were released continuously. The resulting changes ranged from small details to larger changes such as new fields of use. Some required functionalities could demand rather small changes in the Interactor system, but incurred larger changes in the work flow of the GPs' electronic patient record system (EPR).

4.2.2 From the first simple Interactor solution to a highly integrated product

The very first solution satisfied the minimum requirements to enable submission of an electronic order and was more or less a digitized version of the existing paper-based order. Based on the real-life use and testing they started from there, the iterations continued and the product was continuously changed and adapted to the needs of the users.

A fundamental idea for the architecture was to utilize as much as possible of the existing infrastructure in general practice, in the hospital and nationally, and integrate Interactor as tightly as possible to these systems. The Interactor component in the GP office is set up to automatically download presentations of the offered services from the hospitals. This component is fully integrated with the GP's electronic patient record system and the GPs can choose and order laboratory services or make referrals directly from the EPR. This made it crucial to establish a close relationship with the vendor of this EPR system which was a market leader in the Norwegian primary care sector. The two vendors had already a long history of cooperation. To ensure commitment as well as sharing risk the EPR vendor was invited as partner in the project, and granted a share of Interactor sale incomes.

In the process of laboratory ordering, the system creates labels with bar codes to be stuck onto the sample tubes. The sample tubes are sent using regular mail or delivery service to the hospital laboratory, while the electronic orders are sent as ordinary secure e-mails within the national healthcare network. In the hospital laboratory the bar code is scanned and information from the order is transferred directly into the appropriate laboratory IS for the appropriate laboratory. The first version of Interactor was integrated with one laboratory IS in the biochemistry laboratory. All

information required for the presentation of services to the GPs was in this laboratory IS, but the system was not able to export this information. This implied total manual creating and editing of service presentations.

In accordance with agile methodology, the development had started at one end, integrating with one laboratory system and one EPR system. Now it was time for the product to expand, and the generification process at this stage was related to the different needs that emerged as the microbiology laboratory at UNN was included. This implied adaption to new work practices as well as integration with another laboratory IS. The work processes in the microbiology laboratory were different than the practices of the clinical biochemistry laboratory. The differences appeared in analysing techniques as well as in the logistics of handling the specimens and the information related to them. These differences in work practices resulted in different needs for the information content of the electronic orders. The first presentation of services from the hospital was a long searchable list of analyses, but when the microbiology laboratory's analyses were included, the list became too long and there was a need to organize the list differently. So far all editing of the presentation had been done by the developers, but with more laboratories and more frequent editing, the need to make this editing easier emerged. An editing tool was therefore developed making it possible for the hospital staff to be able to create or edit the presentation in an easy manner themselves. It also appeared that there were different work practices within the group of GPs. The presentation of laboratory services appeared as a choose-and-pick list for the GP. One way to make it more generic and to encompass the diverging work practices among the GPs was to develop a feature to enable the GPs to define their own 'Favourites'.

Figure 1 The Interactor concept shows the Interactor concept. The resulting solution includes components to be used either on the GP side, on the laboratory side, or in the communication between them.

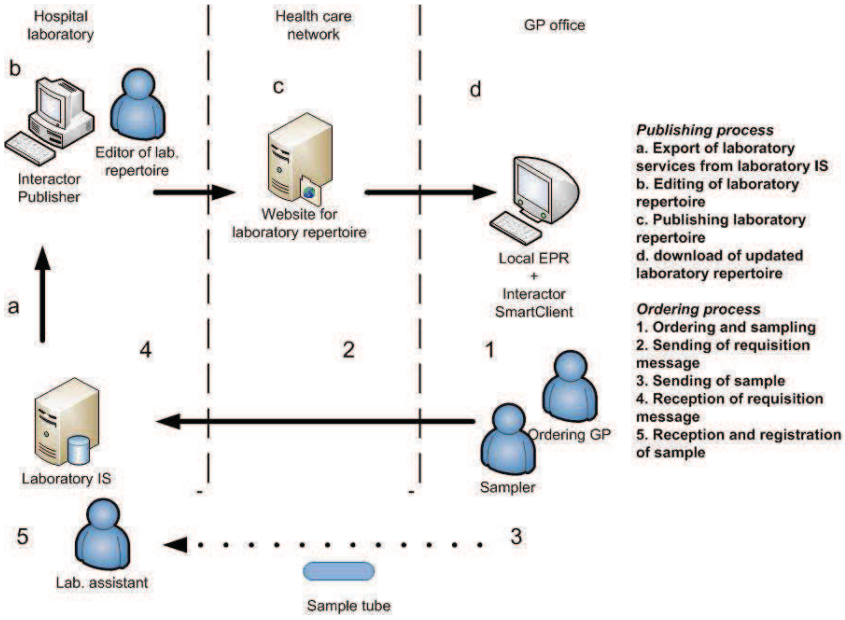

FIGURE 1 THE INTERACTOR CONCEPT

4.3 Moving out of the local context (2006)

While Well was in the process of developing the first version of Interactor, they won a contract for electronic laboratory orders at the Akershus University Hospital (Ahus). Ahus is among the largest hospitals in the southern part of Norway, serving a densely populated area around Oslo. For Well, this represented a breakthrough in this particular market and an important step towards commercialisation of Interactor. Being part of an agile development process, Ahus bought what had been developed so far at the time of purchase, and took part in the on-going design process of the system. This implied a new setting for the product with new customers leading to new requirements and new relations. The prioritisation of user stories took on a new dimension and Well had to face choices between new user stories entailing new functionalities and mere improvements of existing ones. Some of these had general interests for many customers, while others were based on the specific needs of one particular user. A need for systematic methods to handle the diverging needs emerged. Well attempted to align the users by arranging workshops and meetings between users from different customers. Another result of getting more customers was an increasing lack of direct contact between developers and users. Instead internal user proxies from Well or customer representatives acted as user proxies in the development process.

4.4 From Well Interactor to DIPS Interactor (2008)

In 2008 Well merged with the larger vendor DIPS. The name Well disappeared both as company name and product name. In the short run the change of name was the largest change resulting from the merger for the Interactor product. With the new company there were a few changes in development methods, but in practice the actual development continued in the same way with the same people. However the surrounding organization changed with more formal procedures and decisions. For the development of Interactor this implied better access to resources on administration and marketing, but it also implied a competition with other products about resources for further development.

4.5 Beyond laboratory orders – extension to referrals (2009)

The extension of Interactor to referrals was initiated through two different projects, one at UNN and another at the Ahus. The project at UNN was a research project aiming at evaluating the effects of direct referrals from general practice to surgery at the hospital. At Ahus the aim was to improve quality by providing guidelines for particularly complicated problems or diagnoses. The two projects collaborated on an informal basis and their needs for technical solutions were quite similar. The solution became an even tighter integration with the GP's EPR than for electronic laboratory orders.

4.6 A national tender competition (2010)

Due to an increased demand for electronic laboratory orders the Northern Norway Regional Health Authority and the South-Eastern Norway Regional Health Authority initiated large coordinated procurement processes for all hospitals in these regions. The result of this process was that further deployment and development of the system was stopped for one and a half year. In order to secure

adherence to international legislation they announced international competitive tenders. The requirements specifications were quite similar to the Interactor product and DIPS participated in both tender competitions. User representatives participated in the specification processes, but not all user groups were represented in this process. To secure equal treatment of potential vendors and independence of the customer the Northern Norway Regional Health Authority put restrictions on all communication between hospital employees and the vendors. This implied that the close cooperation between developers and users in the hospitals stopped.

The resulting requirement specifications were comprehensive and detailed and included specifications of product and deployment. Contracts were signed between preferred vendors in 2011. In the Northern Norway Regional Health Authority DIPS won the contract and further development and deployment will continue, while a competing solution won in the South-Eastern Norway Regional Health Authority. The requirements specification from the Northern Norway Regional Health will now serve as the basis for further development of Interactor.

4.7 STATUS OF USAGE (2011)

The system is presently in use for laboratory orders at UNN, Ahus and seven other hospitals in south-eastern part of Norway. Approximately 60 GP offices are using the system. UNN and Ahus are also using the system for referrals, with six GPs in Ahus' catchment area and installations in all GP offices in Troms County (part of UNN's catchment area).

Table 4 Timeline of the development of Interactor below shows an overview of the development process of Interactor.

Early 2006	Innovation Norway decide to support the GiLab project
June 2006	Well Diagnostics wins the contract with Ahus
September 2006	Start of the clinical biochemistry pilot at UNN
Spring 2007	Start of the generification to the Microbiology laboratory
September 2007	First pilot for Interactor at Ahus
Fall 2007	Pre-project Innlandet and Asker and Bærum hospitals
Fall 2008	Start of the microbiology pilot at UNN
Spring 2009	Start of project for interactive referrals
Spring 2010	Tender competitions in Northern and South-eastern health regions

TABLE 4 TIMELINE OF THE DEVELOPMENT OF INTERACTOR

5 RESULTS

This thesis includes six papers published or submitted to conference proceedings and peer-reviewed journals. The papers' titles are as follows:

1. Lightweight methods in heavyweight organizations
2. Integration and generification – Agile software development in the healthcare market
3. Pilot Users in Agile Development Processes: Motivational factors
4. Users as designers of information infrastructures and the role of generativity
5. Top-down or bottom-up? Building information infrastructures for healthcare
6. Scaling of an information system in a public healthcare market – infrastructuring and generification

The papers are from different stages in my PhD-project, and have been written with different authors. They are presented in the order I wrote them, and in that way they also illustrate how my PhD project has evolved. The papers illuminate processes related to expanding small local IS into large scale integrated IS, viewed from the perspectives of users, vendors and public authorities.

Paper 1 is further developed into the paper "Lightweight Design Methods in Integrated Practices" which is accepted for publication in the journal "Design Issues". However the format of this journal did not allow for the same detailed case descriptions and discussion, and I therefore chose to include paper 1 instead. Paper 3 is rather short, and is therefore lacking a theory section and a detailed discussion. This was due to the limitations to length of the manuscript in this journal. I have tried to make up for this shortage in this thesis, and have therefore included a section on motivation, which is the main theme of paper 3, in chapter 2 *Theory and related research* and a thorough discussion of the findings in chapter 6 *Implications*.

The rest of this chapter contains a summary of each paper and an overview of the findings.

5.1 PAPER1: LIGHTWEIGHT METHODS IN HEAVYWEIGHT ORGANIZATIONS

This paper studies the first years of Interactor, from the initiation to when electronic laboratory orders were implemented in several hospitals. The main focus of the paper is related to user participation as seen from the users themselves and from the vendor's perspective. The aim is to contribute to an understanding of how PD plays out in emerging large-scale IS projects. The system was developed using agile methods.

Firstly, the paper elaborates on user involvement in the Interactor project as it evolved from a small-scale system, to include more laboratories at the hospital, and finally to include other health regions in Norway, i.e. becoming a more complex II. Interactor depended heavily on integration with a conservative existing laboratory infrastructure and systems in general practice. These dependencies increased the complexity which made it difficult for single user-groups (or a practice) to have full

overview of limitations and possibilities in the infrastructure hence limiting the actual user participation.

Secondly, in agile methods and in PD research the user role is considered to be clearly defined. However, given the emerging complexity of the organizational setting, the user role showed to be increasingly blurry: New user groups (like secretaries) emerged, there were complex relationships between different users groups, and users in hospital were both customers and users, while the GPs were end users and not customers. This implied an imbalance in perceived usefulness of the system, and it became difficult to involve GPs from primary care. In addition, since the hospital was the customer of the system the hospital decided in case of disagreements among the different user groups.

Thirdly, the paper discusses how the vendor had to face the full complexity of large-scale health organizations as it grew in size and scope, and how this undermined the neutral vendor role ascribed to agile engineering methods. During the project the vendor had to take some crucial choices about the new technology and on organizational consequences of a new system, siding with some users at the expense of others.

5.2 Paper 2: Integration and generification – Agile software development in the healthcare market

This paper also studies the first years of Interactor, evolving from a small tailored product to a more complex product sold in a larger market. For vendors a key dilemma in such processes is to determine how much local tailoring the vendor should offer, while at the same time making the system as general as possible. The aim of this paper is to contribute to strategies applicable to vendors who want to move their locally designed and highly integrated systems to a larger market. A further aim is to explore how such systems developed for a local practice, and tightly integrated with the existing infrastructure, can be adapted to a larger market. The analysis draws on the CSCW field, notions of generification of packaged software products, and boundary work.

First the paper explores how the vendor negotiated the boundaries of its (initially non-existent) product with regard to the systems from the other vendors, and how they later increasingly created space for themselves as their product emerged successfully. As the product's basic functionality was dependent of the systems in general practice and in the hospitals this required negotiations with the other vendors of the borders of the product.

Secondly, the paper examines how the vendor aligned the increasing user groups from different contexts throughout the process to obtain common requirements. The vendor aimed at moving user requirements to a public arena by arranging workshops to get feedback from the users and to facilitate exchange of experience among the users. Some coordination among the users occurred and they learned from each other's work practices, but there were limitations to how far it was possible to align them. The vendor therefore created a tool enabling easy tailoring to local needs and work practices.

Thirdly, the paper analyses how the roles of the actors actually changed as the vendor obtained a larger market share. The integrated setting made the user roles mixed up in a set of other roles, and

the boundaries between the user groups in the different organizations were not that clear and especially not when it came to making decisions. In the early phases the developers could work closely with the end users, but as the system was sold to more hospitals, the user role gradually changed into a customer role. We also saw that the end users, the GPs, tended to be represented by intermediaries such as customer representatives from the hospital, and the vendor had to make informal contacts with them to get direct feedback.

The strategic implication of the findings for a small vendor is the need to engage in boundary work from the start, to anchor the product and find its place in the landscape with the larger vendors. This requires much patience as the vendor depends so much on the priorities of the other vendors. It also implies that the vendor must expect to engage in the boundary work with the different users groups. This work is tedious and will require that the vendor invest much time and effort by trying to mobilize.

5.3 Paper 3: Pilot Users in Agile Development Processes: Motivational factors

This paper goes deeper into the motivational aspects of participating in design processes and is based on interviews made with some of the pilot users of the system. The extra burden on the pilot users was substantial and on-going in setting up new work processes, and by testing and providing internal support. Despite this the pilot users have remained highly motivated throughout the process. The paper discusses how collaboration between users and developers evolve. The pilot users reported experiencing their roles as designers, more than mere users, and the paper conclude that distinctions between users and developers may distract from the real contributions of users.

The paper further discusses key motivational aspects at play when users volunteer and continue contributing in the face of considerable added burdens. It was an obvious and underlying premise for interpreting the pilot users' experiences that they were highly motivated to acquire the system. Also, the agile method in itself was mutually motivating for pilot users as well as developers by immediate incorporation of the system into real life use. The presumed asymmetry in benefits of the system between users in general practice and at the hospital was addressed from the outset of the project by aiming to make the ordering process more effective for the GP practices, as well as improve the safety and effectiveness of receiving samples at the hospital.

The paper concludes by listing up factors to foster motivations of users:

- Facilitate attitudes of mutual collaboration by acknowledging the users' role as co-designers.
- Promote arenas that enable good working relationships between the user groups.
- Create an early win-win-situation where all user groups develop something they genuinely want and can see immediate benefits of.
- Developers' quick response to user input.
- Facilitate events where users can demonstrate their acquired expertise and contributions to peers and be acknowledged for it.

5.4 Paper 4: Users as designers of information infrastructures and the role of generativity

This paper proposes the notion of generativity as a framework to assess generative socio-technical characteristics of II. Further, the paper discusses the role these characteristics play in users' involvement by exploring in which ways users can contribute as designers and thereby expand on the conceptual views of users and design processes of generative II. The paper is based on interviews of users and also developers of the system. Theoretically, the paper draws on the concepts of web of users and developers as well as research on II and generativity as a way of assessing the nature of IS in terms of ability to build on the infrastructure.

This paper showed how socio-technical characteristics of the II to be designed influenced the roles that users play and the nature of the design processes. More specifically; the system must be flexible enough to be changed by the users. We found the generativity concept as it was coined by Zittrain (2006) to be a useful framework to assess the flexibility of II. The paper showed that a high degree of generativity in the system itself is a necessary condition for the users to make changes. However, the case also showed that in an integrated and complex setting like an II, generativity in the system is not enough; it also depends on the generativity of the installed base.

Given a high degree of generativity in the II users have opportunities for playing major roles in the design of the system. This gives rise to new ways of viewing design as well as user roles. Distinctions between users and developers have been recognized as blurry and changing, and this is supported by the Interactor case. These roles and the influence the groups had on each other were performed and changed in interaction with different circumstances, relationships, phases of design and system characteristics. The fact that these changes were constructive, rather than chaotic, were in large part due to the time and effort put into measures that facilitated good working relationships between users and developers throughout the design process.

This paper supports the infrastructuring view of IS design, but further suggests a co-constructed view of design which also encompasses the design of work practices that accompany the technology. We saw how the technology had to be used during the design process in ways that also encompassed the design of work practices in a continuously iterative process. The design of work practices is arguably the users' most valuable contribution to the design process and agile methods can be well suited to elicit their contributions.

5.5 Paper 5: Top-down or bottom-up? Building information infrastructures for healthcare

In this paper the Interactor case is compared with the Norwegian ePrescription project aiming to establish electronically sent prescriptions in Norwegian healthcare to control public-sector financial aspects of medication distribution, faster writing and handling of prescriptions, reduce errors and give patients the freedom to choose pharmacy. The ePrescription project was established with a 30 million Euros grant from the Norwegian parliament for a six-year period. The Directorate of Health was put in charge and had a strong focus on keeping budget and time schedule. The project was organized into four sub-projects representing the stakeholders. The development was run according to the waterfall principle with requirement specifications made by the sub-projects. The first version

of the ePrescription system was highly influenced by the requirements from the authorities and the pharmacies, but it showed to be insufficient and after a short pilot implementation the pilot was aborted. Version two was made after strong pressure from the GPs. After two years the second version was pilot tested with reasonably good results, however the project had overrun both time and budget, and project management has been much criticized.

By comparing the Interactor project and the ePrescription this paper actually compares a large scale top-down project with a small scale bottom-up project. The paper explores how inter-organizational IS projects can be organized and run. In particular the paper discusses bottom-up and top-down approaches to project organization and development models including conditions for user participation.

The ePrescription project was initiated from a top-political level and was organized in a top-down way. The project used the sequential waterfall model for development, which pre-specifies the complete system before the developers start to make the software. Both the top-down organizing and the waterfall development model incorporate the best intentions of time and budget control, but they presuppose a predictable and stable environment and future. However, the ePrescription case showed, in line with experience from other projects and research results, that the environment is unpredictable and unstable. The project seemed to grow in scope and time, and the requirements specification became huge. The large scale also made user participation difficult. The project was run for several years without any participation from 'real' users. The user participation was organized in a way that resulted in isolation between the end users and the developers. The upside of this project was of course high level political and administrative anchoring and support which seems important for a national project. The bottom-up Interactor project on the other hand succeeded with their iterative approach to development and implementation and the way they involved the users from the outset and throughout the project. However, this was only evident in as long as the scale of the product was relatively small. The further expansion to new customers in the bottom-up approach was hampered by public purchasing legislation.

The paper argues that in a real setting, the step-by-step strategy would be preferable, but needs better conditions for continued growth. A middle position on the organizing and development methods of such large scale integrated IS is therefore suggested. This would acknowledge the changing context, government bodies would be just one of several equal units in a network, and the role of the public body would be to facilitate rather than command and control. This would ensure a high level anchoring and ensure co-ordination into one coherent service. The development processes must be agile, but must at the same time adhere to overall goals and overall plans for integration. In this way all design issues could be shaped through a participatory process involving real users.

5.6 Paper 6: Scaling of an information system in a public healthcare market – infrastructuring and generification

This paper explores the making and scaling of public healthcare IS, and how the conditions to scale a component changes for the vendor. It asks how the making and scaling of a healthcare IS can be done and by whom. It also asks what scope for manoeuvre there might be for vendors aiming to expand their market. The paper describes briefly the first phase of making and scaling Interactor, and goes

more into detail on the large-scale procurement process in Northern Norway Regional Health Authority, and the implications this had for the vendor and users.

The paper demonstrates that the making and scaling of IS is not always by means of evolution, as the literature suggests. It may be evolving, as in the first phase, but it may also be achieved in different, larger steps, as in the second phase of the case, during which a few large actors designed and planned to implement the new solution for many users. The evolutionary aspect of II presupposes openness where many actors are more or less free to establish and integrate new components. However, the public healthcare market is not an open and free market. Instead, it is dominated by a few central actors on the demand side, where establishment of the infrastructure is regulated through procurement directives. Public authorities had multiple roles in this process. National innovation policy makers and funders of innovation had a facilitating role, while the regional health authorities had a more direct role in designing the II.

The paper discusses the notion of infrastructuring and suggests that in addition to the work done by end users this concept should also encompass work done by and for other users, for instance ICT staff. From the vendor's perspective, infrastructuring is a process of generification. In this paper these strategies related particularly to the need to participate in tender competitions. Some of the II literature suggests a somewhat passive role for the human actors, and that the II has a life of its own. However, this paper suggests that the concept of infrastructuring implies that the making and scaling of IS is something that requires action and agency from the participating actors, who are likely to have different and often competing preferences, aims and agendas.
The paper demonstrates different conditions for the vendor in the two phases: From considerable freedom in a smooth and agile development process, to the more rigid procurement process where the vendor largely lost control of its product, and had to adhere to requirements specified by the regional health authorities.

5.7 OVERVIEW OF PAPERS AND FINDINGS

Table 5 *Themes and contribution of the different papers* offers an overview of which actors are involved, theme and contribution for the different papers.

Actor	Concept/Theme	Paper No.	Conceptual contribution and empirical insight
II	Characteristics	1	The more complex the more limitations on participation
User	Roles	1	Increasingly blurry. User-customer relationship
Vendor	Strategy	1	Need to take a stand on user issues
Vendor	Strategy	2	The need for and nature of negotiating the boundaries of an integrated system with other vendors
Vendor	Strategy	2	Tailoring vs. general requirements and the coordinating/ aligning user groups to
User	Roles	2	Changing: from users to customers
User	Motivation	3	Factors to foster motivation
User	Roles	3	Unclear. Users felt as designers
User	Contribution	4	Main contribution is through designing work practices and using the technology
User	Role	4	Changing, needs to be nourished
Vendor	Developers role	4	Changing, needs to be nourished
II	Characteristics	4	Possibilities for design determined by the generativity of the new technology and the installed base
Government/ vendor	Methodology	5	Pre-specification (waterfall) vs. agile
Government	Project management	5	Top-down vs. bottom-up. Conclusion: middle position
User	Role	5	ePrescription: purely as users, included only in pilot implementation. Interactor: part of the design process
Vendor	Developers role	5	ePrescription: not part of the design/specification process
Government	Role	6	In direct and indirect governance
User	Role	6	Consequence of government's role
Vendor	Role	6	Consequence of government's role

TABLE 5 THEMES AND CONTRIBUTION OF THE DIFFERENT PAPERS

6 IMPLICATIONS

In this section I will discuss the implications of my research. Van der Ven (2007) divides knowledge into scientific and practical knowledge. Scientific knowledge is viewed to be committed to building generalizations and theories that often take the form of formal logical principles or rules involving causal relationships. The purpose of scientific knowledge is to see specific situations as instances of a more general case that can be used to explain how something works or can be understood. Practical knowledge on the other hand is context situated based on problems encountered in everyday activities. This knowledge is typically customized, connected to experience and directed to the structure and dynamics of particular situations. According to van de Ven (2007) these two types of knowledge may complement each other to get a better understanding of the world. I will try to follow this distinction in this section by outlining the theoretical and practical implications of my research. Finally there will be a small discussion on methodological implications of my research.

6.1 PRACTICAL IMPLICATIONS

This thesis will contribute with some empirical insights on how the making and scaling of large scale integrated IS in public healthcare might play out in practice. It will also describe the actors involved and their roles, strategies, motivations and relations.

6.1.1 THE MAKING AND SCALING OF IS: A HETEROGENEOUS ASSEMBLAGE OF HUMAN ACTORS

The heterogeneous nature of II could be described as a heterogeneous assemblage (Pollock and Williams 2010). But this heterogeneity does not only relate to material heterogeneity, but also to heterogeneous human actors. In the making of II there is not one vendor and one group of users like in smaller IS. This implies that there are several vendors, user groups and also public authorities that are closely related and where all actors depend on each other in some way. These actors may have contradictory and competing strategies and aims (Aanestad et al. 2005) that will influence the process and the result of the building process. This section will elaborate on some of these relations and strategies.

6.1.1.1 Using agile methods to compensate for unclear and changing requirements

One major challenge for vendors is to find ways to make the product fit the needs of the users. For Well/DIPS the use of agile development methods (Beck 2000) was a pragmatic strategy (Greenbaum 1993) to develop the product by letting users participate and shape the product together with the developers. This choice was based on their prior bad experience with the waterfall method (Lyytinen 1987; Royce 1970) which they viewed as too static. They had also experienced that the customers were not able to define their requirements clearly enough as presupposed in the waterfall method and in addition the developers lacked detailed knowledge of the work practices of the users. The choice of agile methods made the developer role different than in traditional development projects where developers are supposed to implement the requirements that is specified by someone else by doing the programming (Grudin 1991). In the agile Interactor project, on the other hand, the developer role was more unclear and complex. The developers wrote the user stories (Rittenbruch et al. 2002) based on the discussions with the users, and with conflicting requirements they needed to take stance on issues related to customers and their use of the product, and could not remain

neutral doing everything the users wanted. The close involvement with the users and their work practices have resulted in an involvement in problematic organizational issues and consequences also in the users' organizations. In this way the political aspects (Greenbaum 1993) of involving users came to the fore and inevitably had to be dealt with by the vendor. Agile development methods are not tools for user participation as such, but this thesis argues that such methods facilitates for close collaboration with users and user participation in design. For developers these methods implicate a more involved role where they have to relate to everyday issues in the user organization.

6.1.1.2 Users motivated by agile development and virtue

The active participation by the users could not be taken for granted as their participation was both time consuming and at times frustrating. Despite this the users participating were for the most part highly motivated and committed throughout the development process. Particularly it seemed that the employment of agile methods was motivational in itself by the immediate incorporation of the system into real life use, the short development cycles with quick responses to feedback and users' involvement in the decision-making processes. The extrinsic motivational factors (Venkatesh 2000) were obvious: This was an opportunity for them to influence the design of the system, and an opportunity to get it fast. However the intrinsic motivational factors (ibid) were just as prominent: This was an opportunity for doing something interesting in their job giving them job-enrichment (Hertzberg 1987), a way to foster self-esteem (Maslow 1943), and to demonstrate their acquired expertise and contributions and be acknowledged for it. Intrinsic motivation fosters creativity: "*People will be most creative when they feel motivated primarily by the interest, satisfaction, and challenge of the work itself - and not by external pressures*" (Amabile 1998). The development of Interactor was a result of such creative users. But another type of intrinsic motivation, virtue (Benkler and Nissenbaum 2006), was also demonstrated. In this context virtue is the belief of doing something good for themselves or for others by volunteering to take on the extra work that their peer GPs, secretaries or biomedical scientist will benefit from. But the users also made clear that there was a common understanding among their peers that they would rotate and that someone else would take the responsibility of developing something for the community another time. But the high motivation was not evident in all groups at all times, and GPs showed to be difficult to mobilize into the project in the beginning. In this inter-organizational setting the benefits seemed unevenly distributed because the aim of the system was to improve the work process of the hospital while the GPs had to do the extra work using the system. Hence the GPs didn't immediately see the same usefulness as the hospital, so this problem had to be addressed from the outset, and the project sought to create an early win-win-situation where all user groups developed something they genuinely wanted and could see immediate benefits of. This thesis suggests the following factors to foster users' motivation: Facilitate good working relationships between the user groups, create an early win-win-situation where all user groups develop something they genuinely want and can see immediate benefits of, quick response to user input and facilitate events where users can demonstrate their acquired expertise and contributions to peers and be acknowledged for it.

6.1.1.3 Healthcare authorities' contradictory roles

The close collaboration between users and developers, and large freedom to develop the product according to the immediate needs of the users were only evident in the first phase of the scaling process of Interactor. In this phase the healthcare authorities had a facilitating role offering technical infrastructure, establishing standards and finances for the project. But healthcare authorities have

many overlapping responsibilities and their strategies for the making and scaling of healthcare IS reflect that: Delegation of power, financing innovation, large scale procurement and establishing and running large scale systems themselves. This became evident in the regional procurement process where the regional healthcare authorities took direct control of design and implementation of electronic orders by making detailed descriptions of the system. This specification document was made for trading and contractual purposes, but by making this document the regional authorities actually designed the system, and taking over some of the design work done by users and developers in the early phase.

6.1.2 *From evolution to large steps: changing conditions for development*

The second phase of the Interactor scaling process demonstrated that the public healthcare market is not an open and free market as the evolutionary approach (Hanseth and Monteiro 1998; Star and Ruhleder 1995) to the making and scaling of II presupposes. Instead, it is dominated by a few different public healthcare bodies on the demand side, and where establishment of the infrastructure is regulated through procurement directives. This situation was a change from the establishment phase of Interactor, and this change resulted in changed conditions for the development process:

- The creation and implementation of the initial Interactor product was made possible through public financing that enabled small vendors to collaborate with public bodies to develop a product that the public body needed. This was based in an innovation policy acknowledging that development of new electronic solutions needs creativity and leeway, and that it is difficult to manage or predict the exact outcomes of such processes. For the small vendor, this implied a financial safety net, close cooperation with end users and great freedom in the choice of the development methodology and features of the product. However, the tender process revealed another way of thinking about the building and managing of healthcare IS. In their tender specifications the Northern Norway Regional Health Authority proposed a process of system design with comprehensive and detailed specifications and implementation plans, and the development process had to comply strictly with the contract. Despite the common perception that vendors of such systems have full control over their product development (Halford et al. 2009), the Interactor case shows that vendors have only limited freedom in such development processes.
- Also the conditions for cooperation between vendor and users changed. While the first phase was characterized by close cooperation, on an equal basis, between the vendor and end users in the health service, whereby both parties could take advantage of each other's knowledge and experience, the second phase demonstrated different relationships. In this process a more formal customer-vendor relationship was established, based on contracts for delivery.
- In addition, the relation to other vendors changed. In the first phase, this interaction had easily been accomplished by including integrated vendors in the project group, where they took an active part in negotiating and prioritizing technical issues. In the tender process, the vendors of integrated systems were not part of the procurement process, but the system was still depending on changes made to integrated systems – although this integration was now largely outside the vendor of Interactor's control.

- The actual size of the procurement process also changed the conditions for scaling. Small businesses are the target for innovation support as in this case, and the attempt to take the small product into a larger market was in harmony with this innovation policy. However, such a process may not always be possible for small businesses, which may lack the capability to participate and eventually to win the tender competitions, and thus make it into the market. In this case, this was possible because the small company, Well, had merged with a larger company, DIPS, which had the resources and the experience to participate in such a large tender competition.
- While waiting for the tender process to finish further development of the product and rollout to new users stopped for one and a half years. Such delays and stopping the further rollout of the product may reduce motivation for users to participate further, and it may be difficult for vendors to ensure the future involvement of these users because their motivation for participation has been closely associated with influencing the process, and with the satisfaction of seeing the results of their efforts, when other practitioners use 'their' solution.

6.2 THEORETICAL IMPLICATIONS

Theoretically, this thesis will contribute to the conceptual views on the nature of a large-scale integrated IS in terms of use and change flexibility within the IS itself. It will also broaden the concept of infrastructuring by seeing it from the perspective of other users, the vendors and what strategies the vendors employ in the making and scaling of an IS.

6.2.1 TOWARDS A SOCIO-TECHNICAL UNDERSTANDING OF FLEXIBILITY IN II

The scaling of the II in terms of scope requires that it is flexible. By introducing the concept of generativity (Zittrain 2008) this thesis seeks to contribute to the theoretical discussions on flexibility of II. While the existing literature mostly suggests technical solutions to this challenge, the generativity concept directs us towards a socio-technical understanding of flexibility that includes both use and change flexibility. Generativity as it was coined by Zittrain (2008) is a socio-technical approach to flexibility which poses that the ability to change something is depending on both use and change flexibility. In a highly integrated environment like an II the degree of complexity and range will determine the degree of generativity. In such systems generativity in only one part is not enough, one should think of it as an ecosystem of generativity (Grimmelmann and Ohm 2010). In II terminology this means that also the installed base, i.e. the existing systems to be integrated with, needs to be generative. As any new part of an II is always built upon the installed base the new component inherits the installed base's flexibility or lack thereof, hence the installed base may both hamper and facilitate design. The more tightly integrated the system in question is with the installed base, the more the generativity of the installed base will determine the actors' ability to design something new. However the Interactor case showed that flexibility in the installed base is not a purely technological issue. Flexibility is just as much a social issue: It is about willingness to change and the balancing of needs and priorities. Zittrain's five factors for generativity are all related to use of the technology: It makes the task easier, it is easy to learn, easy to adapt etc. Hence, the generativity concept is a way to see how the properties of a technology relate to the users and their use and change of the technology. Infrastructuring is defined as all the activities and processes of integrating materials, tools, methods and practices that make up and change an II (Karasti and

Syrjänen 2004). This is portrayed as the appropriation, use and changes made by the end users. This implicates that for users to be able to do infrastructuring the technology needs a certain degree of generativity.

The benefits of generativity are innovation and potential for people to use their creativity (Post 2010), while the drawbacks are the possibilities of hostile access and changes that might cause security problems. For a healthcare IS containing much sensitive information and where large organizations are depending on these systems 24 hours a day these are serious issues that need thorough consideration. Designers of such systems will have to find the balance between encouraging and restricting generativity (Grimmelmann and Ohm 2010).

6.2.2 AN EXPANDED UNDERSTANDING OF INFRASTRUCTURING

The infrastructuring concept as applied in the II literature (Karasti and Syrjänen 2004; Pipek and Wolf 2009) focuses on the end users and their use of the technology. However, this concept ignores the contribution of other actors and users, and this thesis argues firstly, for including the contribution of other actors, like ICT-personnel, vendors and public authorities' into this concept. Secondly, this thesis argues for an expanded conceptual view of users doing infrastructuring, and hence their contribution in design.

One example demonstrating the first expansion of the infrastructuring concept; how infrastructuring could be done by other than end users, is from the purchasing process in the Interactor case. In this phase the system design was created on paper and in negotiations between vendor and regional healthcare authorities. In the planning and specifying of technical systems, integrations, work processes and implementation of II the Public healthcare authorities did the infrastructuring. In the procurement process the end users had very limited influence on the system design, while the opinions of the regional health authority's ICT staff substantially affected the solution. The ICT staffs does not simply deal with technical ICT issues such as support and technical implementation; they are also deeply involved in the procurement and specification of new systems for hospitals (Halford et al. 2009). The resulting contract strongly emphasized technological issues relating to the operation, maintenance and security of the system, issues that are relevant to the work practices of the ICT staff. In this way the ICT staffs are also users and the work done by them was also infrastructuring.

The second expansion relates to the user role and users' contribution. This thesis supports the view that the distinctions between users and developers are somewhat blurry and changing, and design processes may be viewed as an emerging web of users and designers (Millerand and Baker 2010). In the Interactor case the users continuously appropriated (Carroll 2004) the technology, by using it and making changes to the technology as well as the work practices. Although at first sight it seemed that the users' contribution was that of testing functionality in real life and giving feedback to the developers, eventually the users felt and acted as designers and took responsibility in the process. This thesis argues that the users' main contribution to the development of Interactor was by developing and adapting the work practices together with the development of the technology, and in that way acted as designers. This implicates a co-constructed view of design which also encompasses the design of work practices that accompany the technology, and an expanded view of users as designers of work practices.

6.2.3 *GENERIFICATION: THE VENDORS' PERSPECTIVE ON INFRASTRUCTURING*

The thesis also expands on the concept of infrastructuring by viewing it from the vendors' perspective. Infrastructuring from the vendor's perspective can be conceptualised as a process of generification, i.e. strategies to take a tailored product made for one customer into a larger market (Pollock et al. 2007). A new IS often begins as a small local solution, tailored to the needs of a few customers, and scaling from the vendor's perspective is about capturing a larger part of a market. However, going into a larger market is not just selling to more customers. The vendor needs strategies to balance the vendor's need for a generic product and the users' diverging requirements. It is trade-off between particularisation and generification (Pollock et al. 2007). In the Interactor case balancing the boundary between particular and general functionality included attempting to align users and making the parts of the software tailorable. In this case the market conditions changed throughout the process: From one where the vendor exercised considerable freedom, in a smooth and agile development process, to the more rigid procurement process. In this last phase, the vendor largely lost control of its product, and had to adhere to a contract largely based on requirements specified by the regional health authorities. For the vendor this implied that they had to change their generification strategies, and take part in the tender competition.

In an integrated context generification also includes boundary work towards other vendors and user groups. The expansion of Interactor to new hospitals and new laboratory specialties also implied new systems to integrate with in the hospitals and in general practice. The boundaries between Interactor and the integrated products were not obvious, i.e. what to be done in Interactor, and what to be done in the integrated products, and how the communication between the systems should be. Due to the emerging character of the system these boundaries needed to be continuously re-negotiated. This implies that vendors need to engage in this boundary work with other vendors from the start, to anchor the product and find its place in the landscape with the other products. This requires much patience as the vendor depends on the priorities of the other vendors. In an integrated context the boundaries between the different user groups are not necessarily obvious either. In the Interactor case the user groups belonged to different organizations, and particularly when some of these groups were not the customer of the product, this implied more demanding boundary work between the vendor and the users than otherwise would have been needed.

6.2.4 *PERFORMATIVE RELATIONS IN THE MAKING AND SCALING OF HEALTHCARE IS*

Performativity states that entities are performed in, by, and through the relations in which they are located. Performativity is about doing. However, this doing is full of tensions between different interests, taking control and being erratic. These tensions cannot be avoided; they need to be handled (Mol and Law 2004). Infrastructuring is about doing infrastructures. This means that infrastructures are enacted or performed. This again means that the outcome of the making and scaling process is unpredictable. The II literature describes how a strong inertia associated with the installed base, what is already existing (Hanseth and Lyytinen 2004), makes it difficult for any actor to do anything other than make small changes to the existing infrastructure. This suggests that there is only a somewhat passive role for the human actors, and that the II has a life of its own. However, this thesis suggests that the concept of infrastructuring implies that the making and scaling of II is something that requires action and agency from the participating actors, who are likely to have

different and often competing preferences, aims and agendas (Aanestad et al. 2005), and that this is a performative process. This implicates that the making and scaling of II is not just something that happens; it requires action and agency, and that all actors must actively engage in the design, implementation and use of the technology.

Performativity also implies that actors are related to each other in such a way that they make a difference to each other, and it is not always clear who is doing what. An actor is the result of both what other allows it to do and its own characteristics (Law and Mol 2008). This means for instance that roles, relationships and power is not given, but performed. In the Interactor case the user role changed from merely that of testing to that of designers. Also the predefined relations among the developers and users developed over time and became a result of the design process and depended on the context; they were performed. These close and informal relationships did not emerge by themselves: It required work and had to be nourished. It was facilitated by spending much time working together but also by social events. However these informal relationships were not that easy to maintain for the vendor in the transition from working directly with users to customer representatives. This process was challenging and confusing for all actors, and the vendor needed to establish strategies to maintain contact with the end-users. The power relations and influence was not given due to the initial roles in the project, this thesis rather argue that degrees of influence are performed, and circumstantial. Although the vendor was in a formal position users also had and exercised power. Also the power relations among the users groups were performed: The laboratory had the authority to configure the GPs' work practices. However, the GPs wielded influence by threatening to boycott the system (and laboratory) to impose their will.

A stable and durable network is just one of the possible outcomes of an actor network. There might be multiple networks which are complex, non-coherent, uncertain, and in interference with each other (Mol and Law 2004). In this thesis the vendor's perspective is prominent. However, infrastructuring is also a multiple story: The story of the users and how they were involved, the story of the vendor, and the story of the healthcare authorities. In the papers one might catch sight of a number of other stories, other networks and other outcomes: For the staff at Sentrum general practice participation in the development of Interactor was part of a longer process of making the practice paper-less, for Northern Norway Regional Health Authority the tender on electronic laboratory orders was just one of several tenders to acquire and implement coordinated and centrally operated clinical IS throughout the healthcare region, for the staff at the unit for receiving samples at UNN implementation of electronic laboratory orders was a story of technical and organisational problems and delays, for the national government the early development phase of Interactor was a successful innovation process. Telling any of these stories might have given a completely different picture of the making and scaling of Interactor.

6.3 METHODOLOGICAL IMPLICATIONS

The methodological implications of this PhD project is related to being employed in the company to be studied, and the unique opportunity this gives for contributing with knowledge to the company. This close relationship with the vendor would have been an extraordinary possibility to first of all get a common view on what research questions would be of interest for the company and secondly co-produce the knowledge from the study. In the book "Engaged scholarship" Andrew van de Ven

(2007) calls for a closer relationship between researchers and practitioners in order for the findings to have an impact on both science and practice. He defines engaged scholarships as: "*A participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems*". This implies that the organization to study is not just for collecting data, but just as much for discussing and defining the research questions and the findings. In this approach the field to study can be viewed as a learning work place where researchers and practitioners can co-produce knowledge. This will incorporate different perspectives on the problems and methodologically it will serve as a way of triangulation the findings. Action research is one possible strategy for engaged scholarship, but also other strategies are possible as long as it is some sort of joint effort between researcher and practitioners. Following such a strategy would have made the research more relevant for the vendor and other similar practitioners, and could also have increased the overall quality of the research. And finally, it would have been even more in line with the aim of the research program as this PhD-project is part of the Tromsø Telemedicine Laboratory which is to integrate research and industry.

7 CONCLUSION

7.1 SUMMARIZING COMMENTS

This thesis has aimed to provide some detailed empirical insights as well as expand on conceptual perspectives of processes related to expanding small local IS into large scale integrated IS. The empirical insights was drawn from the case of developing a product named Interactor which is an IS making it possible for GPs to order laboratory services from the hospital. Theoretically the thesis has mostly drawn on and contributed to literature on II.

The Interactor product can be conceptualised as a healthcare II (Hanseth and Monteiro 1998), and the making and building of this II can roughly be divided in two phases. The first phase was characterised by a small step and iterative approach where the product was developed with users participating actively in the process and according to the users immediate needs. The second phase was characterised by a large procurement process where the regional healthcare authority wanted to buy a system for laboratory ordering. The Interactor product was chosen and further development and implementation was done in large steps based on a detailed tender specification. In order to make and change a healthcare IS it must have certain generative (Zittrain 2008) characteristics. These are both social and technical characteristics, and include both use and change flexibility. But in anintegrated context generativity in the system itself is not enough, also the existing systems, i.e. the installed base, needs to be generative. The making and scaling of such large scale IS is not just the result of a technological momentum (Hughes 2000), it takes work and negotiations among the human actors involved. This thesis have categorised these actors into users, vendors and public healthcare authorities, each with a set of motivations and strategies. However the roles were blurry and changing. For vendors the process of taking a product from a local setting and into a larger market requires work and strategies. This is a process of generification (Pollock and Williams 2008) which implies to balance particular and general user requirements. But in an integrated setting it also involves strategies towards other vendors, and in a public healthcare market it involves strategies to handle a different set of regulations, and hence different conditions for development related to large procurements.

7.2 LIMITATIONS

Although this thesis is both lengthy and detailed it has several limitations. Firstly, the methods employed in this thesis include many details in the case descriptions, but it also involves many decisions to take continuously about which details to include and which details to omit. In this process important information may have been missed. Along the same lines decisions about which perspective to take has been made. Multiplicity (Mol and Law 2004) implicates that there are more than one reality and more than one story that could have been told. For instance, since this thesis has been about the making and scaling of the Interactor product I have mostly talked to and interviewed users that were directly involved in the development process. The other users that were just using the system have not been the objects of my investigation. However, talking to them might have given a completely different story and revealed other interesting questions and problems.

Another limitation has been the length of the research. The development process of Interactor is not finished yet, and it goes into a new phase presently as it is supposed to be implemented in all GP offices and all hospitals in the Northern Healthcare region. However, due to the time restrictions on my PhD project I had to stop the research here although it somehow seems incomplete. The biography approach that has inspired my research also suggests that several comparable cases should be studied to get a broader view. This thesis only adheres to this to a very limited degree in the paper "Top-down or bottom-up? Building information infrastructures for healthcare" where the Interactor case and the Norwegian ePrescription project is compared. However, finding other comparable cases taking a small tailored product into a similar market has been difficult.

Being an insider in relation to my case has been an advantage in many respects as described in the section *3.5.3 Being an insider*. Yet, this insider role of course also implies a danger of being too narrow minded with respect to the choice of research themes and questions, and data collection and interpretations.

7.3 FURTHER RESEARCH

As mentioned the Interactor product is just entering a new phase where it is planned to be implemented in large scale. This also means that the technology will be appropriated by many new users, and a new phase of infrastructuring will take place. Future research could address this new phase to study infrastructuring in large scale, and also study how the further product development will be influenced by all these new users.

The group of builders that has got the least attention in this thesis is public healthcare authorities. It would be interesting to see some more research on this group of actors, in particular related to how they seek to manage these large scale development and implementation projects that we have seen in the second phase of Interactor and the ePrescription project.

Finally, some more research on effects of large step building processes could be appropriate. This thesis has taken the perspective that making and scaling can be done both in an evolutionary and a large scale approach. However, it does not really take a stand on whether the large scale approach is a good approach. The paper "Top-down or bottom-up? Building information infrastructures for healthcare" has touched upon the effects on user participation and also project management of a large steps approach, but more research of effects is needed.

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Paper 1

Paper 2

Paper 3

Paper 4

Paper 5

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