FACULTY OF HEALTH SCIENCES
DEPARTMENT OF CLINICAL MEDICINE

"The road is made by walking"

EVALUATING THE IMPLEMENTATION OF A LABORATORY SYSTEM

Gro-Hilde Ulriksen

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Abstract

This evaluation of implementing LabCraft to the Bloodbank at UNN Tromsø aimed to reveal positive and negative issues of the process useful for future implementations. A qualitative method based on semi-structured interviews of different users five years after the implementation finished was the main basis for the evaluation combined with literature reviews.

Most of the problems with implementing LabCraft to UNN Tromsø were directly or in-directly caused by the struggle between the top-down and the socio-technical approach. The top-down management-controlled approach used at hospitals where standardizations, cost saving and efficiency is key factors, is challenged by the socio-technical approach, based on user participation, and room for local adjustments in the system. The roles the users have in the process directly influence the outcome of the process as well as the communication between the different actors in the implementation. It is clearly a need for more user participation in hospital implementations, especially in the pre-implementation phase. Users know the workplace best, and the important issues to include in a new system. The pre-implementation phase is where the foundation for the new system is established. To detect possible errors and flaws in the system in the pre implementation phase prevents challenges from occurring later in the process.

There were several important findings in this evaluation in addition to the need for more user involvement. When creating demands for the tender it is important to include all the needed specifications, for the new system to fit the needs of the Bloodbank. It is important to focus on including all parts of the system in the tender, including those that work well. The installed base and the information infrastructure are also important to consider. A too close attachment to the old system may prevent users from seeing the improvements the new system may bring. Some routines for conducting hospital implementations should be established as well as defining areas of responsibility for the different actors.

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1 Introduction

The implementation of new computerized systems is done frequently in the healthcare sector of Western Europe. This creates several new challenges both for the users, and the vendors of such systems.

"Developing a comprehensive medical information system appears a more complex task than putting a man on the moon (Collen 1995)."

This is due to:

"The health services and hospitals in developed economies are some of the largest and most complex organisational structures of all time (Johannessen and Ellingsen 2009)."

There is an increased focus on the need and advantage for such systems, but until now most of the implementations of these applications has failed to be successful (Berg 1999). The health-care sector, and especially the modern hospitals today, consists of several systems from different vendors (Johannessen and Ellingsen 2008), and introducing additional systems is a complex and complicated process. Many of the implementations fail their expectation and create additional work instead of making better and easier solutions for the users. Rather than a new and improved system, the end result is one that only partially works, and don't fit the information infrastructure at the hospital.

Implementing a new laboratory system to a complex organization as a hospital is a challenging and troublesome process. When implementing a new system it is important to establish good collaboration between users, management and vendors. This is done to give the users an understanding of possibilities and limitations in the new system. Also this will help the vendors to create a system that meets the needs of the workplace, and contribute to show management what users needs from a new system to enrich their workplace. The healthcare sector in most western countries is very fragmented across technical, organisational and professional boundaries. This creates a healthcare service that do not benefit the patients (Ellingsen and Munkvold 2007). Therefore it is necessary to take the time needed and the

work required to work towards standardization of such systems. Standardization is done to make a more unison system that can be managed, updated and run from one place.

"System integration would provide the platform for improved workflow, patient throughput and patient safety, as well as decreased cost(Ellingsen and Monteiro 2005)."

But are there room for standardized systems in specialized areas as the Bloodbank, or is there still need for local adjustments here? The process of implementing a new system is traditionally a top-down process controlled by hospital management. The question is if a more socio-technical approach in heterogeneous organizations as hospitals can be beneficial, or if this complicates and slows down the process instead. Users are they useful or useless in this process?

Health Authority North Norway implemented in 2006 a new laboratory system, LabCraft, at the Bloodbank of the University hospital of North Norway (UNN) in Tromsø as a part of getting the same standardized system for all their 11 Bloodbanks. Lack of user involvement demanded for a lot of extra work to define the implementation process and the new system a success.

This evaluation will address this implementation process in Tromsø, based on a qualitative method. The foundation of this evaluation is the interviews with several actors in this process and their interpretations of the implementation. In this case it was interesting to explore how the implementation process affected the Bloodbank and the existing information infrastructure, and to see if there were room for improvements in the implementation process. It was important to focus on the need for future laboratory system implementations to see the workers not just as passive receivers of the system, but also as active actors who creates the context, circumstances and consequences of the new laboratory system.

1.1 Outlining of the thesis

Chapter 1 Context and introduction:
This research will be limited to the Bloodbank of UNN Tromsø and leave out the other 10 Bloodbanks in Health Authority North Norway.

Chapter 2 Theory:
This is the theoretical framework based mainly on online research and the syllable from the telemedicine program. Top-down approach, socio-technical approach, information infrastructure and standardization are the topics addressed here.

Chapter 3 Method:
This study is based on a qualitative method with open-ender interviews of different actors. Also a reflection of the method and the interview process is found in this chapter. Issues like getting access to a workplace, researcher role, and study form is discussed.

Chapter 4 The study:
The focus of the study is on issues like the "bid for tender" process and the pre-implementation phase. The benefits and challenges this implementation created were important to look at, and also how they matched the expectations of the users. Also the cooperation's between the actors in this process, the installed base and the new system and within Health Authority North Norway is found here. The time and resources used in the project and how the system is supported is also looked into.

Chapter 5 Discussion:
Key points are discussed like the dilemma between a detailed tender to satisfy users and a general enough tender to get any vendors to apply. The need for more user involvement vs. the need for management control, and the distance to the installed base and the information infrastructure is addressed here. A balance between standardization and local adjustments is looked at. Time and resource use in the implementation process is also addressed here.

Chapter 6 Conclusion:
In this part focus is on the findings and the success of this evaluation.

1.2 Research questions

1.2.1 The goal of this research

This research will be evaluating the process of implementing the laboratory system LabCraft to the Bloodbank at the University hospital of North Norway in Tromsø.

1.2.2 Research questions

- How can the implementation process improve from replacing the management controlled top-down approach with a socio technical approach managed by users?

- Why is it important to consider the installed base and the information infrastructure in hospital implementations?

- In what ways can standardization of Bloodbanks be challenging and necessary?

- Why is there a need for procedures and guidelines for how to conduct implementations for computerized laboratory systems?

- How can cooperation between actors strengthen an implementation process?

The implementation process is finished, and this research can therefore follow the process over time.

2. Theory

In this section some of the important theoretical aspects of the thesis will be defined and explained. It is useful to see how a top-down and a socio-technical approach can influence the process of an implementation. Also the balance between standardization and local adjustments are important to address and closely connected to the previous issue. The way a new system fits the already existing information infrastructure, and installed base can help determine the success of the implementation so these factors are also important to include.

2.1 The top-down approach traditionally used in hospital implementations

At Norwegian hospitals the top-down approach is traditionally used for system implementations. When it comes to investing in IT based systems hospitals have to go through centralized tender processes. The top–down approach is a hierarchic design with a centralization of power at the top (Stream 2010). This structure creates a clear path of authority, and help increase productivity and efficiency at a workplace (Stream 2010). The top-down approach attempts to standardize the implementation process, and make it more efficient and cost saving (Ellingsen and Monteiro 2006). In a traditional top-down process, system engineers design the functions and features of new systems without any user involvement. Instead they use computer-aided design tools and standardized forms to capture and formalize the results of a design process (Scacchi 2003). A top-down approach for implementing an information system anticipates the essence of a work practice to be caught in pre-fixed workflows, formal task descriptions and pre-defined models (Berg 1999). All the designing and developing of a system is done before the system is released (Johannessen and Ellingsen 2008). The users are presented with a more or less finished product. Often it is almost impossible to make changes to the system without rewriting the whole program. As a result the workers have to adjust their work to the new system, to make it as good as possible for their workplace (Kaushikj 2009). This demands a lot of fitting, augmenting and work-around for the users of the system (Gasser 1986). Top-down methods are useful when interaction with the customers is limited and the instructions for the processes are very clear

(Kaushikj 2009).

In a hospital setting the consequence is that the decisions concerning new investment, and implementations in e.g. the clinical or laboratory practice, is mainly made by the hospital or health trust management and not the practices where the actual system will be used. This increases the risk of getting a system that is based on priorities like cost saving and goals of standardization rather than usability for the workers. All the important decisions connected to the process like what system to choose, when to start the implementation process, and how much time to use preparing for the implementation are made by the management. This gives the users a passive role in the process and no chance of controlling what system they end up with.

A large-scale "bid for tender" process performed at the top level of the hospital is a typical example of a top-down approach. By using a formal tender process, the hospital can document that the preferred vendor is selected fairly, quickly and efficiently (Method-123 2010). To make sure that resources are used as good as possible, the government has decided that public purchases will as far as possible be based on competition between vendors in an objective and non-discriminating process (Regjeringen 2011).

This "bid for tender" contains parts like:

- Scope of the work: Including any associated work such as providing ongoing system support and training of staff. It may also include asking for the experience of the vendor and their view on future developments (The.project.management.hut 2007).

- Supplier profile: This should describe what the supplier must demonstrate to be considered for the tender. For example: previous experience in similar type of work, clear methods of work, and problem management (The.project.management.hut 2007).

- Success criteria: like meeting the hospital as regards to price and quality and in addition offer creative solutions to the requirements (The.project.management.hut 2007).

The “bid for tender” process has to proceed within specified EU regulations, as well as regulations set by the Norwegian government in Law of public purchases (Lovdata 1999).

Users write down their needs for the new system in a set of demands for the tender. This is the only way they participate in the implementation process. To participate in a “bid for tender” process, vendors have to fulfil the demands that are listed up in the tender. If they cannot fulfil the criteria’s here they are excluded from the process. Therefore creating demands for a tender is a very important process of purchasing a new system. The criteria’s set in the tender are the basis for what system the workplace end up with, since the vendors only have to fulfil these demands to be qualified to create the new system. Representatives for the users of the system are brought in to write a list of necessary specifications for the system. This is a process that should not be rushed since a proper set of demands will give a system that contains the specifications the users need for their daily work. To write good demands for the tender, the workers have to know the workplace well to include all the important parts. The purchase department and the hospital management decide if the demands can be used in the tender.

2.2 A socio-technical approach with more user involvement

As a contrast to the top-down design, a socio-technical approach with more user involvement was developed (Berg 1999). This was a result of top-down implementation processes failing their expectations in areas like system implementations at hospitals. It came clear that system development and implementation did include social and organizational challenges as well as technological ones (Bansler 1989). Changing from the top-down management controlled approach today into a socio technical approach with users as central actors is not done over night. There is a need for defining how this design should be practiced, like how the users should be included and what users to include in large heterogeneous information infrastructures like a hospital. There is an increased need for user involvement in hospital implementations, which makes this approach more and more valued. This way of thinking includes the network of users, developers, information technology at hand, and the

environments in which the system will be used and supported (Scacchi 2003). When the user is at the centre of a development process it is defined as a socio-technical approach. The systems need to be human-centred, and be able to work at both a small and large-scale infrastructure. Socio-technical systems must have interactions profitable for all participants (Brown 2009). In a socio-technical implementation process, the users are not just involved in the implementation, but are also the leaders of the process with the responsibility and control of the design process (Hirschheim 1989).

This approach is build on the assumption that the starting point for implementing and designing an IT system for a work practice should be the experience and knowledge of the persons working there (Berg 1999). According to this practice users need to have a central role in the whole process of developing and implementing a new system, because there is a need for lots of insight into the workplace to get the best possible system (Berg 1999). The users have to be involved in the implementation process to receive the best possible outcome. Participation will make the users feel commited to the system and willing to make the changes needed for improving the system (Hirschheim 1989). The usere also get a better technical understanding of the system from being more involved in implementing it (Orlikowski 1992). This leads to less need of assistance from the vendors and support system later.

The socio-technical approach believes that if human needs in system development were prioritized, more users would be satisfied with the new system. This would again lead to higher productivity and increased job satisfactory (Bansler 1989). All the different parts of the complex hospital IT structure have to be considered when implementing a new system. It is likely that changing one part of the infrastructure will interact with the whole system in total. The end-users ought to be involved, and qualitative methods must be used for gathering information before starting an implementation process (Berg 1999). A socio-technical approach will benefit the implementation process because in addition to consider the technical aspect of the implementation, the users will also be able to see the social and human aspect of introducing a new system to a workplace (Bansler 1989).

When a socio-technical approach requires the workers to adjust the system to the workplace there are three ways this can be managed: fitting, augmenting and working-around (Gasser 1986). Fitting is the effort made to change a workplace to compensate for computing misfit.

This may include adjusting work processes and schedules or change routines. Augmenting is the additional work done to make up for misfits like verifying and revising data. Efforts are done to assess reasons and effects of anomalies or misfits to find the causes and consequences for them; these create extra work and can create potential errors. Work-around is the intentional use of computer programs in ways it was not designed for, this often include: ad hock solution to immediate problems, procedure adjustments and data adjustments like inserting inaccurate data to get accurate results. To make these kinds of adjustments substantial knowledge and experience is required (Gasser 1986).

When using a socio-technical approach with extensive user participation in an implementation process, changes and adjustments can be made in the pre-implementation phase instead of waiting until the program is implemented. This way it is possible to avoid stress for the workers and mistrust towards the system. The users may contribute to identify problems that will rise when the new technology is introduced (Balka and Kahnamoui 2004). Some extra time may help remove these problems beforehand and make the implementation process more successful.

One example of using a socio-technological approach is to use an agile method. The agile method is based on constant cooperation between users and developers to create an optimal solution. The users are involved in frequent upgrades in the system, and in the decision of what issues to improve. The agile method is called a "Lightweight" method because it has mainly been used in small scale experimental or prototype based projects with limited range and duration (Johannessen and Ellingsen 2008). Agile methods can be more challenging to use when the projects involve complex organizational settings like a hospital with large scale integrated systems (Johannessen and Ellingsen 2008). The developer release software that is unfinished, and the workers try it out for short iterations. Than they give feedback with modifications needed in the system for the next version. The progress is based on prioritized user stories workers bring to the system developers. User stories are changes in the program that has to be made. In this method communication between the users and the programmers is essential. The design of the program is kept simple and clean and the first version of the program can be released very soon (Kaushikj 2009). In health organizations there are many existing information systems and heterogeneous users with different practises that make the agile method more challenging to use. The agile method is considered a user-friendly way of developing an IT system (Johannessen and Ellingsen 2008).

Socio-technical approaches emphasize that designing and implementing a system cannot be done without a thorough insight into the information infrastructure in which the IT applications will be used (Berg 1999). User involvement have to start early and continue systematically through the whole process (Berg 1999). When implementing a system to use at hospitals with different sizes and needs, involving many different user groups, it challenges the traditional user and vendor roles. Different users may have partially competing strategies and goals for the project, and this makes a socio-technical project management challenging but not impossible.

2.3 The information infrastructure a hospital laboratory system has to fit

2.3.1 Important aspects of the information infrastructure.

When a laboratory system is implemented at a hospital, whether it is in a top-down or a socio technical design, it becomes a part of the existing information infrastructure. It is important to know and consider the existing infrastructure for the implementation to be as successful as possible. A new laboratory system cannot exist independently and therefore must be prepared for cooperating with the other parts of the information infrastructure. The information infrastructure is the relationship between a workplace and its technology (Star and Ruhleder 1995), like between the a laboratory, the laboratory system, the workers, the instruments at the workplace and the other systems connected to it. Information infrastructure not just make work easier, faster and more efficient, it changes the very nature of what is understood by work (Star and Ruhleder 1995; Bowker and Star 1999). Hanseth and Monteiro (1998) define the information infrastructure as a highly socio-technical issue that gives an understanding of all the processes involved. Information infrastructure is a combination of information and technologies and is designed to support a variety of activities and open up for new ones as well (Hanseth and Monteiro 1998). A hospital is a large information infrastructure and all health professions like doctors, bioengineers, nurses, office personnel, are defined as users. The system represents the main artefact for administrative work, registration of medical

information, and is supporting the coordination of work (Coiera 2004). Laboratories as a part of the information infrastructure have to consider all the other parts of the infrastructure as well when implementing new systems. If not there is a chance that the infrastructure breaks down.

Important factors of information infrastructures:

- Information infrastructures are open: No limited number of participants like users, vendors technological components etc. Contains several activities, varying relations, different constellations and alliances. They are heterogeneous infrastructures including: Different equipments, information, applications, software, network standards and transmission codes, and the people creating the information. Every component of the information infrastructure must be integrated into the system (Hanseth and Monteiro 1998).

- These are Socio-technical networks rather than pure technology networks. Encompasses technological components, humans, organizations and institutions (Hanseth and Monteiro 1998).

- The infrastructure is layered and is linking logical related networks and integrating independent components (Hanseth and Monteiro 1998).

- Infrastructures are heterogeneous meaning that the same logical functions can be implemented in different ways (Hanseth and Monteiro 1998).

A large infrastructure involves many users and vendors. This makes it impossible for all of them to participate in the requirements or design of the infrastructure. Therefore they make a minimum set of functionality they all can agree on to make the infrastructure work. In many cases the number of users in infrastructures like hospitals are so high that it is impossible to even set up an agreements between all of them. When a system is designed using standards it can be integrated without any further agreements. Standards and infrastructures can be seen as the flip sides of the same coin (Hanseth 2002). As Hanseth, Monteiro et al states

"*Standards are absolutely necessary for the information infrastructure to exist; without standards there is no such thing as an information infrastructure. To communicate, the communicating partners have to use a common standard, that is, a "language." "*

In addition, different layers of infrastructures are built upon each other. An infrastructure is heterogeneous since it includes sub-infrastructures based on different versions of the same standard, or different standards that covers the same areas of functionality (Hanseth 2002)
An information infrastructure is the basis of e.g. a hospital and is sunk into the background of other structures at the workplace like a laboratory system (Star and Ruhleder 1995). It is not visible to the users when everything is well functioning.

2.3.2 The importance of the installed base

The installed base is an important part of an information infrastructure that has to be considered when implementing a new laboratory system. The installed base is the basis for the everyday work routines and the connections to other systems and instruments as well as the old system already in use at the laboratory. Information infrastructures are considered as always already existing, they are never developed from scratch (Hanseth and Monteiro 1998). The development of an infrastructure is done by extending and improving an installed base (Hanseth and Monteiro 1998). Therefore when implementing a new system to a laboratory it is important to consider both the information infrastructure that is all the other parts of the hospital, and also the installed base, to fit the new system as good as possible with the workplace.

"The existing portfolio of information systems and old practices needs to be taken into account when designing new systems (Johannessen and Ellingsen 2008)."

What they want from the new system is often based on what needs to be improved in the old system. Therefore the old – installed base have a huge say in how the new infrastructure is designed. The demands for a new tender are written based on the existing installed base. Ellingsen et al. (2007) states:

"Creating a new system which is highly integrated with an installed base requires the

designers to have relatively detailed knowledge about the existing systems, interfaces and work practice. The designers must take into account interdependencies between the systems, information flow, different technologies, responsibilities, interests and layouts, etc."

Also how the old and the new system cooperate when information is moved from one system to another can influence the implementation process and the creating of a new information infrastructure (Hanseth and Monteiro 1998). When new technology is introduced they have to negotiate and compromise on how this can fit the existing systems already in use (Johannessen and Ellingsen 2008). It is important for the new system to evolve from the existing system so there are not to many changes for the workers to adjust to (Bowker and Star 1999). If the new system demands to many changes in their routines this takes lots of time and creates extra work for the users of the system. User participation is an important way to keep the system from getting too far from the installed base (Bowker and Star 1999) since the users are the ones most familiar with the existing work practises and routines.

2.4 Standardization is important in hospital information infrastructures

An important part of making an information infrastructure work is standardization. There is an increased need for standardization to make hospitals more cost effective. One goal for Health Authority North Norway was by implementing the same system to all their 11 Bloodbanks they would get a more standardized Bloodbank to maintain and support. One of the main reasons for standardizing healthcare services and hospitals are the increased need for efficiency, improved quality, and productivity in the healthcare sector (Schmidt and Werle 1998; Ellingsen, Monteiro et al. 2007). To use the top-down approach for implementations are used for the managers to be able to fulfil these needs. When users are involved in the process it tends to be a more inefficient and time-consuming process.

In Norway 10.3% of the GDP (gross domestic product) (WHO 2003) is used for healthcare, and despite efforts of reduction, it just keeps increasing. To try to improve efficiency and quality at the same time is very challenging since they often are seen as opposite concepts (Ellingsen, Monteiro et al. 2007). Standards are created to make something work together

over distances and heterogeneous metrics. It is important to define standards because as Ellingsen (2004) states:

"*Standardization serves as means for collaboration, shared meaning and far-reaching coordination among different health care professionals."*

Hospitals often lack standards in their information systems, because they have a variety of heterogeneous systems from different vendors (Johannessen and Ellingsen 2008). This makes it challenging for the systems to work together.

"It is amazing that today's large scale hospitals rarely have a truly integrated hospital information system (Ellingsen and Monteiro 2006)."

To standardize information systems has been a long ongoing process, but the attempts to standardize healthcare has been very challenging (Pedersen, Ellingsen et al. 2010). This may be because the hospitals and healthcare sector in addition to many different systems from different vendors, consist of many specialized work groups, with their own routines and procedures (Pedersen, Ellingsen et al. 2010). Many software products have been built and acquired from heterogeneous sources during a long period of time, and the systems have differences in implementation technologies and architectures that make it impossible for them to cooperate (Mykka¨ nen, Porrasmaa et al. 2003). Another reason why it is challenging to implement a standardized system is the need for local adjustments required to make the system fit many different workplaces, as well as possible. There is no standardization between the same laboratory types, all the different laboratories makes their own procedures and work routines. Before there are done a general standardization of the work practises it seems impossible to implement a standardized systems without risking to end up with a system that don't fit any vendors or information infrastructures.

To standardize several laboratories in a Health trust makes it possible to centralize the technical maintenance and support of the system. There is a need for streamlining the information flow in the laboratories. A close collaboration among the laboratories in one health region can be very beneficial and raise the quality of the Bloodbanks. Development of a socio-technical understanding of integration and standardization in health care discuss what manifestations and implications are necessary for integration to be possible. LabCraft is a

system with a standardized foundation with possibilities for socio technical adjustments based on the needs from the users and different workplaces. This may contribute to decrease the discrepancies, work-around and glitches in the way information systems are used relative to initial intentions (Berg and Timmermans, 2000;(Ellingsen and Monteiro 2003).

2.3.1 Generification: From using a system at one workplace to using it everywhere

Generification is one way of standardizing systems. Pollock and Williams (2010) introduced the notion of generification, like this:

"The supplier strategy of taking a technology that has worked in one place and attempting to make it work elsewhere, and, in principle, everywhere."

This concept is about how a system that is developed for local use is changed into a system useable for a larger marked (Johannessen and Ellingsen 2009). Laboratory systems have to be generificated if they are developed in cooperation with one specific workplace, to fit any other workplaces. Berg (1999) underlines the importance of the generalization to be a bottom up user-involved process, not a top-down approach, when the goal is to create a universal model for healthcare practices to fit. In this process Johannessen and Ellingsen (2009) asked the question:

"How much local tailoring the vendor should offer, while trying to exploit the potential in the larger market at the same time by making the system as general as possible."

It is often challenging to decide what features designed for one workplace that will be useful for laboratories in general. There often occurs several challenges when a system designed for one customer is moved to a larger marked or a new context (Pollock and Williams 2010). Especially with such detailed systems as laboratory systems, because they often contain lots of specially designed features that fits one specific laboratory very well, but may not fit others at all. It also depends on the installed base and the information infrastructure surrounding the system at the new hospital how successful a generification of a system has been.

In a process of generification it is important to have strategies towards new users and other

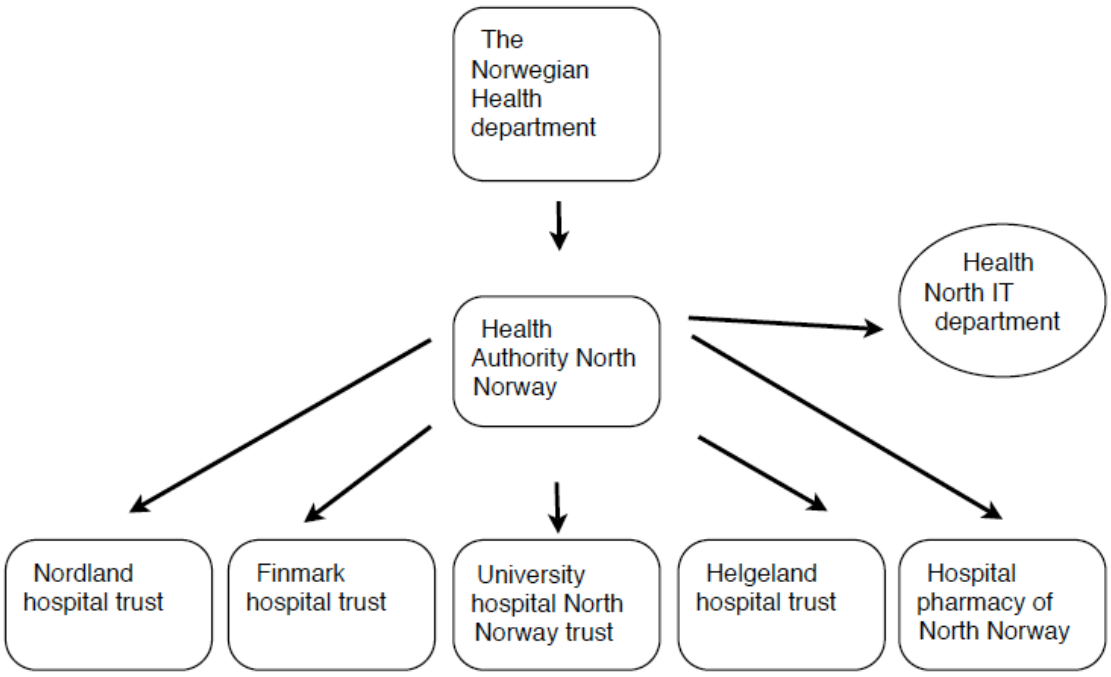
vendors (Johannessen and Ellingsen 2009). There are often a need for adjusting the system and adding some extra software component to make successful generification (Johannessen and Ellingsen 2009). For large scaled EPR system generification is easier than for smaller locally developed systems. This is because the EPR systems are much less attached to the vendors and the information infrastructure than smaller systems, and they are not so detailed and specified as e.g. laboratory systems. The smaller systems are much more depended on cooperation with the installed base and the information infrastructure right from the start in contrast to EPR systems that may exist as independent units at least for a while (Johannessen and Ellingsen 2009).

2.5 Health Authority North Norway (Helse Nord RHF)

In January 2002 the Regional Health Authority was established to provide necessary specialist health services for the population of North Norway and Svalbard. The Northern Norway Regional Health Authority is owned by The Royal Norwegian Ministry of Health and Care Services. A management board located in Bodø administrates the Regional Health Authority. The hospitals are organized in 5 trusts and the University Hospital of Northern Norway Trust is located in the trust Health Authority North Norway.

The vision of the Northern Norway Regional Health Authority is to meet the patients with the appropriate competence at the right time, when undertaking examination and treatment in the region of Northern Norway (Helse-NordRHF 2005). The main tasks of the regional health authorities are: to plan, organize, and promote patient care. Education of healthcare personnel, research, education of patients and their families are also important tasks, as well as developing medical practice care and knowledge (Helse-NordRHF 2009).

Figure 1:A simplified view of the organization of Health Authority North Norway

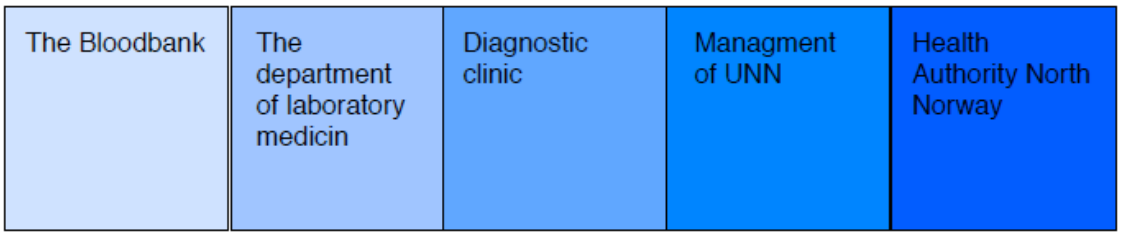


2.6 The University hospital North Norway (UNN)

Figure 2: The university hospital North Norway

The University hospital North Norway (UNN) is one of the five Norwegian university hospitals. UNN is the smallest of the university hospitals, and covers large parts of North Norway. There are about 4000 employees and 650 beds at this hospital. UNN currently has 10 clinics with about 150 departments (Universitetssykehuset.Nord.Norge-UNN 2009). Since this is a university hospital, education and research are important factors in the daily life of UNN. The hospital is a decentralized organization with 5 different units in 4 different cities, with both somatic and psychiatric departments. This research was conducted at the somatic part of UNN-Tromsø (Universitetssykehuset.Nord.Norge-UNN 2009). An overview of the different types of treatments done at UNN Tromsø can be found on the University hospital of North Norway's home page (Universitetssykehuset.Nord.Norge-UNN 2009).

Figure 3: From the Bloodbank to Health Authority North Norway

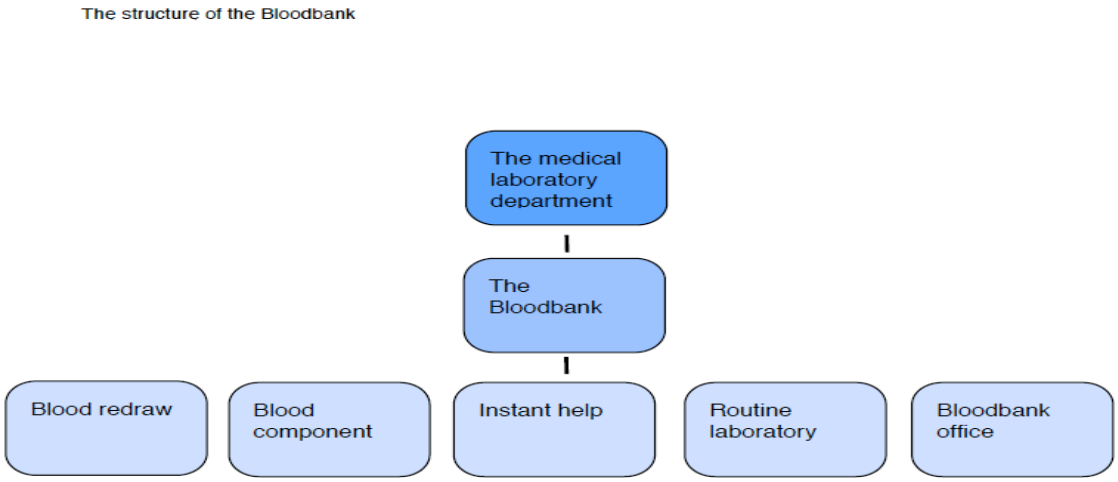


2.7 The Bloodbank

Figure 4 The Bloodbank

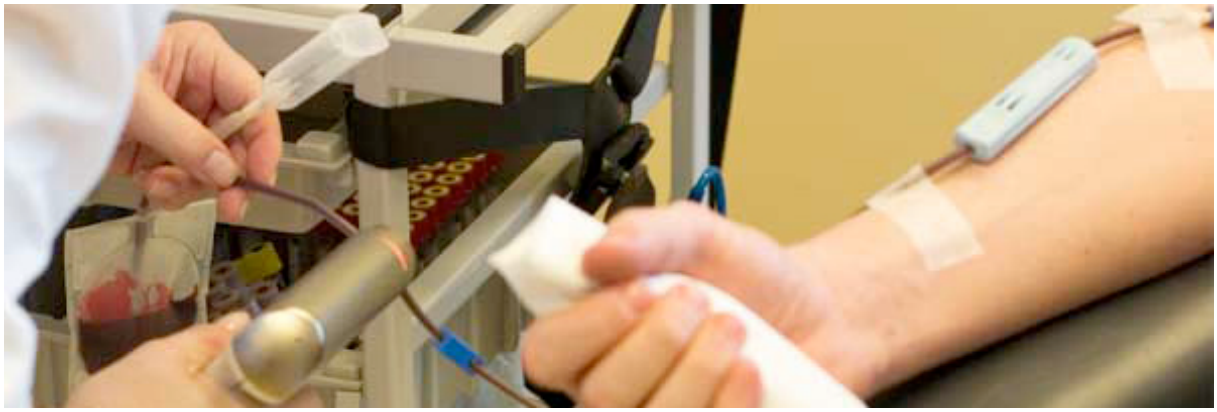
The Bloodbank at the University hospital North Norway is a section under the department of Laboratory Medicine at the Diagnostic Clinic. This department is responsible for the medical laboratory services at the hospital, with a broad spectre of different medical analysis and specialities. The department of Laboratory Medicine contains most of the laboratories at UNN (Universitetssykehuset.Nord.Norge-UNN 2009).

Figure 5:The structure of the Bloodbank at UNN Tromsø



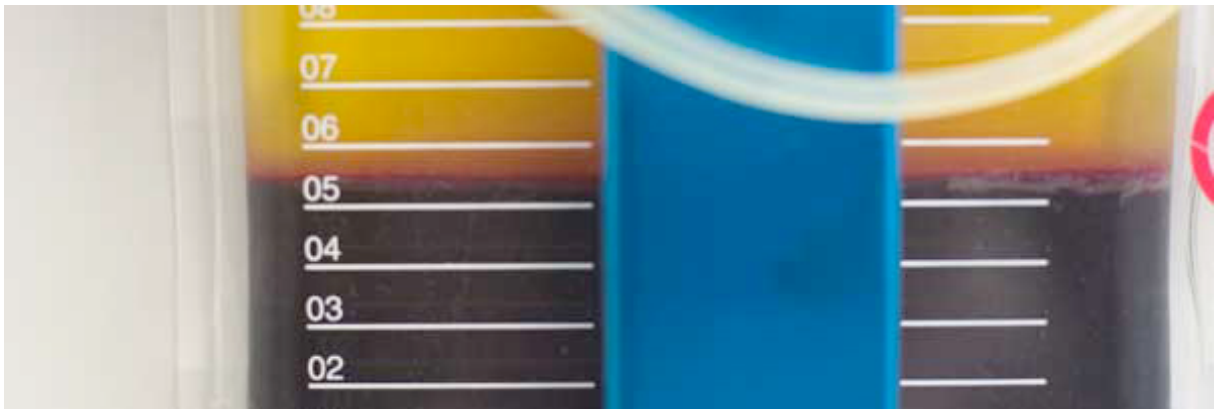
The Bloodbank has four laboratory sections and one office section. The office is where the blood donors are registered and booked for new appointments. All requisitions received by the Bloodbank are registered here, and they also do additional administrative work. The part of the Bloodbank most known to the public is “Blood redraw”(Tapping), where the main purpose is to redraw and test blood from donors.

Figure 6:Blood redraw at the Bloodbank (Rødekors.blodprogram 2012)



Another part of the laboratory is the blood component section where blood from donors are taken care of and separated into different products. Most quality controls of the blood products are handled here. Here they also monitoring the blood supply of the Bloodbank.

Figure 7:Separation of blood (Rødekors.blodprogram 2012)



“Instant help (Ø-help)” is the part of the Bloodbank the other hospital departments contact when they need blood products for patients or emergencies. The blood products are prepared and labelled here before they are sent to the departments.

Figure 8:Blood units (Aker-Universitetssykehus 2012)

The last part of the Bloodbank is the routine laboratory (routine laboratory), where automatic analysis of samples from all the blood donors and patients admitted to the hospital are conducted. The routine laboratory also screens all pregnant women in Troms and Finnmark to detect their blood type and possible blood antibodies. The routine laboratory receives samples from laboratories at smaller hospitals that UNN-Tromsø is responsible for, e.g. when they have problems with a difficult identification of an antibody.

3. Method

3.1 Research design

The evaluation of an implementation process at a hospital laboratory can be carried out using different methods. There are good arguments for using both qualitative or quantitative methods, and even a combination of the two (Stoop and Berg 2003).

Quantitative methods and particularly randomized control trials (RCT) has long been the golden standard for evaluating information system implementations (Stoop and Berg 2003). This method is used for measuring the actual effect of a new system, without considering the consequences the implementation has on the workers and the workplace. Quantitative methods are mainly used to establish numbers, size, extent, and duration of a research (Stoop and Berg 2003). In this particular case it seems like a quantitative method would be too rigid and fixed, that is why a qualitative interpretive method has been chosen instead.

Qualitative interpretive research is a qualitative research, based on realism (Robson 2002), and ethnography (Walsham 1995). This research method seems to be suitable for covering all the aspects of an implementation process, not just quantitative measurable facts. Qualitative interpretive methods have lately been recognized by researchers as an alternative to quantitative methods (Thorne, Reimer Kirkham et al. 2004), especially for revealing the user aspect of an implementation process. This method seeks to understand a phenomena based on different participants views and assumptions of an issue, within a particular context (Robson 2002). It also tries to understand how the context influences the process (Walsham 1995; Klein and Myers 1999). This research method focus on finding meaning within a social interaction (Popay and Williams 1998), and is a way of reporting an interpretation of other peoples interpretations in a case (Walsham 1995). Qualitative interpretive research typically involves systematic and detailed studies of individuals in their natural settings (Kaplan and Maxwell 1994). The knowledge of reality is gained through social factors like, language, consciousness, shared meanings and documents (Klein and Myers 1999). This group of

research is considered the best way to answer questions like "why and how" in an implementation process, since this flexible method has room for the interpretations of both the researcher and the research participants. Qualitative interpretive research is based on unstructured or semi-structured methods like participant observations and open-ended interviews (Robson 2002). This way the participants get the opportunity to tell there stories, and respond with their own words. Some quantitative measurements may be useful, but they need to be grounded in qualitative data to make it possible to understand the meaning of them (Berg 1999).

There are five main reasons for using qualitative methods in evaluating computer information systems, according to Kaplan and Maxwell (1994). The first reason is to understand the meaning the system has for the users, includes how the users evaluate and recognize a system. This helps to decide if the users consider the implementation of a system a success or a failure. The second reason is putting implementations into social and organizational contexts to understand what happens to the workplace when starting to use a new system. Diversion in context will make the implementation of the same system different from one workplace to another. Qualitative research is useful in detecting such differences. The third reason is to investigate casual processes. Qualitative research is helpful in explaining an actual process that lead to specific results, and for coming up with reasons and theories of how and why they experienced these outcomes. The fourth reason is to provide a proper evaluation. A qualitative approach may help identifying problems and contribute to improve the system. The last reasons stated by Kaplan and Maxwell, is the ability to evaluate the process in a way that seems useful, trustworthy and recognizable to the users (Kaplan and Maxwell 1994). Another argument for using a qualitative interpretive research is that it makes room for changing strategies and research questions during the research (Forsythe 1999). The answer to one question in an interview may influence the decision of which one to ask next, or lead to create new questions not considered in forehand. This can be seen in the context of the 7.principle of Klein and Myers (1999):

"If your preconceptions don't fit the data, change your preconceptions."

Forsythe (1999) also recognize the need for evaluating the research questions as the research proceed. This can however be a disadvantage to be able to do if the result is that the research question and the direction of the research change too many times.

A qualitative research can be conducted in many ways, there are good arguments both for being an outsider (Forsythe 1999) and an insider (Walsham 1995). It is however necessary to be aware of the role you have as a researcher, and how this role can influence the results of the research. The most important part of conducting data for an interpretive research is interviewing different participants in e.g. an implementation. Other forms of data collection are observations, document analysis, literature studies, and data recording.

There is however some challenges with using qualitative research methods. One problem is the lack of well-defined frameworks and structures to define and back up these researches. They are often seen as descriptive explanations of small numbered phenomena's, without any real measurements (Popay and Williams 1998). Qualitative methods may be seen as a way of making a hypothesis for a quantitative research rather than a research method of its own (Popay and Williams 1998). There are no strict rules on how to conduct qualitative research. Several researchers have tried to create some guidelines, like Walsham (1995), and Popay and Williams (1998) Such guidelines may be necessary in order to make the research trustworthy. Klein and Myers (1999) have developed a set of well-defined principles on how to conduct qualitative research, in the context of a hermeneutic, anthropologic, and phenomenological thinking. The reasons for making such principles are to ensure the validity, and make interpretive research more widely accepted, and better understood. Interpretive research can be defended more easily by referring to these established principles. The seven principles "*summarize important insights to interpretive studies*," and the principle of human understanding is the base for all the other six. These seven principles are important to consider separately and as a whole. None of the principles must be left out on purpose when using this hermeneutic interpretive method in a research (Klein and Myers 1999).

Another concern addressing qualitative research is the question of generalization; how can one single in-depth study give a general understanding of an issue? These researches may not have the same way of being generalised as quantitative researches, but Walsham (1995) recognizes these aspects of generalization in qualitative research:

"The development of concept, the generation of theory, the drawing of specific implications and contribution of rich insight."

The strength of qualitative research is the ability to provide complex textual descriptions of how people experience a given issue. It provides information about the "human" side of a process like an implementation (Mack, Woodsong et al. 2006). Readers of a research interpret the text actively, and the interpretations people make of the text depend on their own background and experience. They don't necessarily interpret the text the way the authors intended. To try to convince the readers about the validity and credibility in the text the researcher need to include authenticity, plausibility, and criticality into the research (Golden-Biddle and Locke 1993).

3.2 Data collection

3.2.1 Interviewing workers and vendors

The data collection in this project included interviews of ten persons, nine at the Bloodbank, involved in the process of implementing LabCraft, and one representative from the vendors at LabCraft. All the interviews were completed at the Bloodbank of UNN Tromsø except the one with the representative from LabCraft. That interview was conducted at their office in Oslo. I preferred to meet for personal interviews, because interviewing by telephone or mail are often more challenging and less successful, especially when you don't know the person interviewed in forehand. The data collection lasted from February to April in 2011.

Figure 9:The interviews for this research

Who	Why?	How long
One member of the Bloodbank management	She is familiar with the formal processes of hospital implementations. Does not use the system daily. May have a more distant view of the process than the other workers.	60 min
One person from LabCraft	To get the vendors aspects and impression of this process. See the process from a different angle.	90 min
The two project managers of the implementation process	Get an overview of the whole process. Define the communication between the actors of the process.	90 min
One person from the blood redraw	To detect the improvements and challenges here. To have the view of one of the "super users."	30 min
One person from the office part of the Bloodbank.	To get an impression of how LabCraft improved this part of the Bloodbank.	45 min
The section manager of the immune haematology part of the Bloodbank	Get a good overview of the implementation from a central user. She had a central role in the whole implementation process and knows the Bloodbank well enough to detect benefits and challenges in the process.	75 min
One person from "shift work." Use the system in different work areas	To have the view of a worker that use LabCraft in all parts of the Bloodbank. Establish the view of a worker not directly involved in the implementation and decision making process.	30 min
One of the main users of the program at the routine laboratory	To establish the benefits and challenges at this part of the laboratory.	60 min
One of the doctors at the Bloodbank	Detect the medical view of the system. See how LabCraft work for users not directly involved in the daily Bloodbank routine	60 min

I chose to interview workers from different user groups with various roles in the implementation process. The goal was to get several different perspective and aspects of the process. This was done to detect the variety of views and experiences the workers had of the process. This is according to Klein and Myers (1999) 6.principle important when conducting a qualitative research.

To get the different workers impressions and view of the implementation process I choose to conduct open-ended interviews. They all started with an introduction of my purpose for writing this evaluation before asking about their role in the implementation process. The workers then told their story from the process. Some questions were asked along the way, so the interviews covered mainly the same issues. Lots of information was collected from these interviews. I agree with Walsham (1995) that the main sources of data collection in interpretive qualitative studies are interviews. Another useful part of the data collection was to gather some written documentation. I got the demands for a tender which LabCraft had to fulfil from one of the project managers, and I got the tender rules of UNN from one of the workers at the purchase department.

3.2.2 Evaluating the interview process

Since using qualitative methods and interviewing persons was a new experience for me, I was a bit nervous whether this was a working method I would be comfortable with. Robson (2002) states that creating good and informative interviews requires extensive practice. I tried to prepare well for the interviews and had wrote several questions down to make sure I got answers to all the issues I wanted to cover: like positive and negative experiences with the system, expectations to the systems and the users role in this process. (See appendix 4)

One observation I did from listening to the recordings from the first interviews was that I started all the interviews with asking several questions at the same time. This did not seem as a good way of starting interviews, since the person interviewed might feel overwhelmed by all the questions and not know where to start answering. It was impossible to remember all the different questions when they were all asked at once. I managed to improve this for the later interviews and I got better on letting the workers tell their story and ask only one question at the time. Some argues that the interviewer should start by talking the first minutes of the interview. This might seem relaxing if the one interviewed is nervous (Walsham 2006). Walsham further states that:

"The interviewer may 'lose' some precious interview time, but if it succeeds in its purpose of getting the interviewee to relax, than the quality of the rest of the interview is likely to be much higher, in terms of honesty of response for example (Walsham 2006)."

I think I started the interviews by asking to many questions because I was nervous.

It was priceless for me as a researcher to use a recorder when interviewing people. This way it was easy to go back and listen to the interviews afterwards. The recorder could have made the participants more aware of what they answered but in this case they did not seem to mind the recorder at all. I made some written notes during the interviews as well, but they were almost unreadable and useless afterwards. When recording the interviews I made sure that the person interviewed knew that the purpose of recording would only be to assist me in writing this evaluation. After finishing the interviews I used many hours transcribing the interviews. These transcribed interviews were the main source of data collection in this research. It is important to remember that the data collected may not be the results of the research but the information the researcher analyze and work with to find what is useful for the outcome of the research (Forsythe 1999). The interviews were not used directly in the evaluation. They were used for quotations, background information and supporting arguments.

Some of the persons interviewed started by stating that they did not remember much from the implementation process since it was a long time ago. But as the interview proceeded, it seemed like more and more came back to them, and all the interviews lasted at least 30 minutes. The most challenging interview to prepare for was the one with the representative from LabCraft. I could not use the same questions here as for the workers of the Bloodbank, since the vendors had a different role in the process than the users of the system. (See appendix 5). Also I knew all the workers at the Bloodbank since they were my former work colleagues, but I had never met the LabCraft representative before. I was very grateful for the positive response from LabCraft when I asked for an interview. To have the vendor's view of the implementation process increased the quality of my evaluation, and provided a more nuanced view of the process. I got to see the process from a whole new perspective.

I learned many things from the interview process, both regarding interview techniques, and the process of implementing LabCraft at the Bloodbank. All the interviews were conducted in a semi flexible interview design, and I agree with Walsham (1995), that this is the best way to interview people. If interviews are too fixed and rigid it may be more challenging for the ones interviewed to express their opinions of the implementation. The result of using a more fixed design may have been ending up with interviews and research data coloured by my own

opinions and pre-set assumptions (Klein and Myers 1999), since I worked at the Bloodbank when this implementation was carried out. As an example: The issues covering lack of user support and questionable use of resources in this implementation process would not have been revealed if a more fixed design were used, since this was not something that I would had thought to ask about. I did however have some questions written down to make sure that the information from the different interview objects was comparable. The written questions were also useful to start the interview with, and to move the interview forward when the conversation stopped. To have some questions prepared gave me as a researcher an active role, and made me seem interested in the project. It also created the impression that I had some previous knowledge in the field. Most of the interviews proceeded very well, and the workers shared plenty of information just by telling their story of how they remembered the implementation process. Sometimes I had to ask some questions to help refresh their memories about the implementation process. I tried not to drift to far from the research questions and remain focused during the interviews. It was important not to waste people's time.

3.2.3 Documents and theory used in the evaluation

It is often useful to have some documents collected to supplement interviews in qualitative research. In this case the documents used were the demands for the tender, some tender related papers, some information about the tender process at UNN and some information slides from LabCraft. The written documentation was useful as a supplement for understanding the implementation process better, and to get to know LabCraft better.

It was very important to connect theories with the data collected in the study to have a framework to build this evaluation on. Here the 4. principle of abstraction and generalization by Klein and Myers (1999), is important to consider. If we cannot connect the research with theories and previous research, it has much less credibility, and may be dismissed as a pile of assumptions and ideas made up by the researcher. Walsham (1995) mention three possible ways of using theory in interpretive research conducted by Eisenhardt (1989). Theories can be used as a starting point or framework for a research, or for collection and analyzed of data. The last way of using theory according to Eisenhardt (1989) is to make theory the final product of the research meaning coming up with new theories. In this case theory was mostly

used as a theoretical framework to start the research process and for analyzing data. Walsham (1995) sais:

"The researcher should be aware of not using theory too rigid when starting a research."

By using the theory to rigid there is a chance that the researcher seeks a premature closure that fits the already known theory, rather than being open for new interpretations (Thorne, Reimer Kirkham et al. 2004). It is also useful to use theory when collecting and analyzing research data. It seems like Walsham (1995), Eisenhardt (1989) and Klein and Myers (1999) all agrees that theory is important to make data in a research valid and trustworthy.

3.2.4 Literature review

In the search for literature the University Library in Tromsø as well as www.google.com, were used most frequently. The phrases most searched were e.g. Implementation, "bid for tender", standardization, generification, information infrastructure, and qualitative method. The Internet sites of LabCraft, Health Authority North Norway, the Norwegian government etc were useful supplements. Syllabus from the Master of Science in Telemedicine and E-health were frequently used especially in the areas of qualitative research, EPR, implementations, information infrastructure and so on from authors like Ellingsen and Monteiro (2005), Hanseth and Monteiro (1998), Johannessen and Ellingsen (2008), Orlikowski (1992), and Walsham (1995). This provided most of the theoretical framework for this thesis.

3.3 Reflections on the method

3.3.1. Researcher role in qualitative research

In qualitative methods the researcher has an active role in the research process (Walsham 1995), and has to be both critical and flexible. It is also important that the work is mainly

driven by the researcher and not by some recipe of what a research should look like (Thorne, Reimer Kirkham et al. 2004). That means to take the different principles and frameworks made out for this kind of research seriously but not follow them blindly. On the other hand it is just as important to "avoid going native." That means nobody but you understands a phenomena in a certain way (Thorne, Reimer Kirkham et al. 2004), and you don't use any of the principles or guidelines pointed out as frameworks to back up the research.

Since I worked at the Bloodbank of UNN Tromsø at the time this implementation was done, it was important to letting my own experiences and preconceptions influence the evaluation too much. It was important that the workers saw me as a researcher and not just as a former co-worker. The researcher should not let his background and preconceptions decide what is important in a research and what is not (Randal, Harper et al. 2007). Klein and Myers (1999) seems to support this argument in their 5.principle. The researcher should be aware of their preconceptions and prejudice when starting a research, and that their view may be challenged during the research process. I agree with the statements of these researchers. I had many preconceptions regarding the implementation of LabCraft, and I had to reconsider many of them during the process and be open for new aspects along the way. Walsham (2006) states that:

"It is a danger that the closely involved field researcher becomes socialized to the views of the people in the field and loses the benefit of a fresh outlook on the situation"

It can be difficult to detect possible biases during an interpretive research, and it is important for a researcher to consider the 7.principle of Klein and Myers (1999), of suspicion. The researcher must be aware of the chance of favouring certain opinions and meanings. I tried to rule out some of the most speculative and frustrated comments from this evaluation. This 7.principle agrees with the statement of Golden-Biddle and Locke (1993). It is important to let the data and the experiences conducted in the research period decide the outcome of the research. It is important to not just try to make the data and experiences fit your preconceptions. My knowledge of the implementation process expanded very much from evaluating the process, and my view of the implementation changed a bit along the way. Especially the interviews with the project managers, and the vendors gave me a broader perspective of the whole process.

It is important to define the researcher role in a qualitative research. Forsythe (1999) states that an outsider with extended inside information is the best researcher in interpretive studies. If you are an outsider you may be able to see the workplace from a bigger perspective. You have the opportunity to detect things that insiders take for granted, and therefore cannot see. To have inside experience means that you understand the different aspects of a workplace better, and are able to use the data collected during the research in a more useful way. Walsham (1995) argues slightly differently by stating that it is important for the researcher to be an insider, to be able to get all the necessary information. The researcher needs to be included as a member of the workplace. If not it is a risk of being excluded from information witch is defined as too sensitive and confidential for outsiders. I can see the advantages of both these views but I tend to agree with Forsythe (1999), being an outsider with inside experience is the best option. If you are an insider, your research is more likely to be influenced by your previous view and opinion of the process. That makes it possible to miss out on important aspects of the research process. As Walsham say: In an interpretive research the researcher play an active role in forming the research. The researcher and the participants can both contribute as analysts and interpreters, according to Klein and Myers 3. Principle (Klein and Myers 1999).

3.3.2 Challenges with getting access to the workplace

I am very grateful that the manager of the Medical laboratory department and the section leader of the Bloodbank were so positive towards this project. This made the access to the workplace very easy especially since the section leader also made the time for me to come and do the interviews. Interviews are the essential part of a qualitative research, and without them this evaluation could not have been written using a qualitative design. I know that the workers have a full schedule, and a busy workday and it is not easy to prioritize time for such a project. The response has been nothing but positive. All the persons I interviewed shared lots of experiences with me, and they had prepared well for the interview in forehand. It was very interesting to observe how users focused on different aspects of the implementation process. Some workers were most interested in the details of the system: which functions works well and which did not. Others were more concerned with the big picture of the system, and the whole implementation process. The users had different degree of attachment

to the implementation, and the role they had in the process, seemed to influenced the focus and experiences they shared.

Getting access to all parts of a workplace may not always be so easy, especially if the workers see you as an outsider (Randal, Harper et al. 2007). Walsham (2006) states:

"Field researcher needs a willingness to accept 'no' for an answer but the persistence to try elsewhere when it comes to access (Walsham 2006)."

This means that you should not give up even if you get no the first time you try to get access to a workplace. Sometimes all it takes to change this is some adjustments to the project, or an alternative approach. For me it was easy to get access to the workplace, since I recently worked at the Bloodbank. I still knew most of the workers who to negotiate access with. One problem connected to getting access was that it took longer time than expected to get a final answer to if it was possible to do this evaluation at the Bloodbank. The manager of the laboratory medicine department had to present the request for the "leader team" of the department and they did not meet that frequently. The "leader team" were positive towards the project, but not all of the key persons in the implementation process wanted to participate at first. They were concerned that participating in this project could generate extra work for them. But after I ensured that their only contribution would be an interview, and maybe send me some documents from the implementation process, they agreed to participate. If these key persons had decided not to participate, the project would be much less trustworthy and the research almost pointless.

After some weeks I finally scheduled a meeting with the manager of the Bloodbank. This was a very positive meeting, and she just told me to send her the names of the persons I wanted to interview, and when I wanted to do the Interviews, and she would make room for this in their workday. I would have preferred to ask each of the workers personally to participate in the project. By doing that I would have been able to explain more about the project and answer questions they might have about the participation. Instead I just wrote down an introduction to the project and some of the subjects I wanted to focus on in the interviews. This was sent by e-mail to the persons asked to participate in the project. Than the time and place for the interview were set. This worked very well and only one person declined to participate in the project. Unfortunately the person from the purchase department that I had planned to

interview was not able to make time for the interview after all. I got an e-mail with some useful information instead.

3.4 How to make a trustworthy qualitative research?

To ensure the authenticity of my research it was important to convince the readers that I was genuine to my experiences in the Bloodbank, and to make them feel that I was really there in the field. This was done by actively using quotes and examples from the Bloodbank in my evaluation. In addition to this I also described the data collection method and how the data was analyzed. The next aspect of convincing, according to Golden-Biddle and Locke (1993), was to document plausibility. One way of making the text plausible was if it made sense to the reader. This was done by combining a sense of familiarity with new contributions to the field. It was useful to make readers realize how findings in the research were important in a broader way and not just for this particular case. The goal was to make my evaluation of the implementing process at the Bloodbank useful for other laboratories as well. All Bloodbanks and laboratories in Norway uses computerized laboratory systems implemented in a similar way as in this case. The goal was to make this particular research plausible for others (Golden-Biddle and Locke 1993). It would have been useful to extend this research to including the other hospitals of Health Authority North Norway as well. Than it would be possible to compare the implementation process in the different laboratories and what influence this process had on the different parts of Health Authority North Norway.

The last aspect of convincing by Golden-Biddle and Locker is criticality. This has been mentioned before in the method chapter when discussing the researchers role. Criticality means that reader as well as researcher should feel a need to re-think their preconceptions in a field. Being a bit provoking when writing an evaluation may do this. The purpose is to challenge the previous ideas and beliefs of the reader (Golden-Biddle and Locke 1993).

Sometimes, even if researchers use different data collection methods and critical analysis of the data they don't find anything new. This means ending up with "bloodless findings." Even so it is still possible to get some points through, if you make a research paper that has a convincing method, is systematic and plausible enough to be considered a serious research.

3.5 What study form to use in the research?

There are several ways of conducting a qualitative study. An impact study is known as a "before and after" study focusing on a narrow line of progress over a short period of time (Pollock and Williams 2010). It starts with a problem the organization was encountering, than the new technology implemented offer a solution to, and the benefits of this solution is registered. The problem with this method is according to Johannessen and Ellingsen (2009):

"The lack of analytical distance and critical concerns."

A similar study form is the implementation study made short time after the new technology is introduced (Pollock and Williams 2010). Using this method only the immediate reactions of the implementation are detected. The impression of a system may change after using and adjusting it for a while. That is why such immediate reactions may not describe the implementation process very well after all. An implementation study seeks to point out the gap between the expectations towards the new technology, and the immediate outcomes (Pollock and Williams 2010). If an implementation study was conducted just after the implementation of LabCraft most of the users would say that the implementation was not a success, and the system did not fulfil the expectations. This would have given a misleading picture of both the LabCraft system and the implementation process it self. Pollock and Williams (2010) points out that the consequences of technological changes may first become clear after years, and even decades of use. In this evaluation the impression of the system clearly changed over time. From being a system and implementation process with several issues and problems, to a stabile and well-functioning system that users are mostly satisfied with. To carry out this evaluation several years after the implementation finished seemed beneficial for this project, and has provided a bigger perspective of the process. I think that a research following a process over time give a better overview of the process. Following an implementation process for years is defined as a design oriented study.

"Design oriented studies are more complex temporal designs including longitudinal studies, follow-up studies and long-term historical investigations over several years (Pollock and Williams 2010)."

Walsham (2006) say:

"There are some potential disadvantages of close involvement. An ethnographic or action research study is very time-consuming, and opportunity costs are incurred in this. For example, the time saved by a less involved study could be used instead to carry out a second full case study."

It is important to be aware of this when conducting a study and try to prioritize the right study form for the implementation.

I think this study gave a good impression of the implementation of LabCraft at UNN Tromsø. The whole implementation process was covered from the decision of getting a new system until the use of the system today (2011) This research has to be looked at within a particular context (Klein and Myers 1999), if it was conducted another time, and other persons were interviewed, the findings and result may have been different.

4 The study

This section of the evaluation addresses the different parts of the implementation process based on the interviews. This includes the pre-implementation process, with the preparation for a new system, the "bid for tender" process, and the decision of which system to choose. Further the instant benefits and challenges the workplace experienced from this implementation is addressed. Then the post-implementation phase with the issues of cooperation between the actors is looked into like the cooperation between LabCraft and the installed base as well as the information infrastructure. Also the issues of time and resources used in this project, flexibility and support of the system are addressed in this part of the evaluation.

4.1 Introduction to the study

This study evaluates the implementation of LabCraft to the Bloodbank at UNN Tromsø. There were several reasons for investing in a new laboratory system in Tromsø. First of all the system in use was outdated, and the Bloodbank in Tromsø had to use two different systems simultaneously. Also the vendor responsible for the old system did not want to upgrade or maintain the system any longer (Helse-NordRHF 2006). When Health Authority North Norway was left in chare of the North Norwegian hospitals in 2002, they decided to implement a common laboratory system for all their 11 Bloodbanks.

To share the same platform for the Bloodbanks was part of Health Authority North Norway's strategy to streamline and standardized all systems in their region (Ellingsen and Monteiro 2006). The goal was to save money and improve cooperation, efficiency and quality by standardizing the hospital services (Helse-NordRHF 2006).

''System integration would provide the platform for improved workflow, patient throughput and patient safety, as well as decreased cost (Director, Health Authority North Norway). For (...) Bloodbank, pathology and Microbiology we want the same systems and preferably in the same database for each specialised discipline in the whole region (Director, Health Authority

North Norway) (Ellingsen and Monteiro 2005).”

This was a natural next step towards further standardizations for Health Authority North Norway after implementing DIPS ASA to all their hospitals (Ellingsen and Monteiro 2005).
In 2004 a “tender group” was established with representatives from all the 11 Bloodbanks. They were responsible for creating a tender the vendors had to fulfil to provide a system for the Bloodbanks of Health Authority North Norway. All the 11 hospitals were represented when the tender was created, and all participated in deciding what system to recommend for Health Authority North Norway to invest in. Three different vendors provided an offer for this project, one of them was exclude early in the process for unknown reasons. The three different systems were all presented for the “tender group” at UNN Tromsø. They held several meetings in the “tender group”, as well as meetings including the workers at the Bloodbanks before a final decision was made.

Figure 10:The timeline of this project.

Year	Event
2002	Health Authority North Norway took over the control of North Norwegian hospitals. They decided to implement one common platform for their 11 Bloodbanks.
2004	The decision of investing in a new system for the Bloodbanks was finally made and a “tender group” established to create the tender.
2005	The decision of choosing LabCraft was made and the contract with the vendors signed.
2006	LabCraft was implemented at the Bloodbank of UNN Tromsø.
2008	The users were finally satisfied with the system.
2011	The implementation of LabCraft at the last Bloodbank in Health Authority North Norway was finished.
2011	This master thesis of evaluating the implementation project started and interviews made.

4.2 Motivations for getting a new system

There were different motivations for investing in a new laboratory system at the Bloodbank of UNN Tromsø, and some of the actors in the process had conflicting motives. The workers at the Bloodbank needed a more modern and updated system that fit their work routines when it

came to both IT solutions and Bloodbank work. For them the main target was getting a user-friendly, predictable system to ease their workday. They also wanted a system with uncomplicated solutions for communicating with other systems, Bloodbanks at other hospitals, and computerized equipment at the Bloodbank. By implementing LabCraft they expected to get a better workday, and to improve their service towards customers and patients.

The motivation for Health Authority North Norway was to invest in a system able to standardize their 11 Bloodbanks in a timesaving, and cost effective process. They wanted a system that Health Authority North Norway IT could manage, updated, and install easily and unanimously. They needed a system able to communicate easily with the other actors in the hospital information infrastructure. One of their goals was to make the Bloodbanks in the health trust work like one standardized unit instead of 11 separate ones.

So the question might be which interest that wins in the end? As long as the process of implementing a laboratory system is mainly top-down management administrated, it seems like the needs of the users may be challenging to prioritize over the needs of the health trust management. This makes implemented systems challenging to fit the workplace and difficult for the workers to use.

4.3 The LabCraft vendors

LabCraft is the major provider of IT-systems for Bloodbanks and transfusion medicine in Norway. LabCraft focus on programming, software and IT solutions for Bloodbanks. They provide globally cutting edge solutions in this area, and operating both alone and in cooperation with other vendors (LabCraft 2010). The company was established in 1999 after many years of working with different projects within hospitals, laboratories in general, and Bloodbanks in particular. Today their team consists of specialists in several areas like user-support, quality assurance and IT.

The overall goal of LabCraft is to satisfy customer needs through high standard quality work and application development (LabCraft 2010). The Norwegian Bloodbanks becomes more and more complex, and the goal for LabCraft is to offer customers both nationally and

internationally the best possible information technology to use in Bloodbank laboratories. LabCraft wish to keep a close cooperation with customers by constantly improving their products and services (LabCraft 2010). LabCraft is flexible and adjusts quickly to the changes in the Norwegian health services. They have a high competence level on Norwegian laws, regulations and guidance's concerning Bloodbanks, and cooperate actively with the Norwegian health authorities.

4.4 The LabCraft Bloodbank system

LabCraft is a fully integrated Bloodbank system, developed by and for Norwegian Bloodbanks. The system is registered at the international council for commonality in Bloodbank automation (ICCBBA 2011). LabCraft is user-friendly as well as functional, and developed by interacting frequently with customers. All the functions are created to generate a classic Windows application, as well as a web application or web service. This makes the system flexible and helps with validation and evaluation of LabCraft. An important benefit of using this system is the ability to track and trace information about Bloodbank products from redrawing the blood to transfusing a patient. In addition LabCraft provides active forums for the users of their system, which is very valuable in getting to know the system better.

The system is fully compliant with ISBT-128 and has a built-in quality control module (LabCraft 2010). LabCraft uses modern technology and have integration and communication solutions fit to cooperate with other systems like: DIPS ASA, ProfDocS and SafirlIS. The system offers a Web based overview of the journal data at the Bloodbank, retrieved directly from patient systems. In LabCraft donors and patient information is found in the same system, together with information about transfusion reactions linked to donors. LabCraft provides a two-way communication with automated instruments in the laboratory, different types of reports and decision support systems (LabCraft 2010).

When LabCraft was implemented at UNN Tromsø, all parts of the Bloodbank were affected since they are closely connected and also share the same system. The consequences of this implementation for the different parts of the Bloodbank varied significantly. The new

laboratory system would be used for storing information and analysis performed at the Bloodbank. Results should further be transferred electronically to the electronic patient record system (DIPS ASA), general practitioners, and others when needed.

Figure 11:Barcode pen is used to scan ISBT-128 codes connected to the LabCraft system

4.5 The process of implementing LabCraft

4.5.1 Preparing the workplace for the implementation of a new system 2002-2006

In this phase of the process presentations of different systems were made, and demands for the tender ("kravspek") was created. The Norwegian health authority has decided that health trusts and hospitals have to undergo a "bid for tender" process whenever they want to invest in new systems or equipment. This process is mandatory to use when hospitals needs to bring in an external supplier (Regjeringen 2011). The decision of which system to choose was based on the offers from the vendors. This pre-implementation process made the fundament for the success of the implementation.

During the pre-implementation process the users had great expectations towards implementing a new system. They anticipated the new system to bring several improvements to their workplace. Also they expected to receive a more updated and functional system less troublesome than the old one. The "tender group" had an essential role in this part of the

process. They were responsible for the tender that was made, and they recommending Health Authority North Norway to invest in LabCraft.

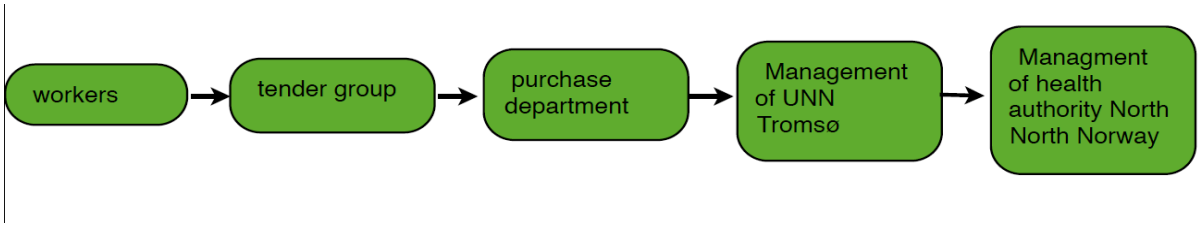
4.5.2 Creating the demands for a tender 2004-2005

The established "tender group" with representatives from all the Bloodbanks in Health Authority North Norway created a tender for the new Bloodbank system. This was done cooperating with some of the other workers at the Bloodbanks. It was important to include all the parts of the system and all the necessary details to make the new system fit the workplace as good as possible. A list of "have to" demands and "should" demands, together with other specifications were included in the demands for the tender. These had to be approved by the purchase department and the hospital management. The first set of demands was discarded for being too detailed. No vendors would have been able to fulfil all the "have to" demands in this tender which would exclude them from the "bid for tender" process. A second set of more general demands was created, (see appendix 1) these together with the rest of the tender (see appendix 2 and 3) were sent out to all the 11 Bloodbanks for approval and commenting. There were several E-mails and meetings between the "tender group", the Bloodbanks and Health Authority North Norway IT, to make the tender as good as possible. The tender group was important in the process and the project management stated that:

"At UNN the representatives for the workplace (fagmiljø) are important actors in such implementation processes."

In this case the workplace was represented in the "tender group," they had about 50% of the saying in the process of creating a tender. Health Authority North Norway IT would be responsible for the technical maintenance and updates of the system, and had about 25 % of the say. The purchase department also had a 25% say since they defined what price to accept, and all the formalities in this process. The decision of which system to finally choose was made by the administration of Health Authority North Norway based on the recommendations from the "tender group." After this was decided, a project group for the actual implementation of LabCraft was established. This consisted of the leader of IT and the leader of quality insurance at the Bloodbank of UNN Tromsø. The first Bloodbank where Health Authority North Norway implemented LabCraft was the Bloodbank of UNN Tromsø.

Figure 12:The line of decision making in the "Bid for tender" process.



4.5.3 A presentation of the different systems at UNN Tromsø in 2005

All three companies that entered the "bid for tender" process visited Tromsø to present their system for the Bloodbanks of Health Authority North Norway. This presentation lasted for two hours, and as one of the workers said:

" You don't get a good enough impression of a system in two hours. It is impossible to see all the functionalities and get all the information needed to decide which system to favour in such short time."

Most of the workers had only these two hours to get an impression of the systems and to decide what system they thought were best for the Bloodbank. Not all of the workers had the opportunity to even see the system at this demonstration. One of the doctors said:

"My opinion about the system was of less value, because I did not get a very good insight to the systems from this short presentation."

It was possible for the workers to ask questions and bring feedback to the vendors regarding the systems. But due to the short presentation many of the workers found it challenging to form questions and detect areas necessary to improve. There were some meetings to discuss the different systems, but the users that did not really get to know the systems found it difficult to participate in the discussions around the systems as well.

After the presentation some representatives went to visit Bloodbanks were the two remaining systems they had to choose from were used. This was the two project leaders, two workers from the Bloodbank in Tromsø, one person from another large Bloodbank, and one

representative from the smaller Bloodbanks in Health Authority North Norway. They spent one day at the Bloodbank of Buskerud Hospital (Drammen hospital) to observe LabCraft, and one day in Bergen at Haukeland university hospital to observe Prosang, the competing system. It was problematic to compare these Bloodbanks to UNN Tromsø since Haukeland had a much larger Bloodbank, and Drammen a much smaller. They both had different routines and needs for their system than the Bloodbank in Tromsø. One of the workers said:

"The only way to really compare the systems would have been to have a hospitals with a Bloodbanks the same size as ours, sharing the same logistics and routines. This didn't exist so it was not easy to compare these Bloodbanks to ours."

One day at each hospital was too short time to register all the important aspects of the two systems. It would have been necessary to observe them for a longer time to reveal more of the benefits and challenges they had for the Bloodbank at UNN Tromsø. One of the workers visiting these Bloodbanks stated:

"The visits to the Bloodbanks should have lasted several days each to really get to know and understand the systems better."

The workers had the opportunity to address the users at these two Bloodbanks and ask them questions about the system. The users opinions about pros and cons in the systems, and their experiences from using the system, were valued just as much as the company presentations of the systems. The users did not only focus on the positive parts, but also mentioned challenges with using the systems. As one of the workers said:

"The companies wanted to sell us the systems, and focused mainly on the positive aspects and benefits. They did not focus much on the challenges and limitations in the systems."

The impression from observing the systems in Bergen and Drammen depended much on what background the person had. The focus was different for the ones working at the routine laboratory of a small, or large Bloodbank, than for workers from the IT part of the Bloodbank.

The only Bloodbank similar in size to UNN Tromsø using LabCraft was the Bloodbank at A-hus university hospital (Akershus universitetssykehus). But they were involved in developing

LabCraft, and might have been too closely connected to the vendors to give an objective presentation of LabCraft. The workers in Tromsø were not so interested in contacting them either.

"No we didn't not contact A-hus, we had our own thoughts and wishes for the program."

4.5.4 How the workers learned to use LabCraft

Before the system was implemented in 2006, some workers were defined as "super users," meaning they were chosen to get an extended knowledge of the system. These workers received some pre-defined basic training in using the system provided by the vendors. The "super users" also got to try out a test version of LabCraft, to better learn the program. This training lasted for two days, which many of them thought was to short. At this training session the workers had the opportunity to ask the vendors questions regarding the system. They were encouraged to provide feedback of improvements required before the system was implemented. The workers feel that the feedback they brought was not really valued.

"We were encouraged to give feedback about the system, but non of the feedback lead to improvements in the system before the implementation."

The worker said that all the issues pointed out at the "super user" training, still remained a problem when the system was implemented, and even a year later.

"Some of the challenges we met when starting to use the system had been avoided if our feedback led to improvements before the system was taken into daily use."

The workers felt that the feedback was not taken seriously. Did the vendors want feedback at all or did they just say so?

Using the test system was however useful to get to know the system. One of the "super users" said there was a good correlation between the test version and the actual LabCraft system." The "super users" said that if more users had the chance to try the test version before the

implementation, they would have been more prepared for how the system really worked, and which challenges they could expect after the implementation.

When starting to use LabCraft the project managers provided some training of the users in the parts of the LabCraft system they needed for daily work. Most of the users interviewed thought this training was sufficient for their daily use. If the users wanted a more extensive knowledge of the system, they had to provide that themselves. One of the users said:

"You just have to try and fail to learn the system better. This is the only way to really get to know it. The challenge was to find time for doing this."

It was said that users with extended computer skills found it easier to learn the system more extensively, than the ones with limited computer skills.

"Extensive computer skills are not one of the main criteria's for working at a Bloodbank. Computers are used only as tools for making the workday easier. Therefore the problems with using the system should not depend on how extensive computer skills the workers have."

There were some meetings between the project managers and the management of the Bloodbank including the vendors, where the system was introduced and discussed. There were no direct contact between LabCraft, and the workers at the Bloodbank. Some of the users found it strange that LabCraft did not prioritize visiting and getting to know the Bloodbank in Tromsø before the actual implementation took place. Looking at the daily routines and talking to the workers could have helped establish the actual needs at this particular Bloodbank.

4.5.5 Implementing LabCraft at the Bloodbank of UNN Tromsø in 2006 from a challenging start to a satisfying outcome.

4.5.5.1 The implementation of LabCraft at UNN Tromsø

The actual implementation of LabCraft at UNN Tromsø took place in just a few stressful and hectic days. This generated a considerable amount of extra work to get the new system up and

running. The users accepted this because of the long-term benefits they expected the system to bring for the Bloodbank. Implementing LabCraft was very positive for the Bloodbank, but the system had some weaknesses and met some unexpected challenges that prohibited it from working optimally. One of the workers said:

"LabCraft worked well for some of the intended tasks like booking of blood donors, storing information at one place, and sharing information between all the Bloodbanks in Health Authority North Norway. For other tasks it did not work that well, like communicating with other systems at the Bloodbank, the use of just one number system, and the possibility to scan blood bags from other hospitals. "

There can be many different ways workers react when introduced to a new computerized system like LabCraft. How they handle the challenges of such an implementation process is very individual. Some users are very positive and treat every obstacle like a challenge and try to find solutions on how to make the most of the system. Others tend to focus on flaws in the system and the extra work required in making it fit the workplace. They focus on limitations instead of all the possibilities and potential in the system. Involving users in the implementation process makes them more positive towards the new system (Orlikowski 1992; Regjeringen 2011).

Many of the uses said that they wanted their workday to be affected as little as possible by the new system.

"We just wanted an updated system that correlated well with our daily routines."

When routines are changed, all of the procedures involved in this routine have to be updated this is often time consuming, and have to be done in addition to the daily routine work. By not being a part of the implementation process, the workers did not know what the new system required of them and which preparations to make at the workplace. The workers expressed the need for a more socio-technical approach in system implementation at hospitals where users are more involved in the process (Berg 1999).

4.5.5.2 Challenges occurring at the Bloodbank of UNN Tromsø after LabCraft was implemented

Since UNN Tromsø was the first Hospital in Health Authority North Norway where LabCraft was installed, some extra difficulties and challenges were discovered here. The problems in the new system varied from how LabCraft communicated with the printers, to serious safety issues revealed. One of the workers had this impression of the system:

"It did not match our routines as well as we expected. It was developed in close cooperation with one specific Bloodbank, and had too many functions and unnecessary steps that did not match our routines."

Since LabCraft did not fit the routines of the workplace as well as expected the users were in many ways disappointed. Instead of improving their workday implementing LabCraft generated additional work because the users had to double-check it all the time. Some of the challenges occurred because the system did not fit the workplace well enough, but others occurred because the workers were quite unwilling to adjust their workday towards LabCraft. They wanted the system to fit their routines without having to making change. Other errors and problems occurred as a consequence of the new system not fitting the installed base and the old system in use. This is one of the challenges with hospitals having systems from many different vendors. The users of the systems find it difficult to make them communicate with each other. In addition to this, some of the challenges and errors that occurred were user related issues from not knowing the system well enough.

For over a year the workers in close cooperation with the project managers and LabCraft tried to improve the system to fit the workplace better. All changes had to go through the project managers since they were the ones communicating with LabCraft. This made the process of making changes very time consuming and the workers impatient. Since the system was used 24 hours a day they had to create temporarily fittings and work-around to fit the routine work at the Bloodbank. It was no room for shutting the system down while upgrades were made. The old system was already removed from the workplace.

"It was a very slow process. Even a year after the system was implemented it still contained flaws that we pointed out on the meetings before the implementation was done. This was very frustrating"

The routine laboratory had some of the biggest challenges with using LabCraft. They detected some major flaws when using the system that made the security and quality of the work questionable. One example was the problems with the ISBT-128. An important argument for choosing LabCraft was the possibility of using ISBT-128 coding. This would help improve the quality assurance of the Bloodbank by providing unique numbers for all samples in the same number system.

"*ISBT-128 is the global standard for the identification, labelling, and information processing of human blood, cell, tissue, and organ products across international borders and disparate health care systems* (ICCBBA 2011)."

The goal of creating ISBT-128 was to develop an accurate, safe, and efficient standard to benefit donors, patients, and health care professionals (ICCBBA 2011). ISBT-128 is used for identification and labelling blood products, and to transfer product information between different computer systems (ICCBBA 2011).

After LabCraft was implemented it should be possible to use only one number system, the ISBT-128. But this was not the case in the routine laboratory because of the lack of communication with DIPS EPR system. Here they still use several number systems. The patient samples are labelled with DIPS numbers and the blood donor samples are labelled with ISBT-128 numbers. The analyze machines cannot read the ISBT-128 numbers unless an extra prefix is added, this is because the number has to be of a certain length to be registered in the machine. Therefore all the blood donor samples are added 9 as a prefix. The samples from the departments are labelled with DIPS numbers since the samples are required in DIPS. DIPS cannot read ISBT-128 numbers. If the samples are not labelled with DIPS numbers the results of the analysis cannot be automatically registered in the DIPS system when the results are sent back from LabCraft. To register these DIPS numbers into the LabCraft system they are added a prefix. The problem with having different number systems in use is when the numbers from the different systems are very similar. This creates opportunities for the systems and the workers to mistake and mix them up.

"We were told that after implementing LabCraft we would only have to use one number system. But we still use several ones that can be easily mistaken."

A consequence of this is if you need to block a blood donor and the DIPS numbers are very similar to the LabCraft numbers, you may end up with blocking a patient number instead. This is of no consequence for the patient, but the blood donor will still be able to donate blood even if he is not fit for it. This can have serious consequences for patients, because blood donors are blocked for a reason. He may have a disease that makes the blood unfit for donation, and the blood receiver sick. The blood donor may be sick from donating blood e.g. by having too little iron or red blood cells. Because of the additional prefixes it is impossible to use the barcode pen for searching for patients numbers. This makes it challenging and troublesome to search for information about patient, or blood donors.

Another example of a challenge that occurred was the possibility of finding the same patient registered with different blood groups (here rhesus antibody). A patient was found registered with both rhesus (rh) + and rhesus (rh) – blood type at the same time. If a patient needs lots of blood and is rh – it may be decided to convert him to rh +. This is because there are more blood donors with rh + than rh – blood and by doing this they don't need to empty the supply of rh-blood. The problem was that he was now rh+ and suddenly when the information from the old system was registered he had "changed" to rh-. The system should have signalized that this rh did not match the other samples from the same person, and the workers said that if this type of mismatch was possible they wondered what else the system would allow. It is important that this type of severe mismatch is not accepted in the new system. The users need to be able to trust that if such major error occurs the system would be able to detect this. This error was most likely caused by the miscommunication between the old and the new system. Information from the old system was transferred into the new system without the new system registering if the information matched.

These examples of problems after the implementation of LabCraft made it difficult for the workers to trust the new system. One of the workers said that:

"Some of the flaws in the system were so serious that they were impossible to accept and it made us have to double check the system all the time. Many hours were used to detect and improve errors connected to the system."

Since some of the detected issues were so serious, several users felt that:

"The vendors and the management had not fully understood what was necessary for making an optimal system for this Bloodbank."

One of the "super users" also stated that:

"The system was not tested out well enough before the implementation to fit our routines. And every time a new version of the system was introduced many of the changes and upgrades done in an earlier version was set *back to scratch."*

This meant that they had to handle the same errors several times and that issues worked out in one version could not be trusted to work in the next one. For every upgrade all of the system had to be checked all over again.

"It felt like we had to test the system over and over again for every new version. This was frustrating and took much time in an already busy workday."

Even though one problem was solved a new one always appeared. Berg and Timmermans (2000) argue that the problems in a system do not disappear they just relocate to other parts of the system and create problems there instead. They further say that:

"*The overall level of order and disorder, appears to be largely constant (Berg and Timmermans 2000)."*

To expect that a new system will remove all the problems the workplace struggled with in the old system and not contain any new problems is not very realistic. As Gasser say:

"*There will always be computer slips like inaccurate data, to seldom or to frequently produced reports, and too slow response to software maintenance request (Gasser 1986)."*

The users have to be prepared for this so they don't have to high expectations regarding the implementation of the new system.

"It is possible to create disappointments and negativity among the workers if they are not well enough prepared in forehand of what to expect from the implementation of a new system."

Another critique towards the new system was:

"The system seemed a bit "unfinished" and "home made" in user interface, "this can be factors that decreases the credibility of the system."

There were great expectations connected to the implementation of LabCraft, because of the general IT development, and also the limitations and troubles in the old system. The workers expected something really modern and updated when it came to user interface and graphics, because of the fast development in IT in general. If the system was compared to the old system it did seem both professional and modern. But compared to a program like Microsoft words it was not particularly ground breaking.

Some of the users also asked if the project managers knew the daily routines well enough to make this system work optimally for the Bloodbank? The project management did not work in the routine part of the Bloodbank, and there are constant changes to the Bloodbank routine work that may be challenging to keep up with if this is not your regular workplace. Since they were the only two persons in the project of implementing the system the workplace depended on their knowledge both in the IT and the Bloodbank part of the system. The project managers as well as other users would have preferred if one of the workers from the Bloodbank laboratory were included in the project group as well.

It was challenging to make LabCraft part of the existing information infrastructure (More about this in the part Communication with other systems page 63).

Another frustrating issue in the system was that some things were impossible to change without extended computer knowledge and password control, and others were too easy to change with just accidentally pushing a button. One of the workers stated that:

"One example of such impracticality is if you want to block a particular time for booking of blood donation e.g. if there is a meeting scheduled at this time, you have to use a password every time. But to change the time for when the donor have an appointment don't demand a password, and is possible to do unintentionally. This may create problems with double booking and misunderstandings for the donors."

To improve errors in LabCraft was very time-consuming. The vendors were not unwilling to make changes but they had to consider how one adjustment would influence the rest of the system as well. Also LabCraft was a small company with limited resources for working with this particular implementation. In addition to this the workplace put lots of pressure on the vendors to make changes without considering the consequences for the rest of the system. These had to be solved out in the best way by the vendors.

When a new system is implemented it is easy to blame all problems and challenges occurring on the system. One user said that some of the difficulties were just as much to blame on the users. It takes some time to get used to a new system and while doing this several user errors may occurre.

4.5.5.3 Benefits from implementing LabCraft at UNN Tromsø

The implementation of LabCraft improved the workday at the Bloodbank of UNN Tromsø in many ways, and most of the workers achieved great benefits from using this new system. Some improvements occurred soon after the implementation, and some arrived later. It was easy to forget the positive effects of the new system, and just focus on the parts that did not work well. Some of the workers interviewed thought it was too much focus on the negative issues. They wished to emphasize more on the enrichment the system brought to the workplace instead.

"We cannot expect to get a system that fits our routines and needs 100% when it is meant to be useable all the Bloodbanks in Health Authority North Norway. That would mean that we had to decide what was best for all the other Bloodbanks as well."

This system was not created only for the Bloodbank in Tromsø but also others Bloodbanks of different size and shape. Therefore some adjustments for it to work optimally for the different Bloodbanks were necessary. Several users agreed that it was impossible to get a perfect system instantly, and that changes were required at the workplace when implementing a new system. One of them said:

"There will never be such thing as a perfect system, it is only possible to create a system containing other problems and limitations than the old one, not a system without any. Control mechanisms and routines always have to be adjusted to fit the new system in some way."

One of the major improvements this system introduced was the capability for gathering all the information of the Bloodbank at one place. Also the possibility to trace the information of blood products from blood redraw to transfusion has contributed to increased quality assurance and safety at the Bloodbank. LabCraft was a very stabile and reliable system compared to the old ones. There are good opportunities for logging information in LabCraft, therefore there are almost no needs for manual logging of information at the Bloodbank anymore. This is positive, and a step forward in the goal of getting a paperless hospital. This way all information is kept at one place, and not in different logs and folders. In this system it is easy to create reports for statistical analysis of the work done at the Bloodbank. The old system also contained lots of information, but it was difficult to get it out of the system.

"Another benefit of choosing LabCraft is that it is a Norwegian system created for Norwegian Bloodbanks, based on Norwegian laws and regulations."

LabCraft keeps track of the national Bloodbank regulations when changes are made they include them as system updates. This is very advantageous for the Bloodbanks because this ensures them to always work within the current national laws and regulations. One of the interviewed workers said:

"To keep up with national changes in Bloodbank regulations had been challenging if we did not choose a Norwegian vendor."

The office/administration was the section of the Bloodbank where the implementation of LabCraft improved the workday the most. Especially the booking system for blood donors with the possibility to send automatic SMS to remind donors about their appointment was very positive. Earlier they had to phone each of the blood donors, and with 50-60 persons coming in each day this was a very time-consuming job. Now one automatically written SMS replaced most of the telephones. Because of this the quality assurance increased, and the number of staff needed, decreased from 5 to 2 persons in this part of the Bloodbank. Several workers stated in their interviews:

"At the office the workday improved considerably from implementing LabCraft. They had an almost instant positive effect of the LabCraft implementation."

The blood redraw and the blood component section of the Bloodbank also experienced great benefits from implementing Labcraft. The use of ISBT-128 coding worked very well here, and eased their work with labelling, registering and tracing products. All the blood units were labelled with a unique ISBT-128 number. When the unit was separated into blood components the unique number followed the different components. They were just added different prefixes to identify what component it was. These numbers could be scanned directly into LabCraft and easily accessed.

Figure 13:Blood samples with ISBT-128 coding (Rødekors.blodprogram 2012)

This contributed to improve the quality assurance of blood products extensively. In both these parts of the Bloodbank there were mostly standard routines with small deviation from day to day, and this made adjustments to a new systems not so challenging here. After some necessary changes were made, the system worked well here. At the instant help and the routine part of the Bloodbank however there were more variations in the work from day to day, and to make a new system fit here was more challenging. There were lots of issues to consider and new ones kept on popping up.

One improvement mentioned by one working with blood redraw was that the system automatically signalize when a donor passed 60 or 65 years, this was positive because at these ages additional tests were required to take extra good care of these blood donors. Such small details help ease the workday since it is one less thing that the workers have to remember.

"It is not always you have the time to check how old the donor is, so to have the system automatically signalizes this is very positive."

Another positive factor was that the LabCraft system was very stabile and predictable. Errors that made the LabCraft system stop occurred very rarely.

"Now we seldom have to use emergency numbers when drawing blood from donors because the system is down. This happened more frequently in the old system."

When the old system was down, they had to make "emergency" labels for the blood bags and the laboratory samples, which had to be relabelled later. This was very time consuming for the workers. It was also reassuring to have a reliable system especially when working alone at evenings, nights and weekends as they did at the Bloodbank. When working alone it was no room for manual procedures and additional work if the system broke down. It was important to be able to rely on the system.

At the laboratory part of the Bloodbank there were several improvements from implementing LabCraft as well not just problems. This was the part of the laboratory where the old system worked best, so they did not immediately feel that the new system was a great improvement. Blood samples from the departments contained DIPS labels possible to scan directly into LabCraft without re-labelling the glass. This was not possible in the old system, and was time

saving both for the laboratory where the analysis were performed, and at the office where samples used to be registered and labellers printed out. In this issue LabCraft cooperated well with the major analysis machines at the Bloodbank. For the Instant help section functions like ”dataforlik” when sending out blood to departments or emergencies made the workday a lot easier. This function automatically matches the blood type of the patient and the blood donor.

It was also very beneficial to have the same laboratory system in all of Health Authority North Norway (More about this subject at page 66: communication within Health Authority North Norway).

Even if there were challenges to deal with at first, LabCraft turned out to be a good and functional system that worked well in the daily routines at the Bloodbank. Both the project managers and the vendors were very positive and helpful in making the system as optimal as possible for the users.

“We were very lucky that the project managers worked here at UNN, without having them available this process would have been much more difficult. They have done a fantastic job with this implementation and the adjustments afterwards.”

For a long period the Bloodbank depended on the project managers to keep the system working cooperating well with their routines, and everybody agreed that they played an essential role in this process. They have invested endless work hours in this project and kept the communication with the vendors well functioning. The system had not worked as well as it does today if it was not for them. The workers at the Bloodbank also spend many extra hours to make the system fit their routines and the information infrastructure as well as possible.

Another statement made by one of the workers was very interesting:

“It can be positive that a system is not too “finished” when receiving it, because than it is often more room for local adjustments and improvements in the system.”

This underlines that an "unfinished" system with room for changes may not be all negative. Such system would be ideal for using a socio technical approach with users involved in implementing and shaping the system. This was not so easy here because of the top-down management controlled process. The workers expressed that it had been beneficial to make more of these adjustments in the pre-implementation phase instead of after the implementation finished as they did in this project. The workplace needs the system to have room for changes to be able to fit their work routines well enough. Adjustments in the system are not automatically a negative thing sometimes changing the work routines creates unknown benefits for the workplace. Often users get a bit "blind" for improvements in work routines because they are so used to the way they work that they don't believe that better options may exist. One of the workers made this statement:

"When we choose to start using a system we have to be willing to adjust our routines to fit the system. Some flexibility and patience would have helped making the transition to the new system easier."

The representative from LabCraft said that their system had been improved from conducting the implementations in Health Authority North Norway. In many ways it was positive that so many changes were demanded in the system during the implementation in Health Authority North Norway. Some improvements made for the next version of LabCraft was even taken into use earlier then planned, after demands from the Bloodbanks in North Norway.

"The older implementations we had in the south of Norway was finished some time ago and the users had already got used to the system. Therefore this new implementation did request necessary changes, and helped refresh the system."

When a system is newly implemented it is easier to see areas that needs changes and improvements than after having used the system for a while.

The LabCraft representative said:

"Bloodbanks are so complicated that it was impossible to get everything they needed into a tender. Including all specifications would create an extremely large document."

The vendor seemed familiar with the problems of having too general tenders, and knew the Norwegian Bloodbank marked well. They were both prepared for and willing to make adjustments to the system that was not specified in the tender.

Implementing LabCraft raised the quality and improved the workday at the Bloodbank in Tromsø. One of the interviewed said that:

"It is so easy to focus on the parts that do not work and forget all the benefits the system has given us. People makes a lot of fuzz when things don't work as expected, they don't do that with the parts that works well."

4.5.6 Information flow in this implementation process between 2004-2011

There were several actors in this process, and good communications between them were important to get a best possible implementation. The communication between the Bloodbank management, the project group and the LabCraft vendors was good throughout the whole project. In the pre-implementation phase they had several meetings to discuss price and functionality of the system. After the implementation there were meetings about how to make the best possible improvements in the system. The communication between the project managers and the management of the Bloodbank was also good and they had frequent meetings and updates of the progress in the project. When problems occurred they discussed which one to prioritize and how to best solve them. Referrals from these meetings were also available for the workers at the Bloodbank to read. They informed the workers of the content of these meetings as well. The manager stated:

"It was important that the workers knew that the management of the Bloodbank treated the problems in the system seriously, and that we tried to solve the problems to improve their workday as much as possible."

Especially in the start of the implementation process everybody was satisfied with the cooperation, and even if LabCraft was a rather small company, and this was a large tender including all the Bloodbanks in North Norway they found time to follow up this project well. When deciding what company to accept in a "bid for tender" process, it is always beneficial

to consider if a company is large enough to handle such a big implementation process within the time limits set. The project managers stated that:

"We communicated well with the vendors and we received lots of information from them."

The users communicated with LabCraft only through the project managers in this implementation. This was the best communication route for all the participants. This way the project managers could sort out the different issues they receive, and decide which problems and improvements they could handle themselves, and which they had to send to LabCraft. It would have been impossible for LabCraft to communicate directly with all the workers at the Bloodbank. The project managers expressed the need for better communication with the vendors regarding the actual installation of LabCraft at UNN Tromsø.

"The company should use the project managers actively in every installation because every Bloodbank is unique. Even if they had implemented the same system before, cooperating closer with the project managers may have provided a smoother and better process. Many of the issues causing trouble could have been handled before the system was taken into daily use."

If the vendors had included the project managers more extensively when preparing for the implementation at UNN Tromsø, the project managers could have informed the users better during the process, and had more control of the process.

"In the other implementations we had more control since we had been through the process before, and knew what problems and issues to be aware of and prepare for. We also knew what was important to make the workers aware of when starting to use the system."

Information was sent from the project managers to the workers at the Bloodbank by e-mails and updated "bulletins" containing information of the progress in the process. At first these were sent weekly, and later when they had something to report. Some of the users not very involved in the implementation process felt this new system was implemented too fast without them receiving enough information about it. They felt that suddenly they had a new system they were supposed to start using. They thought the information regarding changes and challenges in the system was handed out unsystematically and was difficult to get hold of.

"Some information came by e-mail, some in meeting referrals, on post-it's, or oral. Sometimes it felt rather random what information the different workers received."

They expressed the need for a more uniform and systematic way of informing workers to make sure everybody received all necessary information.

4.5.7 Communication with the other systems in the information infrastructure

For the new system to function well it was essential to cooperate with the rest of the information infrastructure. According to the interviews several adjustments were made to get LabCraft collaborating as good as possible with the instruments and system connected to the Bloodbank.

The LabCraft system contributed to improved communication between actors in the information infrastructure. It was integrated with several of the instruments and equipment at the Bloodbank. One of them was the blood collection mixer, the unit where the blood bag lay during blood redraw. This mixer monitors collected blood volume, rocks to mix blood with anticoagulants inside the blood bag, and clamps the tube at pre-set volume to help reduce over-bleed (Fenwal 2012).

Figure 14:Blood collection mixer (Fenwal 2012)

Also the expressers (Presser) that performs automatic extraction of blood components: red cell, Buffy coat (blood platelets) and plasma components from centrifuged whole blood units,

are connected to LabCraft. All information is automatically transferred from the expressers to LabCraft (Australian.red.cross.blood.service 2012).

Figure 15:Optipress blood extractors like the ones used at UNN Tromsø (Australian.red.cross.blood.service 2012)

Having these instruments connected to LabCraft helps the traceability of the products, and prevents the need for manual logging of information. Also the analysing machines at the routine laboratory is connected to LabCraft, even though the information is transferred manually trough a third program. Some instruments like the "Lundair freezer" and the "Hettich centrifuge" is not yet connected to LabCraft, but this is more due to limitations in the programs of these instruments than LabCraft.

Labcraft does not communicate directly with other laboratory systems, like the hospitals electronic patient record system DIPS ASA. The answers from analysis performed at the Bloodbank, is transferred to DIPS two times a day at weekdays and one time in weekends through a third program called "datafangst." This process depends on all the three programs working optimally at the same time. When they do, the communication between the systems works well. It is very unpractical that the test results cannot be sent automatically from LabCraft to DIPS. The other hospital departments have no access to LabCraft, and have to

wait for test results until they are sent back by the Bloodbank. As a consequence the departments think that due to the long time they wait for results they must have forgotten to order tests. Then new ones are ordered, and unnecessary blood redrawn from the patients. The departments often think the Bloodbank uses DIPS ASA, and call about DIPS related issues that the personnel at the Bloodbank cannot answer.

"All in all this makes the service towards the other hospital departments poorer than we want it to be."

There were many issues connected to the cooperation with DIPS ASA that the Bloodbank wanted to improve, but when the DIPS ASA system were put out on tender some time ago, the cooperation and improvement of communication between these two systems stopped.

"If the hospital is no longer using DIPS as a patient record system, it is no use in adjusting it further to fit LabCraft."

The question was also raised if one of the reasons for the implementation of LabCraft being so troublesome and time-consuming was that DIPS was not so interested in prioritizing the improvement of the communication between these systems. LabCraft numbers were not possible to read in the DIPS system and it was impossible to send electronic requisitions from LabCraft to DIPS.

When it came to communicating with Safir (used at the microbiology department) there were some problems as well. This could not necessarily be fully blamed on LabCraft, since the Microbiology department implemented their new Safir system almost at the same time as the Bloodbank implemented LabCraft.

"What demands the Microbiology department had included in their tender concerning cooperation with other systems, we did not know anything about."

Time and effort was invested to improve the communication with Safir, since it is necessary with a daily information flow between these two systems. Now this communication is satisfying according to the workers at the Bloodbank.

Every component of the information infrastructure must be considered when implementing a new system (Hanseth and Monteiro 1998), since a laboratory system cannot not work as an independent unit. At the Bloodbank at UNN Tromsø the new and the old system did not communicating very well.

"*How the old and the new system cooperate when information is moved from one system to another can influence the implementation process and the creating of a new information infrastructure (Hanseth and Monteiro 1998).*"

This was very much the case at the Bloodbank. The data from the old system was not easy to transfer into the new system. The workers felt that the challenges connected to communicating with the existing systems, in the installed base and particularly the old system was one of the main causes for the challenges in this implementation process. The representative from LabCraft pointed out:

"To transfer information from the old system into LabCraft was difficult and troublesome."

The challenges of transferring information from the old system to LabCraft, was one of the reasons why this implementation lasted longer than expected. LabCraft was blamed for most of the problems occurring, since they appeared after the new system was implemented and the old one was out of use. In addition to the problems the old system created it might have been that LabCraft was not well enough prepared for combining their system with the two existing systems running at the Bloodbank of UNN Tromsø. They may have benefited from cooperating closer with the project managers to detect possible challenges connected to transferring information from the old to the new system.

4.5.8 Communication within Health Authority North Norway after implementing LabCraft in 2006

To implement a common laboratory system in all 11 Bloodbanks of Health Authority North Norway has been very positive and beneficial for both the doctors, and the laboratory workers at the Bloodbanks, because of the increased opportunity for cooperation and communication between the different Bloodbanks in Health Authority North Norway.

"There has always been a good cooperation between the North Norwegian Bloodbanks. But the use of one common system has improved the way the Bloodbanks works together and communicate with each other. This has contributed to a rise of competence and quality in the North Norwegian Bloodbanks."

Having a common system has helped raise the safety for the patients, because the information connected to blood transfusion and tests done at the Bloodbank of one hospital, is available at all the Bloodbank in North Norway. One of the workers said:

"This sharing of basic information should have been possible in all of the Norwegian hospitals."

The sharing of information is not limitless this is reduced by regulations of the Norwegian Data inspectorate based on issues of patient confidentiality and patient data control.

LabCraft appeared to be a good system to choose for a large organisation like Health Authority North Norway. It was a flexible system with attentive vendors positive to make adjustments and improvements to their system. As a result the workers stated:

"Several of the other health regions in Norway envy us the extended possibility of data exchange and cooperation we have since all the Bloodbanks in our region use the same system."

The work of standardizing the procedures in all the Bloodbanks has started. It is much easier to have common procedures when using a common Bloodbank system. By doing this the maintenance and updates of the procedures can be handled at one place in the future.

Because of the common system it is possible for a blood donor in one Bloodbank of Health Authority North Norway to donate blood in any Bloodbank within the region without being defined as a new donor that needs to wait three months before donating. This gives more flexibility for the blood donors as well.

"We can find the donors from other hospitals in the system, and the only information that is not available is the "doctors comments". If they are required we can ask the IT personnel for access."

The workers at the routine laboratory found it very useful to be able to look up previous test results at patients from other Bloodbanks in Health Authority North Norway.

"Some times we even find information and results that our own tests and routines has not detected."

This contributes to raise the quality of the Bloodbanks in Health Authority North Norway.

"We still have to do the actual tests in Tromsø because of national regulations. They define that tests has to be done at the treating hospital, to define where the responsibility lies if something happens with the patient. But still it is often easier to do tests if some information in available in forehand."

Having some previous information could help save time and resources compared to starting analysis from scratch. Another positive effect of having the same system in all the North Norwegian Bloodbanks is the possibility of finding useful information on patients if there has been an accident.

"If there already are some information on the patient in the system, we can prepare better for when they arrive to the hospital. If we know the patient is A + we can give rh + blood from the start instead of having to use rh – blood until analysis are finished."

There are more blood donors with rh (rhesus antibody) + blood than rh -. Rh – is used for patients when their blood type is not known because this blood can be given to any patients without risk of reactions. Even if the actual test has to be done after the patient comes into the hospital, they can be used simply as a confirmation of the already known blood type.

To have a similar system with a database containing information of antibodies and specially difficult cases that might be accessed from all the Bloodbanks in Norway have been discussed

for at least 15 years on a national level without any results. Also to have a database containing the ”blood inventory” of the different Norwegian Bloodbanks has been considered. The users at UNN Tromsø expressed a need for both these databases. Sometimes a Bloodbank have to buy blood products from others, and it would be timesaving to be able to check the status of each Bloodbank in forehand before deciding where to call. It is not easy to create such common databases today due to regulations made by the Norwegian data inspectorate, and the use of different laboratory systems in the Norwegian Bloodbanks. Maybe they can establish this now for the North Norwegian Bloodbanks? Having the same system opens a whole aspect of new ways to cooperate.

“It was not important that all of Health Authority North Norway used LabCraft, but it was important for the cooperation within the region that all the 11 Bloodbanks used the same system.”

4.5.9 The use of resources in the implementation process between 2006-2011

There were only two persons working with implementing LabCraft to all the 11 Bloodbanks in Health Authority North Norway. In one way this was a good solution, the project managers said that they worked well together and after a while they had good knowledge of the system and the implementation project. The health trust also saved money by employing only two persons in this project. Health Authority North Norway had a goal to implement LabCraft to all their Bloodbanks in two years (Helse-NordRHF 2006). To hire two persons to implement a new system at 11 Bloodbanks in two years seem rather unrealistic. The project managers had to implement LabCraft at one Bloodbank at a time since they were only two persons. In addition to implementing the system they also trained the workers in how to use it. They worked in the project for 5 years, and did more and more of the implementations at the different Bloodbanks on there own.

“The last installation we did entirely on our own, because of the ”ash cloud” from Island the LabCraft personnel could not make it to the hospital.”

They also said that:

"This whole project has been a learning process for us as well; we did not get more training in using the system than the "super users" at the Bloodbank before the implementations started. We have never been in charge of such a large project before"

This can be described as a "learning as we go along" project and many work hours were invested to make this implementation a success. They did express a need for additional resources put in this project, since it was a big project to run for just the two of them.

"The Bloodbank management /Health Authority North Norway did not seem to realize the workload of this project. We were the ones set to do this job, and no additional resources were prioritized for the project."

It would have been beneficial both for the project managers and the workplace if at least one more person worked in this project full time, as several of the workers expressed a need for. This should have been a person with a good overview of the different sections of the Bloodbank and the work done. It was challenging for the project managers, which did not work directly in the Bloodbank on a daily basis, to have a complete overview of all the important aspects to consider. They expressed that:

"There should have been one person knowing the Bloodbank routines very well that could work at this project full time together with the project management."

This would have cost the department and Health Authority North Norway money, and was not prioritized. This was not due to lack of time, the project managers said time was not an issue here, but it might have to do with management not realising that using resources early in the process could save some later. The project managers said that even if they would like to have one more person in their project group they did not want too many people involved in these implementations. That would have made it more difficult to find time to meet and to actually get the implementations done. It is challenging to decide how many persons to use in a project and weather to include users or not. Getting the size of the project group right is not easy, too large groups gives coordination problems and too many discussions. Too small groups may give an underrepresentation of the users, and too much work for each of the group members (Hirschheim 1989). There were several questions about the time and resources used in the process of implementing LabCraft.

In this project it was two project leaders, this may be a good thing since it was a big project with much work and responsibility to handle. But this way it might be difficult to define what part of the process each of the two project leaders were responsible for and who to turn to with problems. The one interviewed from the management stated:

"Shared management may lead to weaker definitions of responsibilities and is not necessary a positive thing. I don't know if this was the case in this process, but in a similar process in the future there will only be one leader of the project."

4.5.10 Supporting the new laboratory system

To have a sufficient support system was important for the users as a safety assurance, especially when using a newly implemented system. In this case it was not established where the 1.line support of the system should lay. It was very stressful not knowing where and who to call if there were a problem with the system. The most likely place for such support would be Health Authority North Norway IT, but they were only given the technical maintenance and support of the system and the database, not the more specific support of the Bloodbank related issues. To be responsible for the support of this specialized laboratory system, Health Authority North Norway IT would need Bloodbank qualified personnel. This support demanded an insight in both the technical and the Bloodbank related issues of the system.

Health Authority North Norway defined when deciding to invest in a new system that the support of the system should be localized at UNN Tromsø (Helse-NordRHF 2006). They did not however define how this support function should be managed, or finance such function at UNN Tromsø. The result of this was that until now the project managers have been responsible for the 1.line support of the system, without this being their responsibility. This is because they were the only ones that had sufficient insight in both the IT part and the Bloodbank part of the system. The project managers stated that:

"It might have become a sleeping pillow for Health Authority North Norway that the project managers here worked at the Bloodbank in Tromsø."

This way they were “available” at the hospital after the implementation was finished here, and it was easy to call them or just go by their office. If the project managers were from outside UNN this issue would have been necessary to solve a long time ago. LabCraft were available for 2.line support, this was a support function active between 8-16 at weekdays. Only pre defined users could send their requests with issues to take care of here. The project managers were the ones at the Bloodbank of UNN Tromsø that had this communication with LabCraft. This was the only form of support the vendors had agreed to in the tender.

4.5.11 The use of LabCraft at UNN Tromsø in 2011.

The project of implementing LabCraft at UNN Tromsø and making the system good enough to use in the daily routine took more time than expected. It took two years before the users were satisfied with LabCraft at this hospital. The interviewed at LabCraft stated:

“It took a lot more time and cost us much more money than expected, but we finally reached the common goal of LabCraft and Health Authority North Norway to have one common laboratory platform in all the Bloodbanks in the health trust.”

LabCraft had a goal of finishing the implementation process of all the 11 hospitals in 2008, but not until 2010 were all the installations finished. The workers adjusted their work routines and LabCraft adjusted their system to make it fit the Bloodbank as well as it does today. After a lot of adjustments, frustrations and work with the system they finally got a system useable for the Bloodbank at UNN Tromsø.

The workers said that Bloodbank is a field with frequent new developments and challenges important to keep up with. There are also numerous factors like the installed base and the surrounding information infrastructure to consider when installing a system like LabCraft. Also the general IT development is very fast, and it is important to keep up with the IT standards people are used to from general computer use, to have a optimal and trustworthy system. A close cooperation between the users of the system and the ones maintaining and updating it is important to develop the system further. A close cooperation will make a better mutual understanding of the potential and limitations in the system and help creating a best possible system for all parts.

The implementation of LabCraft has strengthened the Bloodbank at UNN Tromsø, with increasing the quality and traceability of the work. All parts of the Bloodbank benefit from this implementation. There are still some parts of the system like the communication with other systems, and getting just one number system that needs improvements. But it is important that the problems are registered and taken care of, not just worked around by creating alternative routines and work practices. The users interviewed were all more or less satisfied with the system today

"It is not possible to get a perfect system, but LabCraft works well today for most of the intended tasks."

5 Discussion

In this part I will look at some of the important findings in this evaluation. The main issue influencing the whole discussion is the lack of user involvement in implementation processes. Another is the struggle between having all the demands needed in the tender, and the chance of getting any vendors to attend the "bid for tender" process. The risk of forgetting to include well functioning parts of the workplace in the demands for a new system is looked at as well as the attachment to the installed base and the information infrastructure. Also the struggle between standardization and needs for local adjustments are addressed here as well as time-use in and lack of system support in this implementation.

5.1 The need for changing the user role in system implementations at hospitals

5.1.1 The need for more user involvement to get a successful outcome of an implementation

During this evaluation I discovered that user involvement in an implementation process is a complex and difficult issue. It's not enough to state the need for more user involvement. Many considerations have to be made of how this user participation should be conducted. How to include the users and what users to involve are some of the challenging aspects. After interviewing workers I noticed that they interpreted the implementation process rather dissimilar. What they remembered of the process, and which issues they focused on, were closely connected to their attachment to the implementation. Users most involved focused mainly on the entire process and saw the implementation from a bigger perspective. They were mainly concerned with the advantages for the Bloodbanks, and how the system developed from needing several adjustments, to working well within the hospital information infrastructure. The workers less involved in the implementation focused on the lack of information during the process, benefits and flaws in the system affecting their workday, and the frustration this implementation cost the first year. These differences in perspective had

probably not been detected using a quantitative method with pre-set questionnaires. Using a qualitative method gave the persons interviewed the opportunity to tell their own stories and made it possible to reveal unexpected issues. Klein and Myers (1999) say in there 6. Principle:

"*It is important to require sensitivity to possible differences in interpretations among the participants of the study."*

This observation indicates that more user involvement establish a better understanding of an implementation process. Several theories underlines this: When including users, getting a better system than the old one is more likely, because users know the improvements required (Hirschheim 1989). Orlikowski (1992) states that lack of user involvement influence the adoption, understanding and use of a new system, and makes the workers see less use of the new system than managers expects (Orlikowski 1992). Including users in the implementation requires less fitting and additional work for the system to be useful in the daily routine (Gasser 1986). Users will also in addition to consider the technical aspect of the implementation, include the social and human aspect needed for introducing a new system to a workplace (Bansler 1989).

Implementing LabCraft at UNN Tromsø was a typical management controlled top-down process with limited user involvement. The decisions about which system to choose, and how to proceed was decided on a higher hierarchical level than the Bloodbank. One risk of using a top-down approach was that decision-makers were likely to choose applications that benefit managers. They may have overlooked or underestimate downsides for users, like extra work required to maintain the application (Grudin 1989). This could have been avoided by using a socio-technical approach controlled by users. Hirschheim says:

"All implementation processes will require some user participation, but to define it as a participative system design, the users have to be the leaders of the implementation process not just participants."

In this process at UNN Tromsø the users had a more consultative than leading role. Some workers wrote demands for the tender, but none of them made any final decisions. As a consequence of this the managers did not meet the users requests for more time to get to know

the new system and make needed adjustments in forehand of the implementation. Participation makes users feel more commited and willing to make changes needed for improving the system (Hirschheim 1989). If they do not know the system well enough to see benefits for the workplace they are less likely to take on extra work to get the system fit the installed base.

There are however several challenges with too much user participation. Some would argue that this is not beneficial in a complex organization like a hospital (Johannessen and Ellingsen 2008). User involvement may cost extra time, is inherently manipulative, and can be hard to manage in practice (Hirschheim 1989). Socio-technical critiques have focused on ways in which IT affect the quality and shift the power balance of the workplace (Lamb and Kling 2002). Having users in charge of such processes gives the managers less control of what is going on and if the process follows all the necessary regulations and protocols. This approach lack clear boundaries which may lead to crossing areas of responsibility, conflicts, and misunderstandings which again leads to systems failing (Hirschheim 1989). It is not always beneficial to have more people involved in a process. This makes it harder to find time for meetings and more difficult to make decisions that moves the process forward. Therefore there is a need for management control of some parts of the implementation process, Røed and Ellingsen (2011) states that:

"*There are limitations as to what the users can do, not only in direct interaction with computers, but also due to a lack of oversight and knowledge in a distributed setting.*"

This last argument shows that implementation processes cannot be conducted and controlled by users alone. But it does not prevent them from having a more central role in such processes. A tender includes many parts like providing ongoing system support, problem management, price and quality (The.project.management.hut 2007). "The bid for tender" process has to follow EU regulations, as well as regulations set by the Norwegian government in Law of public purchases (Lovdata 1999). This is a very complex process, and may not be the important area for a department like the Bloodbank to focus on. Health Authority North Norway/the purchase department at UNN have more control of the formal regulations and procedures in such process. They however don't know the actual needs the Bloodbank have for their new system. There should be a closer cooperation between the different actors to insure a more positive outcome of the process. I agree that more user involvement is

necessary, especially in the pre-implementation process, despite the challenges of defining what users to include and how they should be involved. In a complex organizational setting like a hospital where a heterogeneous group of workers share the same system (Johannessen and Ellingsen 2008), the user role tends to get increasingly blurry. Actors use the system in different ways, and it is not even always given who the users really are. Røed and Ellingsen (2011) says:

"The users plays a big part in bringing technology and end-users together, which in the end will be a part of the system's ability to become successfully implemented."

When involving workers in implementing a new system, it may be difficult to decide which of them to include (Johannessen and Ellingsen 2008). Should all users from the four parts of the Bloodbank have been included, or should they choose some representatives? If some were chosen how should they decide on whom? These workers would belong to specific parts of the workplace. How could the others be sure they would prioritize the benefits of the whole Bloodbank, and not favor their particular work area? The users I interviewed did not express a need for all users to be involved. But they recognized the need for some users as key actors in the implementation process. They even expressed a need for one user being included in the project management to insure that LabCraft fit the workplace.

It seems like the traditional top-down approach is no longer sufficient, and having the users control the whole implementation process seems challenging in a big organization as a hospital. A combination between the socio-technical and top-down approach might be the best way to implement a new system. In the pre-implementation phase more user involvement is necessary, but in others parts of the process there is a need for management control for the process to move forward. Otherwise implementing a new system may end up as a "never ending story," were different users with dissimilar needs tries to make agreements. It is not done over night to move from a top-down management controlled approach to involving the users more in the implementation. I strongly recommend that this process be started as soon as possible to be able to achieve more successful implementations.

5.2 How to make a new system part of an existing information infrastructure?

5.2.1 Creating a tender: Is it possible to make everybody happy?

An important dilemma detected in this implementation was how to make a best possible set of demands for the tender (kravspek). It is challenging to balance the need to create specific enough tender demands to best fit the workplace, with the need for general enough demands to make it possible for vendors to enter the "bid for tender" process. To create the demands for the tender at a specialised workplace like a Bloodbank is not easy. This is the basis for the new system and it is important to include all details and specifications needed. If the demands are incomplete the system will be useless for the workplace. But all these requirements have to be able for vendors to meet, and if they are too detailed and no vendors can meet them there will be nobody able to provide for a new system.

After evaluating the implementation process at the Bloodbank it seemed like the workers had not create good enough demands for the tender since it took so long for the system to fit the workplace after it was implemented. If the demands were good enough, the system should have fit the workplace better, since this was the foundation the vendors based their system upon. But then I detected that the demands used in this tender where not those the workers originally wrote. To ensure to get the best system possible they firs created a very specified set of demands were all important aspects they needed for the new system were included. These demands were returned to the Bloodbank from the purchase department for being too detailed. They had to make a more general set of demands, since there were few vendors of Bloodbank systems especially when a Norwegian system was preferred.

This creation of the demands for the tender was the only area of the implementation process where users had something to say. And even here managers ended up with controlling the process. The top–down approach is a hierarchic design with a centralization of power at the top (Stream 2010). As long as the management is in control, their needs for a more

standardized process will always be prioritized over the Bloodbanks need for making a detailed set of demands. Ellingsen and Monteiro (2006) states:

"The top-down approach attempts to standardize the implementation process, and make it more efficient and cost saving."

But having to make several fittings and workarounds (Gasser 1986) and several adjustments after the implementation was finished did not make this process more efficient or cost saving in the end. How could users make specific enough demands to get a good enough system, when by doing so they might not get any vendors? Creating a shorter and more general set of demands made the workplace lose the chance to assure that the new system contained the specifications needed for improving their workday. Using a more socio technical approach would have helped getting the demands as good as possible for the workplace. Berg (1999) states:

"There is a need for a lot of insight into the workplace to get the best possible system."

The vendors were also in for a surprise if they thought the demands in the tender were all the specifications the Bloodbank needed in the new system. The whole point of writing requirements for the tender was for vendors to know what the workplace expected, and for the workplace to get a system that fit their needs. In this case nobody really knew how well the system would fit the workplace until the implementation finished.

It is also important to have in mind that implementations always create some needs for changes:

"It is hardly ever possible to achieve a project result that precisely meets all of the requirements that were originally specified (The.project.managment.hut 2008)."

No matter how detailed demands the tender contains, adjustments will always be necessary after a system is implemented. In this case LabCraft were prepared to take on extra costs to change and improve the system, even if they were not obligated to do so. The benefit of having all of Health Authority North Norway using their system was greater in the long run than the money it cost to adjust the system. One positive side of Norway having few

Bloodbank vendors was their willingness to go beyond the tender to get a share of the marked. Even so, this prevented the workplace from getting an optimal system sooner.

To have someone outside the Bloodbank controlling the implementation process contributed to compromise the quality of the new system. The needs the users had written down for the system to fit their daily routines might be misinterpreted and down prioritized by the purchase department and management of the health trust. But even if the Bloodbank had more influence in the process they had to make the demands in a way that would give vendors the chance to meet them. How did this process become so difficult? Too detailed demands gives no vendors, too general demands gives an insufficient system and extra work, how should this be solved? There is clearly a need for closer cooperation between the participants in the process vendors, workers, and management, to be able to make the right decisions of what priorities to make. This is not possible to do following a top-down management controlled process where pre-fixed workflows, formal task descriptions and pre-defined models are seen as the way to make the best system (Berg 1999). It is obvious that this issue needs an evaluation beyond what this thesis gives, since this is a very important area of the implementation process to address. It seems like the entire "bid for tender" process has to be evaluated and made more user- friendly for this issue to be solved.

5.2.2 Balancing the new systems attachment to the installed base

A hospital is an information infrastructure with several human and non-human actors (Hanseth and Monteiro 1998). One of the most important actors to consider is the installed base. This is the already existing system, the work routines and the surrounding instruments and systems the new system has to cooperate with. Hanseth and Monteiro as well as Johannessen and Ellingsen underline this in their papers:

"A new system cannot work independently and have to be based on the already installed base (Hanseth and Monteiro 1998)."

If the new system is familiar with the installed base a successful implementation is more likely.

"*You have to integrate with the installed base to improve information and workflow between different organizations, departments, or professionals where each of them already uses a domain-specific system (Johannessen and Ellingsen 2009).*"

This indicates the importance for all parts of the workplace to be included in the tender for a new system. At the Bloodbank of UNN Tromsø it seemed like the need for making more general demands for the tender made the workers focus on improving the parts of the Bloodbank that did not work optimally in the old system, like the office part.

"If we could not have all the detailed demands we wanted, at least we wanted to focus on improving some parts of the workplace."

This way they seem to have down prioritized parts of the Bloodbank that worked well, like the routine laboratory. As a result the office part benefit from the implementation instantly in contrast to the routine laboratory that struggled a long time to make LabCraft fit their work area. When a part of the information infrastructure works well it becomes invisible to the workers (Star and Ruhleder 1995). To notice the existing information infrastructure may be challenging until changes are made e.g. when a new system is implemented and do not fit the existing infrastructure. This may create lots of trouble and eventually make the infrastructure break down (Hanseth and Monteiro 1998; Bowker and Star 1999). Here the infrastructure did not break down, thanks to extra work by users and project managers to improve it. But it seemed like the well routine laboratory became a bit invisible when demands for a new system were created.

Even if the users seemed detached from the installed base when making demands for the tender, they seemed close when it came to keeping to their work routines. They wanted the new system to change their workday as little as possible. This shows that when workers are too close to the installed base this also generates problems for the implementation process. Based on these interviews it seemed like workers at the Bloodbank wanted LabCraft to be as similar to the installed base and the old system as possible. A hectic workday made them want a system that did not require changes in their work routines. As a consequence they used lots of time to make LabCraft fit their routines. If they instead were a bit more flexibility it could have made this implementation easier for them and the benefits from using the new system greater. One example of users lack of flexibility*:*

"They were not even willing to change the time for analysing tests because they had always done this at one particular time and wanted to continue with that."

Another problem with being too attach to the installed base is the challenge for the new system to differ enough from the old and to be a real technological, and otherwise progress for the workplace. In this case some of the challenges connected to the implementation of LabCraft were just as much caused by this lack of flexibility as by the LabCraft system. It was both naive and unrealistic to expect a new system to not demand for changes at the workplace.

Some of the problems could also have been prevented if the vendors knew the workplace better. Ellingsen Monteiro et al (2007) states that:

"Creating a new system which is highly integrated with an installed base requires a detailed knowledge about the existing systems, interfaces and work practice."

This way they had known what parts of the workplace that was important to preserve and what parts that needed to change. There are always a need for adjustments in routines and work processes when implementing a new system. Those may be defined as the encounter between the scripts embodied in the new implemented system and the already existing system at the work practice (Nicolini 2006).

I agree with Hanseth and Monteiro on the importance of considering the installed base when a new system is implemented to make it fit the workplace and get all parts of the workplace included in the new system. On the other hand too close attachment to the installed base and existing infrastructure can result in the workplace missing out on important improvements and enrichments. When new technology is introduced they have to negotiate and compromise how this can fit the systems in use (Johannessen and Ellingsen 2008). A balance is needed between keeping a new system close to the installed base, and the need for developments and upgrades to renew the workplace.

5.3 A balance between standardizations and local adjustments.

A hospital is defined as an information infrastructure (Coiera 2004), and for such to be well functioning it depends on clearly defined standards. Hanseth (2002) states that standards and infrastructures are like flip sides of the same coin. Without standards communication between actors in an installed base will break down. Hanseth and Monteiro (1996) say that standards are the language of the information infrastructure. So what is the problem then, is it not obvious that standards and standardized systems are needed?

Standardization is traditionally a top-down process, and the issue of integrating an information system has not been equally acknowledged as a socio-technical issue as the manner of development and use of new applications has (Berg 1998; Tjora 2004; Ellingsen and Monteiro 2006). Hanseth and Monteiro (1998) points out:

"The development of an information infrastructure, including the standards, should be recognized as a highly complex socio-technical negotiation process."

This means that it is important to include the users in defining which areas to standardize and what standards to use.

"*There is a conflicting demand for the delivery of high-quality, standardized routines and procedures; on one hand, and increasing demands for individualized services and products on the other (Ellingsen, Monteiro et al. 2007)."*

Local adjustments require a more socio technical approach to an implementation phase. The users are the ones that know the work routines best and they are best qualified to point out adjustments a system needs. The top-down approach is the chosen way of performing implementations, which makes it challenging to make necessary adjustments before implementing a system. The hospital/health trust management controls time-use in the process, and tends to prioritize efficiency over the need for adjusting the system to fit a specific Bloodbank. Ellingsen (2004) states that:

"When it comes to standardization there must be a balance between the management level's

need for increased coordination and control, and the local level's need for flexibility."

In this case it was a struggle between the goal of Health Authority North Norway to standardize and streamline their 11 Bloodbanks (Director, Health Authority North Norway), and the different Bloodbanks need for local adjustments to make LabCraft fit their workplace. Health Authority North Norway needed a standardized system run as cheap and efficient as possible, with their IT department in charge of managing and upgrading the system. The workers wanted a flexible detailed system that could be adjusted to fit and improve their specific needs. Making too many local adjustments however might result in LabCraft evolving from one common system into several new ones. Then the benefits of having the same system would disappear. It was also important to be aware that making changes to fit local needs may result in unpredicted challenges in other parts of the system.

"Local adjustments in a system of standards may this way serve different purposes from the ones they were intended to (Berg and Timmermans 2000)."

This may be an explanation for why LabCraft that seemed to fit the Bloodbank well on paper, needed several adjustments after the implementation finished. No matter how well a system seems to fit in forehand, the success of an implementation is always influenced by the information infrastructure it is implemented into. The Bloodbank at UNN Tromsø put lots of pressure on the project managers and LabCraft to make changes in the system to adjust it to their specific needs. This may have created problems in other parts of the system.

"Standardization of information systems and practices across different groups and organizations is always incomplete and has paradoxical and unintended outcomes (Ellingsen and Monteiro 2003; Anderson, Hardstone et al. 2006)."

Maybe some of these unintended outcomes could have been prevented, by involving users more in the implementation process. As mentioned earlier all Bloodbanks were different in shape size and work routines. It was a big difference in the needs of the 11 Bloodbanks in Health Authority North Norway. To use LabCraft the same way in all these Bloodbanks would be impossible. The Bloodbank at UNN Tromsø was large, and redraw blood from 50-60 donors each day. They also analysed patients and blood donors samples themselves. This hospital clearly had other needs and demands for the laboratory system than the smaller

Bloodbanks that redraw 50 donors a week and sent their antibody studies to UNN Tromsø. LabCraft was a flexible system with room for local adjustments and necessary changes before and after it was implemented to the Bloodbank. The system was based on a common platform combined with possibilities for local adjustments. This made it equipped to fit the needs of the different Bloodbanks, and still the technical maintenance and upgrades of the system could be run from one place. It appears to be a standardized system with socio technical possibilities. The future of hospital implementations may depend on such systems. The standardized systems based on "one system fits all,"(Ellingsen and Monteiro 2006) does not fit anyone, and having small systems specially made for one workplace is not a good solution either. To introduce socio technical standards calls for a very close cooperation between vendors, project management and workers. This may not have fully succeeded in the implementation in UNN Tromsø but it is a step in the right direction of getting a compromise between the demands for standardization and the need for local adjustments. I will recommend for even closer cooperation between the actors in such implementation process in the future to get a better outcome of the process.

5.4 Time use and system support, important topics to address

5.4.1 Using more time in the pre-implementation phase saves time later.

To make necessary changes to a laboratory system like LabCraft, a long pre-implementation phase is required. It is impossible to get to know a system well after a 2-hour presentation, 1 day visiting a Bloodbank using the system, and 2 days of "super-user" training. This was the maximum of introduction to the system users at the Bloodbank of UNN Tromsø received, and only some users participated in all this. Some were not introduced to LabCraft before it was implemented and taken into daily use. The managements need for an efficient process (Ellingsen and Monteiro 2006), did in this case clearly overshadow users need for better knowledge of the system. The management did not recognize the need for more time use in the pre-implementation phase. Even so they decided how long time the users would get to learn to know the system. Investing more time in the pre-implementation phase could have decreased the total amount of time and money used in this project. The interviews did not

indicate that LabCraft needed to be implemented in a hurry. The possibility of working out problems in the system before implementing it would have been a great advantage for both users and vendors. One of the users stated:

"It would have been beneficial for the Bloodbank to invest more time and money in this system before it was implemented to avoid some of the post-implementation issues. If the workers knew the system better, giving feedback and discuss the system in meetings at the Bloodbank with the project managers and vendors would have been easier."

If the users were more included in the pre-implementation process they had been likely to recognize issues in need of change or missing in the system. User involvement often lead to more changes during the development process (Hirschheim 1989), which prevent extra work after the process is finished. On the other hand, a longer pre-implementation phase may have made the management impatient to move the process forward.

An easy way of including users more, were letting them spend time using the test version of the system. This would have helped with detecting errors and flaws in the system. In this case however the "super users" were asked to give the vendors feedback when they were introduced to the test version of LabCraft. Later it was revealed that none of this feedback led to improvements in the system before the implementation. It is important for managers and the vendors to take seriously such feedback since the users are the ones knowing what is required for the system to fit the workplace since they use the system every day.

Another challenge connected to more user involvement is the tight time schedule of the workers. Could the Bloodbank afford taking workers out of the daily routine to spend time on the test version of LabCraft, or would this influence the daily work too much? The management of the Bloodbank may have considered more user participation in the pre-implementation phase too troublesome. They probably did not predict the amount of challenges lack of preparation made for this workplace. As Orlikowski (1992) states:

"Users have to be given resources to learn and experiment with the new technology."

This is important for how useful they find the new system. If they don't get to use the system and be familiar with it, they may se little use of it and just try to make it fit the old routines

instead of exploring its potential for improvements. Since LabCraft had to work in the daily routine instantly after the implementation the need for it to be as well adjusted to this workplace as possible was even higher. In this case the users did not get any time to try out the test version. As a consequence they had to use more time after the implementation to make the system fit the Bloodbank. This generated unnecessary stress, frustrations and insecurity for the workers.

The chance for the users to prepare for adjustments needed after the implementation of LabCraft was another argument for using more time in the pre-implementation phase. This way they would have been able to plan for this and also they would have known what expectations that was realistic to have towards the new system.

I would strongly recommend that next time a similar implementation is conducted, more time are invested in the pre-implementation phase to prepare the users and adjust the system. In this phase it is important that users are more involved than today. This will eventually benefit all the actors in the implementation and make similar processes more successful in the future.

5.4.2 The absence of system support; how is this possible?

How to carry out system support for LabCraft in Health Authority North Norway is an issue still not solved five years after implemented the system at UNN Tromsø. Health Authority North Norway defined that system support should be administrated by UNN Tromsø (Helse-NordRHF 2006), but not how to finance this. The best-qualified persons to maintain this support were the project managers. They knew both the Bloodbank and LabCraft well. But there were several challenges with them taking on this system support; First of all they were not asked to take on this extra work. They were however left with it since there was nobody to hand it to. Secondly they already had enough work with implementing LabCraft to the other Bloodbanks, and to train the workers in using the system. The Bloodbank at UNN Tromsø needed a support system right away when the implementation finished. As Broenes, Huis in't Veld et al (2007)states:

"Support for users is a major issue for technological acceptance of a system"

Most problems occurre in the start phase of using a new system, and have to be solved instantly. This generated a considerable amount of extra work for the project managers since they got "stuck" with this system support. Users of the system felt insecure and uncomfortable with using a system where there were no support system to back them up. Third of all no money were invested by the Health trust for establishing this support function in Tromsø. The Bloodbank at UNN Tromsø was not interested in financing the support of all the 11 Bloodbanks in North Norway but in reality this is what they did. Last of all a sufficient support system had to run 24 hours like the Bloodbank. It would have required several persons working in shift to handle. The question of system support may be difficult to solve in cases where different user groups like general practitioners and laboratories at hospitals are involved (Røed and Ellingsen 2011). In this case however this was not a problem since Health region North Norway was managing both the hospitals and the laboratories. It was no doubt that they were responsible for supporting the system.

In this case Health Authority North Norway IT, which is responsible for support and maintenance of computerized system in the health trust, did not have qualified personnel beyond the technical support of LabCraft. Broenes et al (2007) say that support should be offered at a technical level, but also on how to deal with errors and problem situations. Lack of system support may lead to resistance towards using the system, and an increased chance that it is abandoned (Broenes, Huis in't Veld et al. 2007). In this case the lack of a defined support system influenced the use of LabCraft. The users did not know where to call when problems arrived. As a result users called the project managers at all hours, at their office or privately. In practise they have had a 24-hour un-paid support role for five years. The project managers were kind of trapped in this position, they knew there were nobody else for the users to call. But they also knew it was not their job to manage this support.

This unsolved issue of system support was one of the most serious findings in this project. It is impossible to understand how any of the actors in the process could accept the state of this issue. The project managers could never really turn off their phone, and the workers never knew if they would receive help, or even where to call when problems occurred. Since the project managers continued to maintain the support function, the management of the health trust did not experience the consequences of lacking a support system. Maybe they should have let that happened so the management were forced to address this issue at an earlier stage? Who would take on the work of managing a similar process, if they risk being stuck

with unpaid and undefined 24-hour support of the system indefinitely after the implementations finish?

An interesting notion is that by following a quantitative method I would never have detected this lack of system support. This would not have been a concern in a quantitative study of this implementation. This is one of the benefits with qualitative methods, often issues appears during the interviews that was not thought of in forehand.

"It cannot be right that if you manage an implementation process you end up with 24 hour unpaid "on call" system support just because there are nobody else that knows the system?"

Implementing LabCraft should never have started without solving the question of system support. The establishment of a good support system needs to be addressed immediately. It should not be acceptable or even legal for such important function to be missing after implementing a new laboratory system at a hospital.

5.5 Hospital implementation an immature science?

After finishing this evaluation I was left with the impression that implementing a computerized system at a hospital laboratory is in many ways an immature science. The process seemed to lack guidelines for important issues like defining areas of responsibilities, use of time and resources in the process, and managing system support. Should there not be some procedures for implementation processes at hospitals where these issues are defined? Compared to instrument implementations, it seems like computerized system implementation is a rather unfinished matter. The reason may be that implementations of instruments have been conducted for a much longer time at hospitals, and routines and procedures are well established here. According to the workers interviewed there are strict rules for overtaking an instrument from vendors regarding system support and maintenance. There is no question about how this is conducted in the implementation. E.g. support of the system is defined in the tender, and is often maintained by vendors the first year, this way the project managers don't risk getting stuck with it.

There are several unsolved issues to address in hospital implementations and the lines of responsibility and communication seems rather blurry. Who is responsible for following up the necessary steps of the process? The purchase department, the health trusts management or the project managers? Who are best qualified to define necessary criteria's for these detailed implementation processes when users are not significant actors? Who should decide when the workplace is ready to start an implementation? Is it when managers of Health Authority North Norway, and the purchase department finish the formalities in the process? Or should it rather be when the Bloodbank have spent time preparing for the new system by using the test version and changing necessary procedures? What criteria's define when the system is good enough for the workplace? Is it when it fulfil the demands in the tender that is much more general than users need for it to work in practise. Or should there have been a limit for the number of work-around and mismatches between the system and the work-routines the workplace had to accept in the new system?

How could the health trust managers defend leaving all the work and responsibility of this implementation on only two persons? Did the top-down approach made the managers so distanced to the workplace that they did not know the process they controlled? How could they make all the decisions if they did not know what the different work tasks in the project required?

It seems like due to the many actors involved in this large hospital infrastructure the responsibilities in the implementation process just gets shuffled around without anybody really taking it. There are too many hierarchical steps at the hospital ladder between the Health Authority North Norway and the Bloodbank for the health trust managers to have a good overview of the needs of this particular department. It is easy for the different actors to blame each other for matters occurring during an implementation process. There has to be established defined areas of responsibilities in such process, and consequences if these responsibilities are not taken. Due to mismatch between the agenda and expectations of different actors in such process, it is a risk of ending up with a result that does not live up to anyone's expectations.

When conducting similar implementations another time I will recommend the Bloodbank to seek for help from others with experience from similar implementations or using the same system. In this case A-hus had both, and it seems strange not to contact them to learn from

their experiences of implementing LabCraft. They were also involved in developing LabCraft and may have been able to explain some of the functions and features in the program that seemed incomprehensible to the Bloodbank in Tromsø. Another important issue to address is why there was no evaluation of this implementation process conducted by the Bloodbank, UNN Tromsø or Health Authority North Norway? Is it okay to just struggle trough such process, get the system well functioning after a year or two and just move forward without the need of learning anything for a similar process in the future? A full evaluation like the one I have conducted now, go through all the steps of the process to detect positive and negative aspects. This type of evaluation reveals areas of the process in need for improvements before conducting a similar implementation in the future. This was particularly important in this case where the whole implementation project included all Bloodbanks in a health trust. This had not been done before at least not in Norway.

It had been interesting to continue this evaluation including all the 11 Bloodbanks in Health Authority North Norway to fully understand this process, and also include an interview with the management of the health trust. Then this implementation project could have been compared with an implementation at one single hospital to see if there were significant differences detected here.

6 Conclusion

The evaluation of implementing LabCraft at the Bloodbank of UNN Tromsø was a process where the question of user participation and cooperation between actors in the information infrastructure were the central issues influencing the whole process. All the challenges associated with this implementation were directly or indirectly connected to the struggle between top-down and socio-technical approaches. The management of Health Authority North Norway wanted a process where standardizations, cost saving and efficiency were key factors. Challenges detected in this evaluation indicates the need for a more socio-technical approach based on user participation, with workers from the Bloodbank in charge of the implementation, and also a system with room for local adjustments. More user participation seems to be highly necessary in such processes, particularly in the pre-implementation phase. As Balka and Kahnamoui (2004) states: user involvement is an ideal pursue but not always possible to accomplish. In some parts of the process management has to come in and make decisions to move the process forward. Users cannot expect to run the whole implementation process alone. In real life there are no clear boundaries between different implementation approaches (Bansler 1989). It is important to include elements from both sides in a future implementation process.

Implementing computerized laboratory systems at UNN Tromsø seems to be a rather incomplete process with several undefined issues. It is vital to establish procedures for implementing systems like LabCraft. They have to contain clear areas of responsibility and work tasks for the different actors. Areas like how to prioritize time and resources, as well as the establishing of system support are important to define here.

LabCraft brought several improvements to the Bloodbank at UNN Tromsø, and the possibility of having all information easy accessible in the same system has contributed to raise the quality of this workplace. All the different parts of the Bloodbank benefit from implementing this new system, some right away and some after a while.

I would recommend including workers from the daily Bloodbank routine more in implementations, in addition to using more time in the pre-implementation phase. This may prevent the extensive need for improving the system later. The pre-implementation phase is

where the foundation for the new system is set, by defining the demands for the tender, and getting to know the new system e.g. through a test version. It is important for users to be key actors in this part of the implementation. This way errors and flaws can be detected and worked out before the system is taken into daily use. Users are also prepared for what system they get and changes they have to make. It is important to create a well-balanced tender including enough details to get a system that fits the Bloodbank well. LabCraft was based on general demands and created a need for several adjustments after the implementation. It is however also necessary to create a tender that vendors are able to fulfil. It is important to focus on including all parts of the system including those that work well, in the tender. It is important for the workers not to be too attached to the installed base. Flexibility and room for adjustments to the daily routine can reveal opportunities for great improvements in the new system. It seems necessary to review the whole pre -implementation phase and the "bid for tender" process, to get more successful implementations in the future.

It is essential for vendors to be familiar with the information infrastructure at the hospital for an implementation process to be successful. Both the old system, the instruments, the analyze machines and the surrounding systems has to be taken into consideration. LabCraft had to work 24 hours non-stop instantly after the implementation, which made it even more important to have these communication lines in order from the start. To have a really successful implementation there is a need for a better cooperation between the different actors. I will recommend for vendors to use more time getting to know the installed base when a new system is implemented, in addition to using the workers as a resource to get sufficient inside to the needs of the workplace. I recommend a closer cooperation with other Bloodbanks using the new system or having done similar implementations to learn from their experiences. Also evaluations are very important and necessary to create better implementation processes in the future.

In this case all the actors were satisfied with LabCraft as their Bloodbank system. Actors tend to have different perceptions of whether an implementation can be defined as a success (Obstfelder, Engeseth et al. 2007). If the users were asked just after the implementation finished, most of them would not define the implementation a success. But now, five years later, all the users interviewed were more or less satisfied with the system and defined it as a *"success with room for improvements."* It is necessary to follow an implementation process over time to get a sufficient impression of the process. The vendors reached their goal of

implementing LabCraft to all 11 Bloodbanks in Health Authority North Norway and getting an extensive share of the Norwegian Bloodbank marked. Health Authority North Norway reached the goal of having one common system for all their Bloodbanks. The users got a well functioning reliable system with possibilities for cooperating closer with the other Bloodbanks in the health trust. It was important to make adjustments for the system to fit the workplace and not just for the workplace to fit the system.

There is no such thing as saving money in implementing a laboratory system. What you don't spend before the system is implemented, has to be spend afterwards to improve the system. The process of implementing LabCraft to the Bloodbank at UNN Tromsø was a challenging, time-consuming and expensive process. But in the end it increased the quality of the Bloodbank and thereby contributed to create a better hospital for the workers and the patients.

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8 Appendix

Appendix 1: Kravspesifikasjoner

KRAV TIL SYSTEMET:

Generelle krav

Alle funksjoner skal ha manuelle rutiner i tilfelle systemstopp

Systemet skal tilfredsstille krav til lover, forskrifter og retningslinjer som

- Retningslinjer for transfusjonstjenesten i Norge
- Retningslinjer for GMP i blodbanker
- Statens legemiddellov
- Eu direktiv
- Andre lover, forskrifter og retningslinjer i forbindelse med blodbankvirksomhet

Systemet bør ha etablert:

	Kryss av	
	Ja	Nei
Support for feil, rettinger og spørsmål på dagtid		
Ekstra support ved versjonsendringer		
Brukerforum		
Produksjonsstatistikk		
Registrering av kvalitetskontroller		

Blodgiver / Tapping

Systemet skal ha etablert:

- Manuelle rutiner for innkalling av blodgivere
- Tilgjengelighet av rekvirerte og utførte labanalyser
- Merking av blodposer og prøveglass med samme nummer
- Etikett til blodposer og prøveglass skal skrives ut på samme skriver
- Regelbasert rekvirering av analyser i forbindelse med tapping

Systemet bør vise til løsning for:

	Kryss av	
	Ja	Nei
Innkallingsrutiner og tilbakemeldinger – via SMS, E-post og WEB		
Blodgiveropplysninger/-historikk på tvers av blodbankene		
Scanning av egenerklæringsskjema og løsning for elektronisk utfylling		
Håndtering av blodgiveridentifikasjonskort		
HPA -og HLA-typinger for pasient og blodgiver		

Komponent/blodprodukter

Systemet skal ha etablert:

-En funksjonalitet som sikrer at blodproduktene er i karantene inntil alle analyser er besvart etter egendefinerte regler

- Regelbasert frigiving av blodprodukter
- Identifisering av blodprodukter laget av flere blodkomponenter
- Visning av antall disponible produkter og karanteneprodukter til enhver tid
- Logistikk for forsendelse av plasma til fraksjonering
- Kjøp, salg og fakturering av blodprodukter
- Produkthistorikk på alle produkter

Systemet bør vise til løsning for:

	Kryss av	
	Ja	Nei
Felles blodlager med de andre sykehusene		
Registrering av kriseblod		

Pasient

Systemet skal ha etablert:

- Elektronisk rekvirering av blodprodukter fra avdeling
- Dataforlik
- At alle blodprodukter som utleveres skal registreres elektronisk
- System for å registrere transfusjonsreaksjoner

- System for registrering/informasjon angående Rh-konvertering
- Elektronisk kvittering for transfusjon
- Transfusjonsjournal/-historikk

Systemet bør vise til løsning for:

	Kryss av	
	Ja	Nei
Behandling av alle påviste antistoff/autoantistoff		
Utskrift av kort som opplyser om antistoff som har betydning for transfusjon		
Funksjoner for stamcelle/transplantasjon		

Utlevering av blodprodukt

Systemet skal ha etablert:

- Generelle regler for utlevering:
- Overstyring av generelle regler basert på faglig grunnlag
- Kontroll av alle påviste antistoff
- Faste kommentarer og/eller fritekst på blodprodukter

Sporbarhet

Systemet skal ha etablert:

- Sporbarhet av blod og blodkomponenter i tilknytting til donor og pasient
- Oppbevaring av data i minst 30 år, angi alternativ for lagring

Datadelen

Systemet skal ha etablert:

- Sporbarhet på alle aktiviteter i og i forhold til systemet
- Strekkodestandard ISBT128
- Integrasjon mot eksisterende og fremtidige journal- og labsystem
- Enkelt vedlikehold av kodeverket
- Lokale tilpasninger
- Brukere med forskjellige autorisasjonsnivåer
- Enkel pålogging og automatisk avlogging

- Server operativsystem må være Windows eller Linux basert.
- Databaseplattform Windows SQL server eller Oracle (Cluster/RAC)
- Ethernett, TCP/IP nettverksstruktur.
- Windows XP og nyere versjoner av dette som klient plattform.
- Norske ledetekster (ISO 8859-1)
- Konsernløsning med avdeling-/enhets-struktur for frittstående blodbanker.
- Tilgangsstyring, sikring og kontroll i henhold til offentlige lovverk .

Systemet bør vise til løsning for:

	Kryss av	
	Ja	Nei
Integrasjon av blodvipper, presser, sentrifuger, innfrysningsenhet og sterilkontroll for blodprodukter		
Integrasjon mot analyseinstrument		
Elektroniske meldinger mellom forskjellige foretak og innen EU		
Utveksling av databaseopplysninger på tvers av foretakene		
Fritekst med historikk for alle funksjoner		
Elektronisk rapportering til Hemovigilans		

Information received by Bente Johnsen one of the project mangers in the implementation of LabCraft at UNN Tromsø.

Appendix 2 Anbud

VARER Åpen anbudskonkurranse

Avtale om levering av datasystem for blodbank

Norsk lysingsblad referanse: 2004-13297

I OPPDRAGSGIVER

I.1 Oppdragsgivers navn og adresse:

Universitetssykehuset Nord-Norge HF, Sykehusveien 38, 9038 Tromsø, Norge.
Att: Helga Jentoft.
Telefon: 77627159.
Telefaks: 77626042.
E-post: mailto:helga.jentoft@unn.no

I.2 ADRESSE, HVOR YTTERLIGERE INFORMASJON KAN FÅS: Samme som i I.1.

I.3 ADRESSE, HVOR DOKUMENTASJON KAN FÅS: Samme som i I.1.

I.4 ADRESSE, HVOR TILBUD ELLER FORESPØRSEL OM DELTAKELSE SKAL SENDES: S

I.5 TYPE OPPDRAGSGIVER:

II KONTRAKTENS GJENSTAND

II.1 BESKRIVELSE

II.1.2 Type varekontrakt:
Kjøp.

II.1.4 Rammeavtale:

II.1.5 Oppdragsgivers betegnelse av avtalen:
Avtale om levering av datasystem for blodbank

II.1.6 Beskrivelse/kontraktens gjenstand:
Gjelder levering av datasystem til helseforetakene i helseregion nord.

II.1.7 Sted for bygge- og anleggsarbeidet, levering eller utførelsessted:

II.1.8 Nomenklatur:

II.1.8.1 CPV-klassifisering:
Hovedobjekt: 30 23 16 00.

II.1.8.2 Annen relevant nomenklatur (CPA / NACE / CPC) :

II.1.9 Oppdeling i del arbeider:

II.1.10 Alternative tilbud vil tas i betraktning:

II.2 MENGDE ELLER OMFANG AV KONTRAKTEN

II.2.1 Total mengde eller omfang:

II.2.2 Opsjoner. Beskrivelse og tid når de kan bli utført:

II.3 VARIGHET AV KONTRAKT ELLER FRIST FOR UTFØRELSE:

III JURIDISKE, ØKONOMISKE, FINANSIELLE OG TEKNISKE OPPLYSNINGER

III.1 BETINGELSER I TILKNYTNING TIL KONTRAKTEN

III.1.1 Sikkerhetsstillelse og garantier som forlanges:

III.1.2 De viktigste finansierings- og betalingsvilkår og/eller henvisninger til relevante bestemmelser:

III.1.3 Selskapsform på den gruppering av leverandører, som kontrakten tildeles, skal ha:

III.2 KVALIFIKASJONSKRAV

III.2.1 Opplysninger knyttet til leverandørens personlige stilling samt opplysninger og formaliteter nød
Skatteattest og MVA-attest, ikke eldre enn 6 måneder, utstedt av den kompetente myndighet, so
den kommunen hvor leverandøren har sitt hovedkontor og av skattefogden i tilsvarende fylke.

III.2.1.1 Juridisk stilling:
Kvalifikasjonskrav:
Må tilfredsstille krav til registrering gitt av offentlig myndighet
Dokumentasjonskrav:
Firmaattest.

III.2.1.2 Økonomisk og finansiell kapasitet:
Kvalifikasjonskrav:
Må ha god soliditet
Dokumentasjonskrav:
Erklæring om foretakets omsetning de siste årene med relevans til denne kontrakten.
Foretakets 2 siste årsberetninger samt nyere opplysninger som har betydning for foretakets regns

III.2.1.3 Teknisk kapasitet:
Kvalifikasjonskrav:
Må være tilstrekkelig kompetent til å oppfylle kontrakten.
Dokumentasjonskrav:
Foretakets viktigste leveranser de siste 3 årene, inkludert deres verdi, tidspunkt og mottaker.
Prøver, beskrivelser og/eller prospekter av produktene som skal leveres.

IV PROSEDYRE

IV.1 TYPE PROSEDYRE:

Åpen anbudskonkurranse.

IV.1.3 Forutgående kunngjøringer knyttet til samme kontrakt:

IV.1.3.1 Veiledende kunngjøring knyttet til samme kontrakt:

IV.1.3.2 Andre forutgående kunngjøringer:

IV.1.4 Planlagt antall leverandører, som vil bli invitert til å inngi tilbud:

IV.2 TILDELINGSKRITERIER: Det økonomisk mest fordelaktige tilbud vurdert på grunnlag av kriterier som oppgitt i konkurransegrunnlaget.

IV.3 ADMINISTRATIV INFORMASJON

IV.3.1 Saksnummer hos oppdragsgiver:

IV.3.2 Betingelser for å få utlevert konkurransegrunnlaget og ytterligere dokument:

IV.3.3 Frist for mottak av tilbud:

20.09.2004.

IV.3.5 Språk som kan anvendes ved innlevering av tilbud eller forespørsel om å delta:

Norsk.

IV.3.6 Minimumsperiode som tilbyderen er forpliktet til å opprettholde tilbudet:

Inntil 31.03.2005

IV.3.7 Betingelser for åpning av tilbud

IV.3.7.1 Personer som har tillatelse til å overvære åpning av tilbudene:

IV.3.7.2 Dato, tid og sted:

VI ANDRE OPPLYSNINGER

VI.1 FRIVILLIG KUNNGJØRING:

VI.2 PERIODISK INNKJØP:

VI.3 EU-FINANSIERT PROSJEKT/PROGRAM:

VI.4 YTTERLIGERE OPPLYSNINGER:

VI.5 DATO FOR VIDERESENDING AV KUNNGJØRING:

Appendix 3 Tilleggsopplysninger til anbudsdokumentene i forbindelse med levering av datasystem for blodbank

Helseforetak i helseregionen nord:

Helse Finnmark HF: Blodbank i Hammerfest og Kirkenes

Universitetssykehuset Nord-Norge HF: Blodbank på UNN HF

Hålogalandssykehuset HF: Blodbank i Harstad, Narvik og Stokmarknes

Nordlandssykehuset HF: Blodbank i Bodø og Gravdal

Helgelandssykehuset HF: Blodbank i Mo i Rana, Mosjøen og Sandnessjøen

Alle disse blodbankene har pasient og blodgiver virksomhet

Antall lisenser: Kom med forslag.

Statistikk og volum

Tallene er omtrentlig

Antall ABO, Rh : ca: 100000

Screening: ca: 75000

Antall utleveringer til pasienter: ca 30000

Antall leveranser av industriplasma: ca 5000 Kg

Antall tappinger: ca 25000

Vi har ikke statistikk som gjør at vi kan skille mellom analyser på ulike pasientgrupper.

Appendix 4 Stikkord til intervjuene

Hva var bakgrunn for å implementere ett nytt system?

Hvordan var implementerings prosessen?

Hvilken rolle hadde du i implementeringsprosessen?

Hadde de ansatte noe innflytelse på hvilket system som ble valgt?

Fikk ansatte nok informasjon underveis?

Var det et godt nok samarbeid mellom LabCraft --- IT personell på avd--- Ansatte?

Fikk dere tilstrekkelig opplæring i systemet?

Var systemet tilstrekkelig til bruk i Blodbanken?

Nevn noe som fungerte bra i LabCraft eks?

Nevn noe som ikke fungerte bra i LabCraft eks?

Var det noen fordelene med å ha samme system i hele Helse Nord?

Hvor lang tid tok det før systemet fungerte bra nok til deres bruk?

Hva mener du hadde vært nyttig å gjøre annerledes i en slik prosess ?

Hvordan er systemet å bruke i dag?

Appendix 5 Stikkord til intervju med representant fra LabCraft.

Fortell litt om bakgrunn for anbud/anbudsrunden

Fortell litt om Labcraft som firma og LabCraft systemet

Hvor mange brukere hadde LabCraft før/etter implementering i Helse Nord?

Samarbeid med A-hus på hvilken måte under konstruering av programmet?

Implementeringsprosessen i Tromsø og Helse Nord: positive og negative erfaringer

Hvordan var samarbeidet med UNN-Tromsø/Helse Nord?

Hvordan var ansvarsfordeling mellom Labcraft og prosjektledesen i dette prosjektet?

Forskjeller/likheter mellom Implementeringen i Tromsø og andre steder?

Ble det gjort en evaluering av prosjektet?

Hva skjer nytt i Labcraft framover?