Supporting Hospital Interdepartmental Communication and Coordination of Work with Electronic Whiteboards
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Informatics Master Thesis
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1. Abstract

The purpose of this thesis is to investigate the organizational aspects of the use of an electronic whiteboard system implemented in a Danish hospital located in Nykøbing Falster. The investigation or study was conducted using ethno-methodological methods and the empirical data was analyzed using qualitative analysis methods. The electronic (EW) whiteboard system had originally been developed in an ED context, but had later been extended to the entire hospital, and the study was conducted about 10 months after that time. The research question asked whether clinicians experienced impacts or consequences in the context of inter-departmental communication and coordination of work, and where there were any challenges in this respect. The results of the study shows that the EW system had been configured and use of it organized in a manner that actually facilitated support of inter-departmental communication and coordination of work. There were impacts such as inter-departmental access to patient data, inter-departmental standardization of the EW interface, the inter-departmental ordering of surgical operations via the EW system, however the study also found that there were challenges relating to the difficulty of accommodating the heterogeneous practices and terminologies of specialty departments in a standardized format. The results demonstrates the complexity of organizing cooperative work using artifacts and technology across organizational units. Finally, the study found a mixed picture with respect to the momentum of EW system use, as it would seem that there is the potential for two diametrically opposite scenarios occurring: one where EW system use intensifies and another where use becomes more subdued.
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3. Introduction

3.1. What is the Goal of this Thesis

Private and public organizations design and implement computer systems with the intention of realizing benefits of various kinds, for example optimizing use of physical assets, increasing the health and safety of workers or members of society, as cost saving measures, to optimize, modernize and/or streamline work processes in organizations. Some computer systems are designed to support existing work processes, while other computer systems are designed to support new work processes or new ways of dealing with existing work processes to accomplish the tasks that organizations are intended to handle. The Danish Healthcare Region, Zealand, implemented an electronic patient status board system (electronic whiteboard system or EW system) in the Emergency Department (ED) of its Nykøbing Falster Hospital facility (NFH) as part of an ongoing research and developmental project called “Clinical Overview”. The EW system was subsequently rolled out in the remaining departments of NFH, as well as in the EDs of the remaining hospitals in the Healthcare Region Zealand. In 2014 the “Clinical Overview” project will be followed by a new research and developmental project called “Clinical Communication” which will be concerned with the EW system as a tool for supporting interdepartmental communication and coordination.

In the context of the above, this thesis will be concerned with the organizational aspects of the implementation and use of the EW system as a tool for facilitating interdepartmental communication and coordination in three specific departments of the NFH. The thesis will begin by presenting the research question, after which the EW system and the “Clinical Communication” research project will be described. This section will be followed by a section dealing with related academic work concerning EW systems, primarily in the Danish healthcare sector. The next section will describe and discuss the theoretical and organizational aspects of implementing and using IT systems and groupware. Then a research strategy for obtaining and analyzing empirical, qualitative data will be presented and discussed with respect to data collection and analysis methods. The later sections will present the empirical results and discuss the consequences and implications of the study’s results. Finally, a conclusion will sum up the study’s results and offer an answer to the research question. The results of the study present a novelty – the practice (at least in Denmark) of using EW systems for supporting communication and coordination of work between separate departments (inter-departmentally) with respect to healthcare work or tasks.
3.2. Research Questions

The use of electronic patient status boards or whiteboards (EW) is becoming increasingly commonplace in hospital facilities in the US and Europe. Numerous studies have been conducted with respect to how EW systems function in individual departments, in particular in emergency departments, and have studied the challenges, impacts and consequences of EW implementation and use in an intra-departmental context. Very few, if any, studies have investigated the way in which EW systems have been implemented and used in an inter-departmental context. The research questions this study and thesis will investigate and attempt to answer are the following:

- RQ1: What impacts, challenges and consequences do clinicians (say they) experience when using an electronic whiteboard system for inter-departmental communication (collaboration/coordination)?
- RQ2: How can the challenges identified in RQ1 be met/approached?

3.3. Case Description

3.3.1 Introduction to the Electronic Whiteboard System and the Clinical Communication Project

To avoid confusion it should be mentioned that there are two projects related to the implementation of the electronic whiteboard system. The first project, now completed, was called Clinical Overview, and was related to the development and implementation of the electronic whiteboard system as it exists today. The other project, Clinical Communication, is a future project, still in the planning stage, which will deal with the study and optimization of the electronic whiteboard system. A short description of each project will be provided in the following sections.

3.3.1.1 The Clinical Overview Project

An Electronic Whiteboard System was recently (December 2012/January 2013) implemented in all departments of the Nykøbing Falster Hospital (NFH), a hospital located in Healthcare Region Zealand, which is one of the five Healthcare Regions of Denmark. The project to design and implement the new system, called Clinical Overview, was established and conducted in cooperation with Roskilde University, healthcare Region Zealand and the IT-vendor, IMATIS, a Norwegian company. (Rasmussen, et al., 2010, p. 4) The EW system

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1 The search process for finding related literature utilized several search engines: Google Scholar, ISI Web of Knowledge, Springer Link, Elsevier Science Direct and ACM Digital Library. The key words used in the searches were a combination of “inter-departmental” and either “electronic whiteboard”, “status board” or “computerized whiteboard”. There were two results that were related to these topics: (1) Challenges to inter-departmental coordination of patient transfers: A workflow perspective (Abraham & Reddy, 2010), and (2) Novel use of electronic whiteboard in the operating room increases surgical team compliance with pre-incision safety practices (Mainthia, et al., 2012). While the first paper deals with inter-departmental communication, the supporting technology is not an electronic whiteboard system of the same type as in the NFH. In the second paper, the object of interest is an electronic checklist for avoiding surgical error embedded in an electronic whiteboard system, which is however not used in an inter-departmental context. Hence the claim, very few, if any.
replaced the previously used manual dry-erase whiteboards, in order to realize various strategic and operational improvements for the benefit of the hospital and patients alike. An example of the previously used dry-erase whiteboard may be seen in Figure 1 below:

![Figure 1 - Example of older dry-erase whiteboard (Rasmussen, et al., 2010)](image)

EW systems are characterized as being distributed IT systems featuring a central data repository, accessed through multiple, distributed client interfaces, in which the client interface has the appearance of the older, traditional manual dry-erase whiteboards. The EW interface runs on multiple computer monitors located in hospital departments and displays patient information in a tabular, matrix-like form in which each patient is represented by an individual row of information. Each row is divided into specific columns which contain either clinical or logistical information. An example of the new electronic whiteboards implemented at the NFH is shown below in Figure 2:

![Figure 2 - Example of new electronic whiteboard (Rasmussen, et al., 2010)](image)
Filters and user access permissions control the amount and type of information displayed for the specific user who is logged on a particular monitor. The information contained by the EW system is not of the same nature and function as that maintained by an electronic patient journal (EPR), as an EW system is primarily deployed as a tool for communication about and coordination of patient care work processes.

### 3.3.1.2 The Clinical Communication Project

This section will describe the Clinical Communication project. According to a recent research proposal, some of the aims of replacing manual dry-erase whiteboards with an EW system in the Healthcare Region Zealand and NFH are:

- To optimize patient care by improving communication and coordination of work between departments.
- To promote interdisciplinary cooperation between departments contributing to the optimization and clinical qualification of patient care.
- To increase patient security by creating a more cohesive course of treatment, which should ensure a more secure mode of patient identification and a more optimal patient trajectory through the healthcare system.
- To provide more time for clinicians to have direct contact with patients (“warm hands”) by reducing the complexity of interdisciplinary and inter-departmental communication and coordination.
- To address the challenges faced by NFH in connection with the nature of its patient catchment area, which is characterized by vulnerable patient categories, such as the chronically ill, by using IT to facilitate closer cooperation between NFH and patients in their homes, between NFH and physicians and between NFH and the outpatient care sector.
- To make NFH an attractive place to work by carrying out a prestigious project under national and even international attention and by thereby attracting qualified clinicians to work in this region of Denmark.

Following the completion of the Clinical Overview project, Healthcare Region Zealand, NFH and Roskilde University have been cooperating closely for over a year with respect to a successor research project called Clinical Communication. The project will target three areas of interest with respect to the now implemented electronic whiteboard system:

- Transferring patients from one department to another,
- Bottlenecks and the Load Barometer,
- Mobile electronic whiteboards for hospital porters.

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- Outreach³.

During 2014, researchers will be conducting effect-measurements of the effect that the implementation of the EW system has had on the hospital and its work processes compared to what had been the case prior to the introduction of the EW system.

As a prelude to the above-mentioned Clinical Communication Project, a qualitative study was conducted in October 2013, focusing on the implementation and use of the EW for supporting communication and coordination of work in three specific departments of the NFH: (a) the intensive care department, (b) the operation theatre department, and (c) the emergency department. Published academic studies on the topic of EW systems in the US and Denmark seem to deal primarily with the implementation and use of EW systems in the hospital emergency departments for communication and coordination of work intra-departmentally, whereas fewer studies deal with the implementation and use of EW systems to communicate and coordinate work inter-departmentally. This thesis is an exposition of the above-mentioned qualitative study and will reveal aspects of the implementation and use of an EW system that relate to communicating and coordinating work inter-departmentally.

3.3.2. Description of the Electronic Whiteboard System at NFH

3.3.2.1 Description of the Physical System

The electronic whiteboard system at the NFH is a distributed electronic system residing on a centrally located web server connected to a database server for data persistence. The user interface, which is constructed using web technology, is accessed by users via a hyperlink. The hyperlink activates an instance of the application in the user’s web browser, requiring appropriate security credentials. As the application is located on a web server, the application is accessible from any computer device on the healthcare region’s computer network where actual access to the application is restricted to appropriate users for policy reasons. The system may be accessed from outside the healthcare region from PCs that are equipped with a special security device and digital key. Large display screens, some touch sensitive, are attached to stationary computers that are located in halls and common work areas in hospitals. Access to the application on large screens in common work areas depends on appropriate user access privileges, as large display screens are generally restricted to use by staff attached to the department in which the large display screen is located.

³ Outreach: Fra intensiv til sengeafdeling, is the title of a coming study and ph.d. thesis by Kija Østergaard, CBIT, Roskilde University.
3.3.2.2 Description of the Application

The whiteboard application may be accessed by a computer device’s internet browser via a hyperlink on the healthcare region’s intranet. Figure 3 below shows a sample screen shot of a computer monitor where an EW display shows an overview of patients resident in the NFH emergency department’s ward #3.

The web application returns a tabular, matrix-like interactive user interface consisting of a header, footer and body. The body contains rows and columns, where each row features multiple fields or columns, each containing an attribute related to a patient. Table rows and columns are interactive; when users touch or click a table cell the user interface will usually provide the user with a range of options from which to choose. The user interface will only display rows pertaining to those patients that the user has permission to view or with which to interact through the user interface. The functionality that regulates which patients are visible to users on the user interface is called filters. A filter functions as a view, employing user permissions and patient attributes to limit the array of patients a user has access to. A nurse assigned to the emergency department will have a filter that only displays patients in the emergency department, while a physician in the anesthesia department may have a filter that displays all patients in that department.

![Figure 3 - Screenshot of whiteboard in action](image)

Depending on the clinician’s status and job, he or she will have access to a variety of filters that are relevant to their functions in the departments and needs. Each of these filters will be available for the clinician in the user interface header, and it will be possible to switch between the filters or views when logged on from a computer device. Hospital staff generally call the user interface “the whiteboard”, “the screen” or “Imatis”, a terminology that may be used in this thesis. Figure 4 below shows the EW user interface running on three monitors in the ED control room, one for each of the ED’s sub departments or wards. This setup are used by a clinician whose only task during a shift is to coordinate the placement of patients in the ED.
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Figure 4 - Emergency Department – All wards have their own monitor and filter

3.3.2.3 Brief Description of Organizational Implementation.

Going back to the beginning of the process of developing the EW system, a research and implementation project called Clinical Overview was established in 2009 when Healthcare Region Zealand decided to change the way acute patients and hospital admissions procedure were handled. The new mode of organization entailed the creation of actual emergency departments, EDs, following recommendations for improving acute care published in 2007 by the Danish Health and Medicine Authority. The new ED’s functions would be two-fold: (a) to treat acute patients and if possible discharge them or barring that send them on to specialty departments within 48 hours of arrival, and (b) to be the only point of entry to hospitals for patient registration and admission for medical treatment. The emergency departments would henceforth be the sole gateway to the hospital for all patients, whether referred by their general practitioner or transported to hospital by emergency services (Rasmussen, 2013, p. 9).

An implementation group consisting of participants from both emergency departments, Healthcare Region Zealand and the IT-vendor Imatis was established to manage the development and implementation of the electronic whiteboard system in “an ongoing, iterative and improvisional change-management process”. In the early stages of the project, the main responsibility of the group was to collect, analyze and finalize user requirements. In the later stages of the process, the group managed the process of transforming users’ feedback to revised designs that reflected users’ actual requirements. (Rasmussen, et al., 2010, p. 4)

In the phase 1 of the “Clinical Overview” project, Imatis developed a pilot implementation of the EW system in close cooperation with the emergency departments of NFH (ED1 and ED2”). In phase 2 of the project, access to the pilot implementation was expanded in December 2009/January 2010 to include two other emergency departments in the healthcare region. When the implementation group determined that the system was ready to go live, phase 3 was executed in which access to the EW system was expanded to the remaining departments of NFH as well as the EDs of other hospitals in the healthcare region (Fleron, et al., 2012, p. 61).
In phase 3, the EW system was physically implemented in all departments of NFH by installing the large display screens in their designated locations in common work spaces and then publishing a strict deadline for all departments to begin using the EW system as part of their daily work routine. The deadline for implementing the EW was December 31, 2012. The organizational implementation was launched by appointing two “key users”, (equivalent to super-users) per department, who were charged with helping users and acting as a promoters or champions of the EW system in their respective departments. The use of the EW system was made obligatory, and staff would therefore be needing help in getting started with the new system.

There is a single EW system administrator in the hospital, and this person was asked to use two days per department to instruct key users in the use of the EW system immediately prior to the December deadline. The instruction of key users and the installation of all large display screens was accomplished by the published deadline.

Although the implementation project spans over many departments and several regional hospital, this master thesis will be limited to the implementation and use of the system in certain departments of the NFH.

3.4. How the work with study and thesis was approached

The work performed in connection with this thesis was approached in the following way. The author was aware the situation at the NFH and healthcare region Zealand with respect to the introduction and use of electronic whiteboards having been informed by persons familiar with the situation. Interested in making this subject area the focus of a study, the author prepared a project proposal describing how he intended to investigate how the electronic whiteboard system functioned in an organizational context and how it affected the work of clinicians at the hospital. The project proposal was forwarded to the healthcare region by Professor Jesper Simonsen of Roskilde University and was accepted by the healthcare region and the hospital in a matter of weeks. While awaiting the healthcare region’s response to the project proposal, the author began researching the subject area for similar academic work. A number of articles were found relating to the use of EW system, all of which seemed to focus on intra-departmental implementation however none of them touched on the subject of inter-departmental use, e.g. communication and coordination of tasks occurring between departments. A search for theory relating to the development, implementation and use of IT systems in an organizational context having relevance to aspects of the way the EW might be used in the hospital was initiated, and methodologies of collecting the empirical data were reviewed. A research design employing an ethnographic approach in conjunction with interviewing was then chosen as the mode of collecting empirical data. The empirical work was performed by conducting observation sessions in three different hospital departments, and later interviewing seven clinicians and members of staff. Having gathered what appeared to be a sufficient quantity of empirical data for later processing, the last step was to analyze the empirical data and prepare the thesis.

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4. Existing Literature

Section 3 provided a description of the case to be investigated, and the research questions which will be answered. In the following, Section 4.1. Previous Work in Area will describe previous academic work in the area of electronic whiteboard systems in healthcare settings while Section 4.2. Relevant Information System Theory will deal with theory with respect to use and implementation of IT systems in an organizational context. Section 4 will be followed by Section 5 dealing with methods for qualitative studies of work, and techniques for analyzing qualitative empirical data and Section 6 containing a description of how these methods and techniques were actually used in this study and thesis.

4.1. Previous Work in Area

Academic articles concerning the topic of designing, implementing and using EW systems in healthcare settings have been published in Denmark and abroad. While it was not possible to find published articles dealing with aspects of EW systems such as the facilitating or supporting of inter-departmental communication and collaboration, articles concerning various others aspects of their development, implementation, use and effects on work, and work practices in hospitals may be found.

A Ph.D. thesis published in 2013 treats the subject of electronic whiteboards in emergency departments used for communication and coordination of work (Rasmussen, 2013). The thesis is structured as a collection of seven published articles concerning various aspects of using electronic whiteboards for communication and coordination of work and includes a covering paper or article summarizing and perspectivizing the findings of the thesis. The setting in which this research was conducted was the electronic whiteboard implementation project called Clinical Overview, previously mentioned above in section 3.3.1 Introduction to the Electronic Whiteboard System and the Clinical Communication Project. One of the published articles (Rasmussen, 2012) is a review of literature dealing with the development and implementation of EW systems in healthcare settings. The review’s two overall research questions, which were (a) What consequences does introducing and using electronic whiteboards have on ED work? and (b) What mediating factors influence these consequences? were answered based on an analysis of twenty pertinent articles. The analysis identified seven different effects, of which one related to the effect that introducing EW systems has with respect to collaboration and coordination of ED work. Rasmussen called this the Effects on communication and coordination. Positive effect on communication and coordination were caused by features of EW systems such as “distributed access to whiteboard information, quick and easy access to relevant information, the ability to retrieve previously accessed information”. Negative effects were caused by “system deficiencies e.g. system properties that only allow three lines of text in comment fields, and the system’s lack of support for other input
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than text, e.g. symbols...”. Another published article, User Participation in Implementation deals with the subject of how user participation in designing and implementing IT systems affects the design and implementation process, using the implementation of the EW system at NFH as an example of a user-participatory process (Fleron, et al., 2012). Finally, a third article from the collection is a study of how developers and project participants strike balance between tradition of work practices and transcendence of work practices. While tradition preserves the recognizability of work practices and work related artefacts as much as possible, in order to reassure users and ease learning and acceptance of new systems, it also has the disadvantage of freezing the situation and impeding innovation. On the other hand transcendence of work practices happens when the new technology provides hitherto unimagined ways of performing tasks, and those opportunities are used to change existing practices (Rasmussen, et al., 2010).

In Effects of Electronic Emergency Department Whiteboards on Clinician’s Time Distribution and Mental Workload (Hertzum & Simonsen, Forthcoming), a before and after study was conducted to assess the way the implementation of an EW system in the ED of a Danish hospital (called hospital A in the following) affected the distribution of clinicians’ time between their tending to patients and spending time with other clinicians. The other question was how the implementation affected clinicians’ mental workload at time-outs and hand-overs. The study showed that after the implementation of electronic whiteboards clinicians spent less time in patients’ rooms, but were in patients’ rooms for longer periods of time when they were there. Physicians’ mental workload in time-outs was greater after the implementation while nurses’ mental workload at hand-overs was less. In the ED of another similar hospital (called hospital B in the following) in the same healthcare region a similar study provided a different result, as clinicians here spent more time in patients’ rooms after the implementation of the EW than before (Hertzum & Simonsen, 2013). The difference between the results of the two similar studies was partially attributed by the researchers to the fact that clinicians in hospital B had had a better overview of patients using the dry-erase style whiteboards prior to implementation of the EW system that had clinicians in hospital A, so that clinicians in hospital B were better able to take advantage of the enhanced overview provided by the new EW system, than was the case for clinicians in hospital A, who had experienced difficulties in creating an overview using the dry-erase style whiteboards.

4.2. Relevant Information System Theory

This section will present theories and concepts which will be used in a later section when discussing the empirical foundation of this study. First, concepts such as computer supported cooperative work (CSCW) and groupware will be defined, and how they fit into Grudin’s typology of IT systems in organizational settings. Secondly, Patient Care Information Systems (PCIS) is defined as an IT system sub-type, after which Berg’s Socio-technical Approach is defined using certain starting points and presenting the implications the approach has for the development of PCIS systems. Thirdly, Pors and Simonsen’s model for understanding the distinction between the activities of collaborating and coordinating work, and the systems that support this activity. Fourthly, Marcus’s ‘Critical Mass’ Theory of interactive Media is explained as to how it can
contribute to an understanding of success or failure when implementing networked systems. Fifthly, Grudin’s Work vs. Benefit model will be reviewed; a model that describes how users of an IT system may differ with respect to the degree to which users benefit from using the system compared to the amount of work users must contribute to the system. This difference in perception affects attitudes of users towards systems. The Iterative and Participatory Design approach is presented and how this approach contributes to designing IT systems that are fit for their purpose and theory regarding Barriers to Adoption will be briefly presented and related to the concept of technical and organizational Intervention. Finally the complexity of cooperative practices is explained in the context of conducting architectural work and how that may relate to CSCW matters.

4.2.1. Defining CSCW and Groupware

The concept computer supported cooperative work - CSCW - has long antecedents. The concept was supposedly conceived during a workshop arranged by MIT and DEC in 1984 in which the issue of how technology and work are related in the work environment was explored. Groupware refers to systems or applications that support collaboration and coordination of work between groups of users, and is a term that refers to technology. CSCW refers primarily to research into “experimental systems and the nature of workplaces and organizations”. (Grudin, 1994B) According to Grudin there is a typology of IT systems in which IT systems are differentiated by their degree of collectiveness. The conceptual interrelationships between system’s categories are graphically visualized by drawing a series of concentric ellipses with horizontal and vertical labeling, see Figure 5 below. The diagram in Figure 5 below illustrates the notion of groupware as a type of system which is neither a mainframe system nor a micro- or mini-application (PC application would be a more contemporary term for micro/min application). Intended for use not by individuals nor an entire organization, groupware is designed for use by groups of people in an organization for collaboration and coordinating work. The research level associated with groupware is CSCW. (Grudin, 1994A)

![Figure 5 - Development and Research Contexts](Grudin, 1994A)
4.2.2. Socio-technical Approach

Berg (1999) suggests using a Socio-technical Approach to developing and implementing IT systems, specifically with respect to patient care information systems, or PCIS. The term PCIS is used by Berg to denote something with a broader scope than just an electronic patient record, as it encompasses a range of information technology and systems used by healthcare professionals in the healthcare sector. The socio-technical approach to PCISs in healthcare is characterized by Berg with certain starting points having several implications for the development and assessment of such systems.

The starting points are

1. Healthcare practices are seen as heterogeneous networks. On the one hand, work practices, IT systems and even departments should be seen as components of larger entities, while on the other hand should themselves be seen as assemblies or composite objects. The relevant term in the socio-technical approach is networks. Thus, work practices are “networks of people, tools, documents, IT systems, procedures”. Departments are assemblies that are composed of people and supporting objects functioning as a healthcare delivery entity. The point of this is to see IT systems not as just some kind of technology in the organization but as a practice in itself composed of many parts, which cannot be taken apart in its social and technical parts and treated in isolation. The system is an assembly and must be seen as a whole.

2. The nature of healthcare work. Healthcare work practices are collective, collaborative practices that focus on the “management of patients’ trajectories”. There is certain a degree of unpredictability where clinicians frequently face medical events in connection with patient care that require rapid reaction including some modification of the usual routines, the work having a “pragmatic, fluid character”. Multiple clinicians do work, which requires negotiation to arrive at collective decisions relevant to the ongoing healthcare process. The first point is there will be a focus on cooperative work processes rather than delineated, individual tasks. The second point is that it is difficult to capture the “essence” of work practices in pre-defined task descriptions or formal models.

3. An empirical orientation, with emphasis on qualitative methods. It follows from the preceding two points that the socio-technical approach emphasizes the necessity of securing first hand empirical knowledge of any work practice in connection with which an IT application will be developed or purchased/acquired. The approach favors generating models over healthcare practices in a bottom-up process using empirical cases. The preferred mode of data collection is ethnographical/ participant observation supplemented with interviews and surveys. While quantitative measurements may be useful, qualitative methods that provide a better way of studying and understanding “tasks, roles and responsibilities” and the changes caused by the implementation of a PCIS.

The implications of the above are as follows:
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An iterative process in which system development and evaluation activities emerge. The socio-technical approach rejects the notion that a PCIS is a linear process in which an IT system is specified, designed and ultimately implemented. The design and implementation process causes changes in the network of people, tools and systems, disrupting the balance of power between groups of professionals and management and therefore acquiring a “political” dimension. The socio-technical approach recognizes the reality that the organizational changes which accompany design and implementation are inevitably “politically textured”, and are therefore vulnerable to ‘resistance’ or ‘sabotage’ by users who aren’t treated seriously in the process. The political nature of the organizational change process necessitates the employment of an iterative development process, so that “organizational needs, practices and systems can evolve together”. When users participate in the early stages of analysis and design, they will be using pilot or preliminary implementations, and will be able to give the kind of feedback that inform the analysis and development of the next pilot implementation. As Berg writes “Users are involved from early on in the analysis, and feedback from early implementations immediately informs further analysis and design. With design continuing during implementation, and ‘evaluation’ informing analysis and design, ‘analysis’, ‘design’, ‘implementation’ and ‘evaluation’ become co-occurring activities.” It should therefore be possible to produce a resulting system that is a fit for its intended purpose.

The PCIS as a tool in healthcare work. PCISs can play an important role in healthcare by (1) providing facilities to aggregate and “accumulate” data-elements that can be used in coordinating “complex process of interaction and collaboration” and (2) by enabling the linking of clinicians in distributed processes. IT applications should be seen as a tool that is included in the work processes of clinicians in a way that enhances the use of their skills and expertise and not something that attempts to replace paperwork or “clean up” messy procedures or processes. The smooth functioning of PCISs depends greatly on the ability of clinicians to compensate for the innate rigidity of computer systems, however well designed or intended. PCIS should therefore be designed as a tool that enables the best use of professional skill sets and not a way to replace “irrational” or “messy” procedures.

In summary, the socio-technical approach emphasizes the complex nature of healthcare work and the need to involve healthcare professionals in an iterative analysis, design and implementation process producing a PCIS that integrates well in the healthcare setting. The PCIS should be designed to maximize the professional skills of those professionals while exploiting the benefits of computer networking to enhance distributed interaction and collaboration between healthcare professionals.

4.2.3. Coordination Mechanisms as Protocol and Artefact

The term CSCW is generally used to denote IT systems that support collaboration and coordination of work between actors in an organization. The nature of the mechanisms that support such collaboration and coordination as consisting of protocol and artefact is conceptualized in a framework (Pors & Simonsen, 2003) where protocol is the work practices, procedures or work flows as agreed upon by the users of the IT system.
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and the artefact is the (generic) IT system. The generic category indicates that the type of system in question is a system that requires extensive programmatic adaptation and negotiations between interest groups as how to use the IT system as part of the design and implementation process. Such IT systems that will not function in any meaningful way immediately upon installation on the computer network requiring additional effort in terms of their organizational implementation.

Collaboration is a composite of two elements: (a) ‘real’ work and (b) coordination of work. ‘Real work’ is the task, job or undertaking, while coordination of work (“sometimes referred to as articulation work” (Schmidt and Bannon 1992) (Star and Strass 1999) cited in (Pors & Simonsen, 2003)) is the “articulated coordination involved in distributed activities needed in order for many actors to perform a cooperative effort”. Using an example from the subject matter of this thesis, ‘real work’ would be the specific task or job of transferring patients between departments, and coordination of work would be the entire process in which clinicians in both affected departments are engaged in agreeing upon the terms and conditions of transferring the specific patient, see Figure 6 (p.24 below).

The coordination mechanism, is itself a composite element, consisting of a protocol element and an artefact element and is seen as an element that supports coordination of work, as coordination of work is more than just the coordination mechanism. The protocol is the “integrated set of procedures and conventions stipulating the articulation of interdependent distributed activities” while the artefact is the material component that makes it possible to carry out the cooperative work prescribed by the protocol. The artefact is the electronic whiteboard system that supports the functioning of the protocol and the subsequent performance of the task of moving the patient. The purpose of coordination mechanisms is to support the “reduction of complexity” where multiple actors must coordinate work in a geographically distributed context. Berg is quoted as writing that this would afford “… an increase in the complexity of the work practice without a simultaneous increase in the complexity of individual interactions (Berg 1999, p. 391)”. An additional concept relating to the above relationship of protocol to artefact, it is worth mentioning that Suchman suggests that in some cases protocol may be inscribed in the artefact, another way of saying that the protocol is embedded in the technology ( (Suchman, 1993) cited in (Bjørn, 2003)).

The framework above provides a conceptualization of the elements of collaborative work, enabling the realization of the distinction between the ‘real work’ and its attendant collaboration, and with respect to collaboration, the distinction between the generic IT system and the protocol it supports.
4.2.4. A Critical Mass Theory of Interactive Media

Marcus (1987) writes that the notion of universal access covers a situation in which all members of a community can be reached through an interactive medium, where a community is defined as “a group of individuals with common interests and stronger communication flows within than across its boundaries”. Communities may be the public at large or smaller groups such as public and private organizations. Interactive media are media that enable multi-directional messaging between members of a social unit (community) with multiple members. Concrete examples of such media are the ordinary postal system, e-mail, public telephone exchanges, video conferencing and similar systems. A condition of existence for interactive media is that of continuous use by a sufficient number of users so that users, in general, may be confident that users at the other end of the system will reciprocate their use of the system. E.g. if you send an e-mail to a recipient, you should be reasonably confident that that recipient will read the message and react in some way, probably including, returning a reply message.

A fundamental issue for an interactive medium’s continued existence is its degree of universal access, as the less members of a community use an interactive medium, the less it gets used, which could lead to a self-reinforcing declining trend of usage and possibly to its complete discontinuance. Critical mass is a concept borrowed from nuclear physics, where it is defined as a threshold measure of radioactive material, which is enough to bring about a self-sustaining explosion. In relation to universal access to interactive media, critical mass as a concept signifies the notion that the degree of universal access depends on the proportion of a community that choose to contribute resources to the use of the interactive medium.

The viability of an interactive medium thus depends on whether critical mass is achieved, as the theory proposes that the only stable condition for an interactive medium is either a situation where everyone in the community eventually become users of the medium or none become members at all. This principle is called “all or none”. Discontinuance may occur when there is lack of reciprocity or reciprocal interdependence; Reciprocal interdependence means that later adopters influence earlier adopters and vice versa. Early adopters may discontinue their use of the medium if later adopters cease or reduce their usage of the medium. It is therefore crucial for the survival of the interactive medium that the rate of usage continuously progresses.
toward usage by a predominant portion of the community. Several factors influence universal access in a direction favorable for universal access:

- “Heterogeneity of resources and interests in the community”. In this case, universal access will be more probable when the community is geographically distributed rather than concentrated in one central location and members of the community have differing amounts of resources.

- “High interest individuals and high-resource individuals” as early adopters. In this case, universal access will be more probable when individuals in the community that inherently attract interest from others in the community are early adopters of the medium, and where individuals possess resources i.e. information or services, that other members of the community find attractive or necessary to acquire.

- “Interventions that increase the overall level of interests and resources in the community” increase the probability of universal access. What this means is that the way in which an interactive medium is implemented vary depending on the specific community. Some communities that prefer voluntary adoption will use inducements of some kind. In other communities where adoption has been decided by authority decision, coercion may be used.

As universal access is important for the survival of an interactive medium, a community collectively or its management/owner find it necessary to employ devices that affect the above-mentioned factors to secure a critical mass of usage of the medium.

4.2.5. Work vs. Benefit Disparity

In an article presenting what he sees as eight challenges for developers, Jonathan Grudin (1994A) develops the concept of a work vs. benefit disparity. An inevitable feature of most computer applications or systems is a requirement for entering data, as without data most applications or systems become pointless. Users of a groupware application may be divided into groups categorized by the type of exposure they have to the groupware application or system. Some groups could be characterized by being obliged to provide the system with data, but not having much need for retrieving data from the system; as Grudin writes “most groupware requires some people to do additional work to enter or process information required or produced by the application”. Conversely, other groups might have a greater benefit of data contained by the system but have a lower burden of providing the system with data. Thus, whilst groupware is intended to provide collective benefits, the intended benefits are normally unavailable or useless for many users of the group, creating an imbalance in the enjoyment of the provided benefits. This imbalance with respect to expended effort and enjoyment of benefits produces a dilemma, which Grudin calls the Work vs. Benefit Disparity. The challenge faced by groupware system developers and owners is how to motivate users to contribute their time and effort in providing data to the system, despite some groups of users benefiting relatively less from the system than other groups of users. Another way of describing the situation is Marcus and Connolly’s model
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called *Prisoner’s Dilemma* – in which if “everyone acts to further their own best interest, the result is worse for the group as well as the individual.” (Grudin, 1994A, p. 96).

The above dilemma can be addressed in various ways. If management places great importance on the system, extra staff could be hired to handle much of the data entry work, as “the additional work becomes someone’s explicit job”. Another approach is to make sure that all users benefit in some way from the system; finally, the burden of providing data could be reduced, but has the disadvantage of degrading the usefulness of the system for other groups of users who benefit from the ability to retrieve data from the system, an approach which would become self-defeating.

**4.2.6. Participatory Design**

Participatory Design is a developmental and implementation approach that aims to ensure that IT systems have a better organizational and functional fit. A definition of Participatory Design follows: “a process of investigating, understanding, reflecting upon, establishing, developing and supporting mutual learning between multiple participants in collective ‘reflection-in-action’ (Schön 1983)” (Robertson & Simonsen, 2013). The approach requires the involvement of current and future users of a system in the design process as these users provide what is called “reflection-in-action”, which is a process where users learn from real use of the system under development and provide designers and developers with feedback that is used to inform the future design of the system, an approach which was already suggested by Berg in the socio-technical approach, see section 4.2.2. Socio-technical Approach. This approach helps the development process stay true to a course that makes a successful outcome of the process more probable. Another element of this approach is the improvisational change model advocated by Orlikowski and Hofman (1997). This model describes a process in which an iterative developmental process stipulates real use by users, who provide feedback to designers. Designers use that feedback to inform changes to the organization and/or system. The model describes change as either anticipated or unanticipated. Anticipated change are changes to the organization or system that are planned and intended. Unanticipated change are changes to the organization or system which was not originally planned or intended, but which happen as a result of the feedback provided by users of the preliminary system. Unanticipated change can either be emergent or opportunity-based, where emergent change is unplanned and spontaneous change, that emerge as a result of the use of the system, whereas opportunity-based change are changes that are planned and intended but as a result of feedback from users (Orlikowski & Hofman, 1997). The iterative participatory approach can be conceived as a cyclic process, where the process of designing and implementing a system goes through four stages in each iteration, starting with an initial phase where designers plan and specify, followed by a phase with real use by users, in which emergent change and opportunity-based change are enabled. The third phase is where the status of the system under development is assessed and evaluated to identify beneficial changes, followed by the last phase, where identified change is designed and implemented. This completes one iteration of the process. The process is then repeated as often as circumstances permit. In every iteration design is incrementally informed by real use.
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of the system by users providing feedback to planners and designer (Simonsen & Hertzum, 2010, pp. 16-21).

Figure 7 - Iterative Participatory Design Cycle. Below, illustrates the iterative participatory design cycle:

![Figure 7 - Iterative Participatory Design Cycle](image)

In Implementation of Electronic Whiteboards at two Emergency Departments (Rasmussen, et al., 2010) the role of the iterative and participatory approach to development and implementation of the new EW system was described, as an experimental process where an early version of the system was installed in the two EDs that participated in the project. Real use of the this early version of the system enabled users to provide the IT-vendor with feedback about the way the system functioned in reality and how it affected their work. The feedback was used in a continuous process to alter and modify the system, as illustrated by the iterative, participatory model shown in Figure 7, above. The article suggests that using an implementation approach with user involvement and/or participation enables developers to modify and change system features and practices iteratively in response to actual user experience with the system before the final version of the system is put in place. This approach ensures the final product has a better fit to the work practices and functions of the organization and better chance of being accepted by users than otherwise would be the case.

Balancing Tradition and Transcendence in the Implementation of Emergency Department Electronic Whiteboards (Rasmussen, et al., 2010) covers another aspect of iterative and participatory design methods discussing how this approach balanced two opposing tendencies when developing new systems to support existing work practices. The first tendency is for tradition to be preserved in the sense that developers create processes and user interfaces in the new IT system that mimic existing procedures and work practices. The opposite tendency is for tradition to be discarded as the new IT system enables the displacement of traditional practices, and in conjunction with this the development of new work practices and user interfaces.

4.2.7. Barriers to Adoption and organizational and technical Interventions

The organizational implementation of an IT system may be impeded by barriers to adoption, which may either be technical or social in nature. Granlien and Hertzum (2012, p. 12) studied the use of a mandated Electronic Patient Record (EPR) 3 years after its adoption and found eleven categories of barriers that prevented users from adopting the new EPR system to its fullest extent. The five main categories were:
1. Don’t know. Stating that barriers exist without knowing what they are.
2. Time: The system is too slow or time-consuming.
3. Lack of knowledge, information and training.
4. Inadequate support of certain work areas.
5. Poor usability and overview.

The categories that referred to social issues accounted for 52% of the barriers found, while 48% were of a more technical nature. There were three main points or implications for practice. First, managers will often have insufficient knowledge of the existence of barriers to adoption of an IT system, and will therefore not have reason to suspect that members or the organization find it difficult to accept a new system or technology, and will consequently not be able to consider potential inventions that could secure a better quality of adoption by users of a new system when planning for the organization. Second, even where users perceive the usefulness of a new system there may still be a gap between the users’ perception of an IT system’s usefulness and users’ actual usage of the system. As Berg also points out (1999), successfully transitioning users to a new IT system requires more organizational effort than merely implementing the software and providing training in the use of the system. Third, the window of opportunity (Tyre. & Orlikowski, 1994, p. 114), in which users explore and then adopt an IT system, is brief as users, for better or for worse, rapidly routinize their approach to using a new system. They will henceforth use the system in the manner they have learned to do so in that short period of adoption, regardless of how insufficient or incomplete that process of adoption may have been. Keeping focus on the way the system is used, and initiating inventions from time to time provides new windows of opportunity to influence users’ way of using the system in a way that management find more beneficial for the organization.

Intervention has been shown to be an effective method of affecting the user’s ways of using a system in connection with an organization implementation (Granlien & Hertzum, 2009). Granlien and Hertzum write that passive types of interventions such as distributing informational material and guidelines have been found to be less effectual than active types such one-to-one sessions where users receive immediate feedback during work. Manual and computer reminders are sometime effectual, while multiple inventions may be better than single, the overall conclusion is however that interventions do make a difference. Intervention can be used in an iterative process, where the process cycles through a series of stages; designing interventions, intervening, measuring effects, specifying (new) effects. At the end of an iteration, the stage would be set for a new iteration starting with the beginning stage of designing interventions. A few implications for practice should be mentioned:

(1) The process benefits from having the desired effects specified in a process that involves users.
(2) Assessing the effects of interventions is necessary for working “systematically” with organizational implementations. By assessing which interventions were effective, it becomes possible to develop further effective interventions.
(3) A caveat: “The Hawthorne Effect”, points out that ongoing interventions may be effective because of the effect of paying attention to staff, and not because of the actual content of the interventions, which “wear off” in time.

(4) The best mix of interventions contains both technical and organizational interventions, however there will be situations where the technical aspect of an implementation cannot be touched. This should not be an excuse for not intervening organizationally, as it is always imperative to do whatever can be done to benefit the implementation.

4.2.8 Coordinative Practices and Artifacts

In a lengthy (5 years), ethnographic study of coordinative practices and artefacts in an architectural firm, two researchers (Schmidt & Wagner, 2004) attempted a “systematic and comprehensive analysis of coordinative practices in their complex interconnectedness”. One of the conditions of architectural work described is that building construction involves combining and integrating components and parts produced by specialists in various domains, i.e. plumbing, electrics, ventilation, elevators, roofing, structural etc. with each their own technology and terminology. The study was comprehensive in scope and can hardly be summarized in a paragraph or two, but contains certainly one salient point with regard to CSCW. The authors of the study found that coordinative practices and their related coordinative artefacts produce complexes of interconnected practices and artefacts when applied in practice, using the term “ordering systems” to denote such systems. Ordering systems are constructed by actors cooperating in an attempt to perform cooperative work with the intention of creating a degree of consistency, regularity and accountability in the performance of cooperative work. They suggest that since ordering systems are constructed in a cooperative process between participants in the cooperative work, this constitutes a major challenge facing CSCW, raising the non-trivial questions of (1) how does one support interoperability between individual components such as “artifacts, formats and schemes” and (2) how does one support the expression of “heterogeneous schemes of classification and designation…” The authors’ point being that attempting to standardize the cooperative use of artefacts and terminology across organizational units is a non-trivial undertaking.
5. Research Design and Methods

5.1. Empirical Research Methodology

The empirical research approach of this thesis is an empirical, qualitative study of the real use of an electronic whiteboard system in NFH. Section 5.2 Qualitative Data Collection describes the methods chosen for collecting empirical data, their relevance in this context, and the advantages and disadvantages of using them. One of the methods is ethnographic fieldwork where an outside observer watches how clinicians actually use a white board system during the course of a workday. The second chosen method is interviewing, where multiple one hour-long semi-structured interviews were conducted with clinicians. Section 5.3. Qualitative Data Analysis Methods Explained, describes the data analysis methods chosen to interpret the empirical data, their relevance in this context and the advantages and disadvantages of using them. The method initially used is Affinity Diagramming, followed by the use of Diagnostic Mapping.

5.2 Qualitative Data Collection

Relevance of Ethnography to Human Computer Interaction (HCI) and Systems Design

Button and Sharrock describe how ethnography originated when the prominent British-Polish anthropologist Bronislaw Malinowski was forced by circumstances under the First World War to remain in the Far East. Malinowski stayed with an island tribe on a Melanesian island for about a year. During his forced sojourn on the island Malinowski lived as a participant observer and his observations (field work) were later published in his book Argonauts of the Western Pacific. This book is said to be the first example of an ethnographic publication (Myers, 2013, p. 93). Malinowski defined ethnographic work as “detailed, first-hand, long-term, participant observation fieldwork, written up as a monograph about a particular people” (Button & Sharrock, 2009). In recent years ethnographical methods have been increasingly used in the study of work in the context of Human Computer Interaction (HCI). Some early examples of ethnographic studies of the use of IT in organizations are Shosana Zuboff - In The Age Of The Smart Machine: The Future Of Work And Power (Zuboff, 1989) (Myers, 2013, p. 93) and Wanda Orlikowski - Integrated Information Environment or Matrix of Control (Orlikowski, 1991) (Myers, 2013, p. 40)

One purpose of ethnography in systems design would be to gather information as part of a requirements analysis, another to evaluate an existing IT system. Yet another would be as way of providing input to use in an iterative IT systems design and implementation process (Button & Sharrock, 2009, p. 39). Ethnographic
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evaluation studies can be conducted as part of an *iterative participatory design* approach, as this approach provides a way of examining how work practices are affected by the IT system during development, and becoming aware of possible *unanticipated* changes that emerge in the process of using the system (Simonsen & Hertzum, 2010, p. 19). The ethnographic approach lends itself to these purposes as it provides the observer with a clear and realistic picture of the principles underlying the actions, interactions and behavior of people directly involved in using an IT system in an organizational context.

Proponents of the ethnographic approach consider it in general to be a research method that provides a way of acquiring an in-depth understanding of the “human, social and organizational aspects of business organizations” (Myers, 2013, p. 92). When using this method the researcher is physically present in the organization or organizational unit he or she wishes to study, and observes the actual speech, behavior, actions and interactions of persons present and functioning in their usual settings. The point is to see what actually transpires in the organizational unit, as it happens and to see and experience it in its real context. The observer is a first-hand witness and is able to record these impressions using electronic recording devices or handwritten notes and sketches for later analysis. The impressions thus collected will be of actions and events as they actually occur, which is not always the same as what people claim has happened or occurred (Blomberg, 1993, p. 128). The above pertains to the study of work in general, but applies in equal measure to the study of work where the major element of the object of interest is computer systems in an organizational context.

Blomberg (p. 125) writes that ethnography may be defined by four basic principles: (a) *Natural Settings*, (b) *Holism*, (c) *Descriptive*, and (d) *Members’ Point of View*. *Natural Settings* means that people should be studied in their natural settings, and not in a laboratory or experimental situation. *Holism* means that people’s behavior can only be understood as part of a larger whole – in their usual context. Removing people from their natural settings changes behavior in nontrivial ways. *Descriptive* means that ethnography tries to describe people and behavior as it *seems to be* and not how it *ought to be* according to some set of rules or standards. Ethnography is therefore *non prescriptive*. Finally, *Members’ Point of View* means that ethnography aims to describe people and their behavior from the point of view of the members of the observed group and not from the point of view of the observer(s). In a single sentence the essence of ethnography may be summarized as follows: “[it is] concerned with understanding other people’s behavior in the context in which it occurs and from the point of view of the people studied” (p. 128).

One clear advantage of the ethnographic approach is its depth. The researcher obtains over time a real “in-depth understanding” of the culture or organization, which is the object of the study and the context in which it is placed. Another advantage is that the in-depth knowledge obtained in this manner may well trigger a challenge to pre-existing notions of the culture or organization which leads to new knowledge in the subject area (Myers, 2013, p. 97).

A disadvantage of ethnographical research is the traditionally prolonged time period required for participant observation and field work, sometimes over a year. It takes a correspondingly long period to process
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and analyze the field notes taken during the investigation. There may not be sufficient time available for a researcher to realistically contemplate using the ethnographic approach for a given project, and the approach may actually be more appropriate for doctoral work rather than master thesis work. Another disadvantage is the narrowness of the focus, as the ethnographic researcher focuses quite closely on one single culture, organization or organizational unit, where other research methods permit a much broader scope. This has led some researchers to voice concerns about the validity of generalizations arising from an ethnographic study. Myers disagrees; just as one may generalize on the basis of an individual case study, so one should also be able to generalize on the basis of an ethnographic study (p. 98).

Observation or Fieldwork

Fieldwork may be defined as “Observation of people in situ, finding them where they are, staying with them in some role which, while acceptable to them, will allow both intimate observation of certain parts of their behavior, and reporting it in ways useful to social science but not harmful to those observed (Hughes, 2005, p. 3)” (Myers, 2013, p. 136). Myers writes that fieldwork is sometimes called participatory observation and considers the term fieldwork as synonymous with participatory observation. Myers distinguishes between observation and participant observation in this way: Observation – is where an observer watches other people from the outside. Participant observation - is where the observer is in some way a participant in the activities with the people he is observing, in this way the observer is watching from the inside. However clear this way of differentiation is, the boundary between these two types of observation is blurred, where a participant observer might well be very passive and be difficult to distinguish from an ordinary observer (pp. 137-138). Blomberg (1993, p. 130) describes two diametrically opposite observer roles; that of the unobtrusive observer, who is akin to a “fly on the wall”, sometimes called an observer participant, and at the opposite extreme, the participant observer, being an observer who participates in the activities of the group being studied. In reality the two types of observer roles are opposite poles on a continuum of observer roles, where the degree to which an observer participates in the groups under observation varies depending on the nature of the group and its activities. The degree to which it is possible or permitted or even necessary to be participant in order to capture impressions and information relevant to the purpose of the study will to some extent determine the observer role’s position on the continuum.

Observing work in practice

One of the challenges of conducting a study of work is obtaining access to the organization or organizational unit that is the object of study. Gaining access to the site in the place or organization you are going to investigate is essential to the purpose of collecting data for the investigation. As the researcher or student needs to get past the gatekeepers of the organization it is important to be able to provide said persons
with a compelling or convincing reason to do so. A well written project proposal would give gatekeepers a good reason to provide access to a researcher, while poor explanation would be for example to say “I would like to observe the people in your company for four months, see how things work, and then write it up for publication”. The latter approach would probably rapidly lead to a dead end, as Myers writes (2013, p. 140). Myers suggests an approach to the organization, to which one wishes to gain access, consisting of three elements. Firstly, take the time to research the organization to become familiar with it, which will enable the researcher to enter into a dialogue with representatives of the organization in a way which shows a serious commitment to the project and the organization. Secondly, it would be helpful if the student or researcher is able to enlist the visible support of the research institute or university in approaching the organization. A letter of reference by a senior lecturer or professor would go far to opening the door. Thirdly, the researcher or student should prepare a written proposal that gives a compelling narrative of the research project, why it would be of benefit to the organization to make itself available to the project, as well as why the project has inherent academic interest and potential worth to other researchers. Taking these steps should increase the likelihood of a successful application for obtaining access to the organization for the purpose of conducting an empirical study. A description of how these principles were actually applied to obtain the hospital (NFH) management’s permission to observe how the EW system is used to support clinicians’ work practices is described in Section 6.1.2. Obtaining Access to the Organization.

Guidelines for Observing Work

While there seems few absolute rules for observing work in practice, there are a number of guidelines or pointers which when followed make it more likely to produce useful results (Button & Sharrock, 2009, p. 51). The actual process of observing work is not a mechanical process but a cognitive activity, which requires the exercise of all the observer’s social skills, attentiveness, alertness and persistence. Button and Sharrock recommend having a number of things in the back of one’s mind when actually collecting data: Stay close to the work, to see it happen, when it happens. Reflect about how the work relates to the formal description of the work, don’t rely on written procedures to understand the work. Observing is a practical activity, and remember to record what actually happens as opposed to what someone says or writes should be happening. Think about the context of the work one is observing – how does it fit in the organization.

Recording the Data

The impressions and information acquired in an observational session must be recorded in some way to be available for later reference by the original observer as well as interested third parties. Field notes and electronic audio or video recording are primary methods for recording the results of a session. The way field notes are taken may depend on the observer role chosen for the session. If a participant observer role has been chosen, the contemporaneous writing of field notes may be nearly impossible, and in this situation, the observer
will need to reconstruct his or her experiences in writing at a later time. The sooner the better to avoid the omission of vital details. At the other extreme, a non-participant observer will be able to write contemporaneous notes, sometimes verbatim, or use electronic devices to record audio and or visual material. Written notes contain not only a record of events experienced during a session, but should also contain impressions and thoughts which occur to the observer as the events unfold, providing valuable input for later analysis. The results of an observational session represent a snapshot of the situation at a given day and time, and will be referenced at a later date. The date, time, place and persons involved in the session should therefore be a part of the notes.

Video and audio clips represent a literal record of events, but are not necessarily more valuable than written notes. Clips do show actual events and words *verbatim*, but lack the commentary that may be included in written notes. Care should be taken to avoid taking too many hours of video and audio recordings, as later analysis can be extremely time consuming. The method should be used judiciously to record relevant and important details that would be difficult to adequately record in written field notes (Blomberg, 1993, pp. 132-133).

**Interviewing**

Blomberg writes (1993, p. 133) that observation seldom stands alone, and that interviewing may be appropriately used to collect additional information. Myers compares fieldwork with interviews and makes the following points (2013, p. 137):

- An interview has a set time and place whereas fieldwork takes place in a more random fashion.
- An interview has a relatively short duration in time while fieldwork is more time consuming.
- An interview takes place in a more formalized fashion whereas fieldwork takes place in a more informal way.
- Interviewees may well tell the interviewer the “official” story whereas people in a fieldwork setting often give a more forthright version of the truth (as they see it).

There are basically three types of interviews:

- Structured interviews
- Semi-structured interviews
- Unstructured interviews

A structured interview is an interview where the interviewer has prepared a questionnaire or a list of questions before hand, and where the interviewer will conduct the interview strictly on the basis of these questions, posing each question in the same preset sequence to each interviewee. This ensures a consistent structure and quality of the data collected in the course of the interviews. An unstructured interview is an
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interview where the interviewer begins the interview with the topic that interests him or her, but permits the interview to takes its own course, giving the interviewee the freedom to choose the direction of the interview. Finally, a semi-structured interview is an interview in which the interviewer poses pre-formulated questions, as in a structured interview, and while the interviewer will permit the interviewee to deviate from the preset formula, he or she will ultimately try to direct the interview back to the pre-formulated questions.

**Interviewing has Advantages and Disadvantages**

The structured interview has the advantage of consistency throughout the investigation. As each interview follows the precisely identical script, the interviewer has complete control of the process. However, the rigidity of the structured interview has the disadvantage of preventing improvisation from taking place in conjunction with which unexpected data could have been collected. The structured interview is difficult to prepare but relatively easy to administer. The unstructured interview is easy to prepare, but is somewhat difficult to administer as an unstructured interview may lead to unexpected twists and turns. The advantage is the ability to collect unexpected insights and data, but the disadvantage is that the interview is more or less out of the interviewer’s control and may be more time-consuming that its results justify. The semi-structured interview has the advantage of following the preset questions giving a degree of consistency across interviews, yet is able to permit deviation from the pre-formulated questions giving the interview an improvisational dimension which permits the collecting of unexpected insights and data, however without depriving the interviewer of control of the process. (Myers, 2013, pp. 119-124)

5.3. Qualitative Data Analysis Methods Explained

The qualitative data gathered in this investigation was analyzed using the *affinity diagramming* and *diagnostic mapping* techniques. The principles and method of operation of both techniques will be explained in the following two sections. For the practical use of these techniques when used to analyze the empirical data of this study, see section 6.2. *Analyzing the empirical Data using Affinity Diagramming* and section 6.3. *Analyzing the empirical Data using Diagnostic Mapping*.

5.3.1. Affinity Diagramming

According to Simonsen and Friberg (2014) affinity diagramming is an analytical technique with theoretical roots in Grounded Theory (Glaser and Strauss, 1967; Glaser 1992) and is a way of performing a “bottom-up” analysis of quantities of qualitative data. The technique employs inductive reasoning to create an overview of the quantitative data collected when conducting a study. The result of this type of analysis is a consolidation of detailed observation into a limited number of more general categories and themes. Friberg and Simonsen consider the technique to be a collective technique, hence the title of the article: *Collective Analysis of Qualitative Data*, and assume that the technique will typically be employed by a group of analysts.
rather than just one individual acting on his or her own. The same may be said of the Diagnostic Mapping Technique, which is the subject of Section 5.3.2. Diagnostic Mapping.

The technique works by analyzing data extracted from transcripts of interviews, observation journals or summaries of interviews, in a bottom-up approach. The group of analysts study the transcripts, journals or summaries, highlighting and underlining passages that seem to be important or to epitomize in some way the essence of the data. The second step is to write word, phrases, statements, quotes that characterize the marked passages on adhesive notes for later processing. This process is called “coding” the data, where a code can be defined as “... a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language based or visual data” (Saldana, 2013). The third step is to place the notes on a whiteboard in groups in which the notes that are grouped together have some kind of commonality or affinity4. The fourth step is to give the groupings of notes titles that reflect the categories or themes that characterize the affinity that connects the notes one to another. The categories themselves may be arranged in a hierarchy of categories and sub-categories of the data, if that makes sense. The categories and themes emerging from this cognitive process represent the analytical result of an inductive reasoning process.

Simonsen and Friberg explain that affinity diagramming “makes the data talk”, which is characteristic of Grounded Theory, and that “The point is to enable categories to emerge as part of the process of analysing and comparing of the data – rather than analysing data based on predefined categories or hypotheses. (Glaser and Strass 1967; Glaser 1992, 39)” (Simonsen & Friberg, 2014). The analysis is thus a bottom-up process as the categories or themes emerging from the analysis produce a result that is neither preconceived nor anticipated, and which may provide new insights or knowledge regarding the subject domain. It is a way of interpreting and making sense of an unsorted, uncategorized collection of discrete, albeit related, pieces of information.

5.3.2. Diagnostic Mapping

Diagnostic mapping is a technique that may be relevant as a way of analyzing, in further detail, some of the results produced by the affinity diagramming. The results of affinity diagramming may reveal one or more problematic situations with the issues or situations under investigation, and further analysis using diagnostic mapping may help in finding solutions to the problematic situation(s). Diagnostic mapping is considered an abductive approach, in contrast to affinity diagramming which is inductive (Simonsen & Friberg, 2014). As previously mentioned in Section 5.3.1. Affinity Diagramming, Friberg and Simonsen consider the technique to

4 In biology, affinity means “a relation between biological groups involving resemblance in structural plan and indicating a common origin” and more generally a “likeness based on relationship or causal connection” (Meriam-Webster, 2014), a definition that could summarized as being a situation where statements or images characterized by similarity, resemblance, or common origin may be appropriately placed in categorized groups.
be a collective technique, and assume that the technique will typically be employed by a group of analysts rather than just one individual acting on his or her own.

Diagnostic mapping is an approach where questions are asked in a certain sequence in an attempt to generate answers that either lead to solutions, or a better understanding of the problem or problems at hand. The general pattern of questioning is:

1. what happened
2. why
3. what are the consequences and
4. what can be done

In the first question, people familiar with the “situation” being investigated will try to identify what they see as a problem. When the problem is identified, the next question is why, which is to ask, what are the reasons for this problematic situation to be occurring. Then ask, what the negative consequences of the problematic situation are, and finally, what could be done to rectify the situation or solve the problem. The process need not be linear, as issues seen as problems, reasons, or consequence may well be reclassified as the analysis progresses, and the result becomes clearer to the mind. The analysis may be visualized in a matrix-like shape, such as that show in Figure 8 below (Lanzara & Mattiassen, 1985).

<table>
<thead>
<tr>
<th>What happened?</th>
<th>Why?</th>
<th>What are the consequences?</th>
<th>What can be done?</th>
</tr>
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<tbody>
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</tr>
</tbody>
</table>

Figure 8 – Pattern of Diagnostic Map according to Lanzara.

Diagnostic Mapping activities following the identification of problems using the affinity diagramming technique could be performed in the same way by visualizing problems, causes, consequences and solutions by placing adhesive notes on a whiteboard or big sheet of paper (Simonsen & Friberg, 2014). In this approach, there is one map per problematic situation, which is constructed as a matrix with four columns titled: Problem, Causes, Consequences, and Ideas for Solutions, which is an alternate way of formulating the questions used in Lanzara’s model, above.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause or causes</th>
<th>Consequences</th>
<th>Ideas for Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesive notes with problem or candidate problems</td>
<td>Adhesive notes with causes</td>
<td>Adhesive notes with consequences</td>
<td>Adhesive notes with ideas</td>
</tr>
<tr>
<td>....</td>
<td>....</td>
<td>....</td>
<td>....</td>
</tr>
</tbody>
</table>

Figure 9 – Pattern of Diagnostic Map as amended by Friberg and Simonsen
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These problems, causes and consequences are found by re-examining and interpreting the situations described and identified in the affinity diagramming activities. This approach begins by writing suggested problems on adhesive notes that are placed on the map, however suggestions that originally are seen as problem candidates, may soon be seen as causes or consequences. The placement of notes will for this reason be relatively fluid. The next step is to suggest causes and consequences, which could be tied to the suggested problems. Note these causes and consequences on adhesive notes, and place them on the board/sheet of paper. Keeping in mind that consequences are frequently problems in their own right, this process may not only result in producing ideas for solutions to the original problem(s), but will also produce additional problem candidates. Having mapped out the problem, its possible causes and its consequences, attention is finally directed at finding ideas for potential solutions to the problems. The end result of diagnostic mapping will be a presentation of possible interventions for solving those problematic situations that were originally identified by the affinity diagramming process (Simonsen & Friberg, 2014). In situations where the iterative and user-participatory approach is being used, diagnostic mapping, based on the empirical foundation created in the evaluation phase, could be an appropriate means for identifying changes for consideration in the specification and implementation phase.

The use of a flip chart style sheet of paper attached to a wall, and the colorful adhesive notes with handwritten notes enable the group to physically visualize their analysis and share insights leading to a better understanding of the problems taken under consideration. It is a process of mutual learning amongst participants and contributes to anchoring “by creating argumentation for the relevance of the proposed solutions” in the group (Bødker, et al., 2004, p. 213). Anchoring of mutual learning is vital as only changes anchored with decision makers, stakeholders and technicians have a real chance of being realized (Bødker, et al., 2004, p. 71).

5.3.2. Potential weaknesses with the use of the Technique

A fundamental general weakness of both techniques – both affinity diagramming and diagnostic mapping - is that while both involve a process of reasoning based on empirical evidence, both processes ultimately depend on the intellect, objectivity, imagination and creativity of the person(s) using the technique. The quality of the result, whether it be identified problems or suggestions for solutions, depend therefore entirely on the quality of the thought processes of the persons involved, and it would not be surprising if two different persons/analysts were to end up presenting completely different sets of problems or different solutions to the same problem. Another general weakness with these techniques is connected with the narrowness of the source of empirical data. The techniques produce analytical results based on empirical data which may or may not be truly representative of the reality of the situation, in which case the resulting sets of identified problems and potential solution could be entirely off the mark, and either cause more problems or have no effect on the
situation at all. A mitigating factor of these weaknesses is the involvement of multiple participants in the collective process of analysis, for which reason one hopes that the presence of more than one set of eyes on an issue would have a self-correcting effect on the thought processes of the group as a whole.

A final note: a more particular weakness of the technique as it has been employed in the analysis of the empirical evidence collected by this study is the fact that while both techniques are described as collective analytical techniques, this study has been conducted by the author working as an individual, for which reason the benefits of working in a collective manner have been foregone, and this circumstance may have limited the quality and quantity of insights produced by this study.
6. Results

The following section deals exclusively with the actual process of collecting and analyzing empirical data. Section 6.1. Collecting the Empirical Data describes (a) the way the empirical data collection methods were selected, (b) how access to the organization was obtained to collect data, and (c) how the fieldwork and (d) interviewing was conducted. A more theoretical discussion of data collection methods is found in section 5.1. Empirical Research Methodology. Section 6.2. Analyzing the empirical Data using Affinity Diagramming describes the process and the results obtained by analyzing the empirical data using affinity diagramming. Section 6.3. Analyzing the empirical Data using Diagnostic Mapping describes the process and results of analyzing the problems found in the previous step. The final results of the aforementioned analyses are discussed in Section 7. Discussion of the Results of Analyzing the Data.

6.1. Collecting the Empirical Data

6.1.1. Choosing Data Collection Methods

This thesis is concerned with how the electronic whiteboard system (EW) at Nykøbing Falster Hospital (NFH) supports inter-departmental communication and coordination of work. The thesis as such is therefore an investigation into the ways in which clinicians actually use the EW in conjunction with performing their usual routines, procedures and work practices in the context of inter-departmental communication and coordination of work. To be able to answer this question necessitates choosing a method of inquiry that is operational in the specific circumstances and capable of producing sufficient evidence to provide a basis for answering the question or questions. As was seen in Section 4.1. Previous Work in Area, a number of studies of real use of EW systems have been published, some of which have been of a quantitative nature and others of a qualitative nature. It would seem that both approaches have been found to be useful in studying EW systems. The particular interest of this thesis is inter-departmental communication and coordination of work in relation to EW systems as experienced by clinicians, and as little work seems to have been done with respect to precisely this aspect of EW systems, the nature of this inquiry could be of an exploratory nature. The choice of method will also depend of the particular interests of the person conducting the investigation, which in the case of this study is an interest in investigating the interrelationships between members of an organization, their work practices and their use of supporting IT systems.
As described in section 5.2 Qualitative Data Collection, ethnographic methods are a recognized approach to qualitative studies of HCI and IT systems, whether the object of the study is facilitating a design or evaluation process, or generating input to an iterative design and implementation process. The target of this study is the EW system at NFH, which is in a state of flux, as the process of development and implementation have not yet been brought to an end. The healthcare region and the IT-vendor have an iterative and user-participatory nature developmental approach, and it would be interesting to investigate whether unanticipated features or aspects have been developed. An ethnographic approach would therefore be an appropriate choice for an EW study. As previously stated in section 5.2 Qualitative Data Collection, ethnographic studies cannot really stand on their own, and it would therefore increase the validity of the study to supplement the data gathered via ethnographic observational technique with interviews of several users who make real use of the EW system.

The use of the methods chosen have both advantages as well as disadvantages. It has been pointed out by previous sections that lengthiness is a common attribute of ethnographic studies and it would not be practical to conduct a lengthy study of the system in question. It could be claimed that the short time allotted to the investigation could result in the collection of data of a lesser quality than it would have been the case, had there been more time and resources available. In the event, the actual study extended to three out of twenty possible hospital departments, and all observation sessions and interviews were conducted within a time-span of only six weeks starting the 29th September, 2013. The validity of the descriptions and conclusions based on this empirical foundation should therefore be seen in the perspective that a hypothetical study of a different length conducted at a different time with different participants might have led to different results than those obtained in the actual study.

The sessions and interviews are fully explained in Sections 6.1.3 and 6.1.4. A summary of the duration and extent of the interviews and the observation sessions may be seen in the following.

**Interviews**

- Number of interviews 7
- Average duration (min.) 51.28
- Total duration (min.) 359
- Average length of transcript (A4 pages) 15.86
- Total length of transcripts (A4 pages) 111

**Observation Sessions**

- Number of days 4
- Departments observed
  - Intensive care
  - Emergency
  - Operating theatre
  - System administration

- Transcribed field notes (A4 pages) 16
### 6.1.2. Obtaining Access to the Organization

This section will be concerned with how access to the organizational unit site was attained and how the clinicians who were interviewed were found.

The first step of the study was to prepare a project proposal, describing the purpose of the study, and how the collection of the empirical data was intended to take place. The project proposal followed the guidelines previously suggested in section 5.2 Qualitative Data Collection. The project proposal stated that the context of the study was the EW system of the FFH, which after being implemented in the emergency department of NFH in 2009/2012, had subsequently been implemented in all other departments of the NFH. The project proposal requested permission to observe how the work practices of three departments were conducted and how they were affected by the implementation of the new EW system. The departments suggested by the proposal were the medical, geriatric and orthopaedic departments. The proposal suggests conducting the investigation in two phases: Phase #1 would consist of observing the actual use of the EW systems, while phase #2 would consist of interviews with clinicians with experience of using the EW system. The proposal contained a schedule of dates and times for the investigation to take place. It was suggested that there would be 1 day with an administrator giving a technical introduction to the EW system, 3 days of observation sessions in the departments, concluded with 1 day of interviews with clinicians affected by the EW system.

The project proposal was written in the form of a letter to NFH, which Professor Simonsen (C.B.I.T. Roskilde University, simonsen@ruc.dk) forwarded to the hospital with his recommendation. Professor Simonsen has a working relationship with the healthcare region and NFH, was therefore a suitable medium through which to approach the gatekeepers of the hospital and healthcare region, an assumption that seems to have been correct, as access was quickly granted.

The hospital’s director of quality control replied by e-mail of the 26th of September 2013 granting permission for the study to be conducted. The e-mail stated that the technical introduction to the system would be presented by the EW system administrator, and that the remainder of the study’s activities would be coordinated with a clinician in the intensive care department, who was very familiar with the EW system. As mentioned in section 5.2 Qualitative Data Collection, it can be challenging to obtain access to an organizational site that is an appropriate fit to the purpose of a study, and in the current case it was fortunate that a university professor was able to provide a personal introduction to the director of quality control who was favourably disposed to the proposal.

Work with the study began on the 30th of September, when the EW system administrator made a very detailed and technical hands-on presentation of the EW system, providing a thorough grounding in the EW system. The next step was to observe the use of the EW system in practice, where the first session started at 7:30 AM on the 1st of October 2013 in the intensive care department. This session was organized by the earlier-mentioned intensive care clinician, who explained in detail how the EW system supported work practices in the intensive care department. The session involved more than observing as there was direct interaction with
the clinicians being observed as many of these clinicians initiated contact to ask questions about the study and volunteered information about the department’s use of the EW system. The chief nurse of the intensive care department suggested an observation session in the operating theatre department, as she thought that their use of the EW system was more interesting for the study than their own in the intensive care department. Introductions were made over the telephone to the chief nurse of the operating theatre department, and the session was arranged for the 2nd of October 2013.

The chief nurse of the intensive care department also suggested calling the chief nurse of the emergency department to ask if the observation session could continue in the emergency department. As the chief nurse of the emergency department was agreeable to this suggestion, the observation session was resumed in the afternoon in the emergency department. The use of the EW system in a department which had used EW system for some time, was in some contrast to the use of it in the intensive care department, which has only had the EW system since January 2013. This observation session was also characterized by interaction with clinicians in the same as had been the case in the intensive care department. One of the managing physicians in the emergency department indicated her enthusiasm for using the EW system, and suggested participating in an interview. The suggestion was accepted immediately and the date for the interview was set for the 7th of October. At the end of the day’s sessions, the chief nurse of the intensive care department, arranged for the interviewing of two nurses from the intensive care department with respect to their use of the EW system in the intensive care department. The interviews were agreed for the 16th of October 2013.

The next observation session started on the next day the 2nd of October 2013 at 7:00 AM. The observer was welcomed by the chief nurse of the operating theatre department, who asked him to change clothes to the sterile operating theatre clothes supplied by the hospital as no one is allowed to enter the operating theatre unless wearing standard sterile hospital clothing. One of the operating theatre nurses was assigned as guide and facilitator of the observation session. The observation session began by observing the way clinicians used the EW system to support their work practices in the operating theatre while the nurse who functioned as facilitator provided a stream of comments with respect to the events and actions that took place. One of the surgeons contacted us during the session saying that he had a lot to say about the EW system, however the interview never was arranged, even though he was later contacted by e-mail to arrange an interview. At the conclusion of the day’s session, the chief nurse said she would arrange interviews with two experienced operating theatre nurses on the condition that the purpose and agenda of the interview be described in a proposal sent to her by e-mail. An interview proposal was e-mailed to her a few days later, which she promptly answered with the names of the persons to be interviewed. The interviews took place on the 16th of October 2013.

On the 7th of October 2013, a senior physician of the emergency department was interviewed and after the finish of the interview, the physician led a tour of the emergency department. She suggested at the same time interviewing with the chief medical secretary of the emergency department and one of the supervising
nurses. The interview with the chief medical secretary was agreed to take place on the 25th of October 2013, while the other interview was agreed to take place the day before, on the 24th of October. All arranged interviews took place as agreed.

6.1.2.1 Summing it up

The process of attaining the access to the organizational sites and staff that a study requires for observing events and interviewing persons is non-trivial. The process requires a skilful approach and depends to some extent on building personal relationships to people in the organizations and networking with them. In the current case initial access to the site was achieved through the medium of a university professor who was willing to forward the project proposal to a person in the healthcare organization, who had organizational competence to approve/disapprove the proposal, i.e. a gatekeeper (as mentioned in section 5.2 Qualitative Data Collection). It is essential for a project to be permitted access to organizational sites of interest, without which an empirical study cannot be accomplished. The original project proposal contained a request for permission to observe work taking place in the medical, geriatric and orthopaedic departments. These departments were specifically chosen on advice from researchers familiar with the hospital setting because there was a high frequency of patient transfers amongst them, which would provide an opportunity to observe the role played by the EW system in connection with patient transfers. However, the hospital decided to grant access to the intensive care department, which is a completely different department. As this was a slight change of plans, the study would have to adapt by improvising and by taking advantage of the new opportunities. It became therefore possible to extend the scope of the study to observation of work carried out in the emergency and operating theatre departments. The original project proposal had not in its application nor had the healthcare region in its acceptance identified potential interviewees. It was rather the case that potential interviewees were identified and selected on a running basis in the course of interacting with persons working in the departments being observed, thereby building a network of new, personal connections. Each existing connection leading to one or more new connections in a type of chain reaction. The end result of this networking process was the identification of seven specific interviewees, each working in one or the other of the three departments now under observation. The unfolding of these events confirmed the assumption that planning and conducting an empirical study of this nature is a non-trivial exercise that requires collaboration with persons outside of the organizations that are capable of providing access to that organization and people inside the organization capable of providing access to knowledgeable informants and requires in addition a considerable amount of interpersonal skills and agility in improvising, negotiating and exploiting opportunities as they appear.

6.1.3. Fieldwork – The Observation Sessions

Whereas the previous section explained in detail how access to the organizational unit sites and interviewees was achieved, the following section will be concerned with the actual process of observation.
The fieldwork consisted of three or four days of observation, depending on whether one considers the first day at the hospital, where the EW system was introduced by the system administrator an observation session or an interview. The first day of observation will be the system administrator’s introduction to the EW system, and the next three days would be the observation sessions taking place in the intensive care department, the emergency department and the operation theatre department. Unrestricted access to the hospital had been granted as the observer had signed a patient confidentiality document, however he was accompanied by a clinician at all times when observing actual work.

The first day of observing was spent with the system administrator of the EW system, who provided a detailed technical/operational presentation of the EW system’s user interface and demonstrated how clinicians and staff use the system on a daily basis in the hospital. Very little information putting the system in a larger organization context was provided, however the information obtained in this session was sufficient to give the observer some familiarity with the user interface, as well as the ability to relate to how clinicians later described or demonstrated using the EW system.

The three subsequent days of observation took place in, respectively, the intensive care department, the operating theatre department and the emergency department. The first observation session took place in the intensive care department, where an experienced nurse showed the observer around the department, and explained the department’s nature, purpose and operation, whilst actual work was carried out. Various clinicians carried on with their tasks as if the observer was not present. However, some of the nurses and physicians introduced themselves and would inquire as to the purpose of observation describing their own work, and/or their use of the EW board system.

All impressions of events happening while observing work, all descriptions and explanations provided by the accompanying clinician or any other persons present were recorded contemporaneously in a fieldwork notebook. Recording multiple impressions and explanations simultaneously with events taking place at various times as situations unfolded and evolved requires great attentiveness. It was very difficult to photograph events or scenes involving people as most people seemed to demonstrate a general aversion to being photographed. In as far as it was possible to discern reasons for their reticence, the intention seemed to be the protection of patients’ modesty and confidentiality. The field notes were transcribed later the same day and saved in an electronic document, as it is good fieldwork practice to record one’s note as soon as possible after concluding a session. This practice enables the incorporation in the transcripts of impressions and details from memory, which not actually written down in the notes (Myers, 2013). The process of observing actual work provided situations in which the observer was able to expand his circle of acquaintances amongst the clinicians, some of whom were subsequently interviewed in situ with respect to their general experience and work practice as well as their specific experiences and work practices with regard to the EW system. The sources of information were thus fourfold:
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(1) Observation of actual work,
(2) Asking clinicians in situ about their work,
(3) Speaking to clinicians who introduced themselves in order to provide information, and
(4) Listening to the clinician(s) guiding the tour or observation session.

This pattern persisted throughout all of the observation sessions.

While written field notes were taken during the sessions and subsequently transcribed to electronic documents at the end of the day to enable preserve an accurate description of the observed reality of the department, such notes are not a total rendition of all information obtained at the time. Writing verbatim field notes is seldom advisable, as this would require an unnatural ability to record the spoken word while simultaneously observing unfolding events in detail. Transcribing notes at the end of the day therefore ensures accuracy and allows an observer to supplement the recorded details with remembered, but not recorded, details and observations producing a richer, more complete picture of what took place during the sessions. This requires a daily effort to retain such remembered details, as most people’s memories of events fade rapidly with time (Myers, 2013).

6.1.4. Conducting the Interviews

The process of selecting interviewees is mentioned in the section above as part of the process of obtaining access to the organization sites. Although many clinicians were spoken to and informally interviewed during the observation sessions, choosing specific interviewees was a process mediated by their immediate superiors in the organization. The original contact provided by the director of quality was the chief nurse of the intensive care department. The chief nurse provided two links and two interviewees. The links were (a) a link to the chief nurse of the operating theatre department, and (b) a link to the chief nurse of the emergency department. The two interviewees were both experienced nurses in the intensive care department. Link a, the chief nurse of the operating theatre, provided two interviewees, both experienced operating theatre nurses. Link b, the chief nurse of the emergency department, provided a link to one of the senior physicians of the emergency department, who in turn, provided two interviewees, one an experienced nurse, and the other, the chief medical secretary. The senior physician herself volunteered for an interview, bringing the total number of interviewees to seven persons chosen for participation in interviews that took place on October 7, 16, 24 and 25. The interviews conducted individually and recorded using an electronic voice recorder. Each recording was transcribed verbatim and stored electronically.

The semi-structured interview format was chosen, as it is a format where the interview is directed, but where there is the chance of capturing spontaneously provided or revealed information, see section 5.2 Qualitative Data Collection with respect to interview techniques. For the semi-structured interviews, an interview guide was prepared containing 18 questions pertaining to six themes. The themes were developed on the basis of the information gathered during the observation sessions. Each interview started by presenting
the interviewee with the interview guide and explaining to the interviewee what the purpose of the study and the interview was. The interviewer informed the interviewees that digressing from the interview guide was welcomed provided the digression provided added, pertinent information. Each interviewee did actually digress from the interview guide to a certain degree; some interviewees controlled the interview while others followed the interview guide more closely. The interviewees either answered each question along the way during the interview, or when the interview was wrapped up at the end and the interview guide was reviewed one last time.

The material gathered during the observation sessions was used to develop the themes of the interview guide. The themes targeted therefore those points of interests discovered when observing actual work in the departments. The themes are described in the following:

1. **Interviewee’s role in the department** – This determines the position and location in the organization, which provides context for the interview.

2. **Coordination of tasks** – This focuses on an area of interest relating to how tasks are coordinated intra- as well as inter-departmentally and how coordinating task is supported by the EW system.

3. **Coordination of tasks – scheduling operations** – This theme focuses on the task of scheduling operations which is a prominent example of tasks supported by the EW system.

4. **Development of new function or new patterns of work practice** – This theme focuses on how new functions are developed and, importantly, how new functions and patterns are either agreed upon between departments and/or through the management hierarchy.

5. **Significance for work practice** – This theme focuses on how the interviewee sees his or her work practice affected by the EW system.

6. **The EW system is implemented in all departments of the hospital** – This theme focuses on the interviewee’s thoughts and feeling in the perspective of having the EW in all departments of the hospital.

The duration of a single interview ranged from 37 minutes to 86 minutes with an average of 51.28 minutes per interview. The total number of interview minutes was 359 minutes. All interviews were later transcribed verbatim to electronic documents, producing 111 A4 pages of transcripts averaging 15.86 pages per interview.

### 6.2. Analyzing the empirical Data using Affinity Diagramming

The following section contains the analysis of the empirical data collected using the affinity diagramming technique described in Section 5.3, *Qualitative Data Analysis Methods*. As previously mentioned in Section 5.3.2, *Potential weaknesses with the use of the Technique*, the Affinity Diagramming technique is a collective analytical technique which is being used in this study by this author working alone.

The process began by producing a paper copy of all observation journals and interview transcripts and filing them in a binder. The paper copies would be used for highlighting words, phrases and recording of notes,
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remarks and statements in the transcripts themselves. The process of analyzing the material was conducted by carefully reading each journal and transcript, and trying at the same time to reflect on the significance of the answers and remarks made by each interviewee, and in the case of the observation journals, the significance of each observation, impression, and recorded statement made by persons observed while working. If anything of significance was recognized as such, the note or remark or statement would be highlighted, and its essence would be written in an annotation in the manuscript immediately adjacent using a broad tipped ball pen. Friberg and Simonsen call this process “letting the data speak.”, see above, Section 5.3.1. Affinity Diagramming. This analytical process is characterized by being laborious, even tedious, and cognitively demanding. It involves the directing of one’s mental focus to every single word and phrase in the text, and pondering its significance in relation to the question asked, the context of the remark, the identity and function of the person being observed or interviewed, and then cross-referencing the information to prior knowledge directly or indirectly related. Not unlike the effort required of a rickshaw cabbie to keep the rickshaw in motion; if the cabbie’s feet were to stop moving, the rickshaw would stop moving forward. Analyzing transcripts is similar; the process of assimilation ceases to function as soon as the focus relaxes. Analyzing one transcript per day was as much as could be reasonably accomplished in a day’s work.

As a result of the aforementioned process the paper copies of the observation journals and interview transcript were now peppered with highlighted words and annotations, ready for the next step, which was coding. In this step each observation journal and interview transcript was individually processed by reviewing each its highlighted passages and annotation, and writing a statement encapsulating its essence on a yellow adhesive note. Writing a word or words on adhesive notes signifying a category, a sub-category or just a characterization of what was is the essence of highlighted statement or annotation. Every adhesive note is referenced to its origin in the original text to enable tracing and later verification. The adhesive notes were collected separately so that each collection of notes was related to the same original text. In the end of this step, there were 8 lots of adhesive notes corresponding to 7 interviews in addition to 1 observation journal (The journal contained all transcripts of observation sessions). A total of 217 adhesive notes were created.

The next step was using the principle of affinity to organize the 217 adhesive notes in groups characterized by categories, as explained in Section 5.3.1. Affinity Diagramming. Each lot of adhesive notes was processed by reading each note and sorting then into groups of closely related items having a significant degree of affinity. In the process of categorizing and sorting the adhesive notes, the groups needed to be named or titled. The name or title of a group of notes would usually be the theme or category that articulated the affinity of the notes to one another. For example, some of the groups that emerged from this process were called scheduling surgical operations, conflicts between departments, transferring patients between departments etc. The group called conflicts between departments is mentioned as an example of a group containing a number of adhesive notes that all describe some kind of conflict between departments with respect to how to configure, change or use the EW system in their work practice. The same principle was applied in
organizing the other groups of adhesive notes. The process of categorizing and organizing the 217 adhesive notes produced a total of 19 categories, where each category served as the title of a group of notes. The process of categorizing and organizing the adhesive notes progressed in an iterative fashion, rather than in a linear fashion. The process did not go in a straight line to the end result, but required a number of iterations to refine the organizing of notes into the final categories, as the reading and the re-reading of the notes and categories gradually enhanced the understanding of the significance of the material. Notes were grouped and re-grouped, indeed some notes ended in a group called *unassigned* notes, which were notes that either were difficult to categorize or seemed to be irrelevant or trivial.

The end result of the last step was a summary of each categories written as a commentary or factual narrative, summarizing the content of an individual category. These narratives either identify issues, for later discussion or identify problematic situations that may be analyzed in further detail using the diagnostic mapping technique. Summarizing the content of a category requires carefully re-reading the adhesive notes, interpreting and re-interpreting them to capture their ultimate content as described in Section 6.2. Analyzing the empirical Data using Affinity Diagramming. This is however not the same as discussing the significance and implications of these findings; that may be found in Section Discussion of the Results of Analys. The advantage of this process is that it attempts to allow the material to “*speak itself*” and to permit the bottom-up inductive process to reveal potentially new knowledge with respect to the object under investigation. One disadvantage of this process is, for example, an element of subjectivity, even capriciousness which may be hard to avoid. Subjectivity is difficult to avoid, because the approach depends on the faculties of imagination, the endurance and acuteness of the mind of the person who is analyzing the data, without which the data “will not speak”. Capriciousness is difficult to avoid, because the analysis depends on the unbiasedness and emotional detachment of the person conducting the analysis, to avoid prejudgment or pre-ordained conclusions. The process must therefore be documented, so as to allow interested third parties to review the basic data of the investigation, and to test whether the conclusions of the study are warranted.

The original terms used by the analysis were *categories* and *themes*. The difference between theme and category is that a category is a more specific term, such as *hospital admissions procedure*, while theme is a less specific term, such as *patient care conflicts with computer systems*. The difference between the two concepts seems blurred or indistinguishable, and while processing the data it became more natural to use the terms *categories* and *subcategories*, as these terms enabled organizing the resulting categories in a hierarchy. The main categories are called categories, and subordinate categories are called subcategories. Only the most interesting categories discovered in the analysis will be summarized and discussed in the following sections. They are as listed in Table 1 below.

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
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<td>1.  New Collaborative Processes and Practices</td>
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<td>1.1</td>
<td>Scheduling Surgical Operations</td>
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<td>1.2</td>
<td>Hospital Admissions Procedure</td>
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<td>1.3</td>
<td>Transferring Patients between Departments</td>
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2. Flexibility in Work Practices

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<td>2.1</td>
<td>Increased Flexibility in Work Practices</td>
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<td>2.2</td>
<td>Less Flexibility in Work Practices</td>
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<td>2.4</td>
<td>Actions that compensate for missing System Functionality</td>
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<td>2.5</td>
<td>Actions that compensate for the Omissions of other Clinicians</td>
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3. Factors that impair using the whiteboard

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<td>Patient Care conflicts with attending Computer Systems</td>
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<td>3.2</td>
<td>Conflicts between Departments</td>
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4. Attitudes to organizational Change

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<td>4.1</td>
<td>Resistance to Change</td>
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<td>4.2</td>
<td>No Way Back to the old Paper System</td>
</tr>
</tbody>
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Table 1 - List of Categories and Subcategories found in the Affinity Diagramming Process

**Understanding Filters**

The following explanation of the principles underlying the layout of the EW display were provided to the author by the EW system administrator on the first observation day and are repeated here to provide readers with a better understanding of the results described in Section 6. Users log onto the EW system using an electronic chip embedded in an electronic key device, which operates on the large screen displays when held close to the bottom edge of the screen. Users are then logged onto the system with their specific identity, as provided by the electronic key. Ordinary computer devices have a different logon process. There are three main groups of whiteboards (which is what users call the EW system display) which are each produced by a particular filter. The three main groups of filters are:

- Departments
- Operating Theater
- Out-patient Clinics (Ambulatories)

These whiteboards or filters are simply copies of the same original filter, which have been modified in various ways to better fit the needs of the respective groups. A decision was made during the development phase to make sure that all filters are as identical as possible, equipped with shared functions and shared information following a common pattern. On the other hand each specific type of whiteboard (or filter) should only contain the minimum of information necessary for its particular function and needs in order to reduce the number of columns that disappear over to the right side of the screen as screen space is limited. The significance of this information is that all wards or departments have the same basic set up of columns, as the majority of departments belong neither to the operating theater or ambulatories.
6.2.1. New Collaborative and Communicative Practices and Processes

A number of new work practices and processes, supported by the EW system after its implementation in December 2012, relate to intra-departmental and inter-departmental collaboration and communication between clinicians and staff.

6.2.1.1 Hospital Admissions Process

The registration and admission of patients to hospital is a process or procedure supported by the EW system. The previous admissions process was simply to register a patient on physical arrival at the hospital, at which time the patient, the referring general practitioner, family member or emergency service personnel would provide information as required by admissions personnel, which would then be entered into the hospital’s administrative and medical systems. The data entry process required patients or other persons involved in the admissions process to reiterate information, which had already been provided to the hospital at earlier stages of the process, for example at the point in time when the original telephone contact was established with the hospital and when it was determined that the patient’s condition required hospitalization.

The new, current procedure for admissions to hospital is a process that always originates with a telephone call to an emergency number in the emergency department, as patients’ trajectory through the hospital now originates in the ED. A secretary or nurse will take the name and social security number of a prospective patient before the patient, or other person representing the patient, consults a clinician with respect to the necessity of admitting the patient to the hospital. If a decision is made to admit the patient to hospital, the patient’s data will be entered into the EW system. Therefore, when a patient physically arrives at hospital then he or she will already be present in the EW system as an upcoming patient, and the initial registration of the patient may be completed in short order. Depending on the seriousness of the patient’s condition or complaint he or she will either be asked to wait in the reception room until further notice, or if in acute need of attention will be immediately taken into a clinical examination.

When a patient is admitted to hospital, his or her data will need to be entered into other hospital systems such as the electronic patient record (OPUS). As the patient has already been registered in the EW system, personnel will be able to copy information from the EW system to the electronic patient record and other systems, when required, instead of recording information from scratch\(^5\). Manually transferring data is still necessary because the hospital medical systems are not integrated with respect to every type of patient data. Whilst this process is repetitive, it is nonetheless time-saving in comparison with the previous registration and admissions procedure, as the EW system’s patient data is now available to clinicians immediately upon the patient’s arrival at the hospital, and when passing the patient to other departments in the hospital. This gives the process an inter-departmental dimension.

\(^5\) *Manually copy* means that the nurse or secretary uses the copy/paste computer function to copy data from one system to another.
6.2.1.2 Scheduling Surgical Operations

The function supporting scheduling of operations is a function that was added to the EW system as a result of further iterations of the system development cycle, which took place after the EW system originally was launched. The extending of the EW system with the operation scheduling function means that the state of the EW system was changed from what prevailed at the time of the original launch of the system. Using the EW system to support the process of scheduling surgical operation was an idea to expand the use of the EW for supporting coordination of work that was initiated by the operation theatre department (This department is actually a sub-department of the anesthesia department). The development and implementation of support for scheduling operation was approved by the hospital management and the practical work was carried out by the implementation group consisting of participants from the operating theatre department, Healthcare Region Zealand and the IT-vendor Imatis.6

The previous, manual procedure was a procedure in which the department that wished to schedule an operation filled out an operation request form on a pre-formatted A4 paper form with the necessary information, and faxed the paper request to a designated multifunction printer located at the remote end of a corridor in the operation theatre department. Operation theatre nurses were assigned the task of continuously monitoring the multifunction printer to intercept incoming fax requests as soon as they appeared, and subsequently arranging the operation at such time and place as matched available resources and the urgency of the patient’s medical situation. The previous, manual procedure typically required multiple phone calls between the operating theatre and the requesting department, and took a great deal of time and attention before an operation could be successfully scheduled. Patients were occasionally forgotten and days could pass before it was discovered that they were scheduled for an operation that had not been performed.

The new and current procedure is one that supports coordination of work, in which the department that wishes to schedule a surgical operation requests the operation in the “Boarding Pass” column of patient’s row in the user interface of the EW. Activating the “Boarding Pass” column causes the patient’s data to become visible to clinicians in the operating theatre department and enables them to become aware of the patient and the requested operation. No phone call or fax request will be necessary for scheduling an operation, indeed hospital policy prescribes this procedure as the only permissible way to request the scheduling of an operation.

The exception to this rule is when scheduling operations that need to be performed during off hours, as described in more detail in Section 6.2.2.3. Actions that compensate for missing System Functionality. The “Boarding Pass” column contains a subset of preparatory steps that must be completed before a patient can be transported to the operating theatre department to undergo an operation. The requesting department is responsible for executing these seven steps, the completion status of which is visible on the operating theatre department’s EW system. Clinicians in the operating theatre are able to keep abreast of how far each patient

6 The role of the implementation group in the original implementation project is explained in Section 3.3. Case Description.
is coming along with respect to be ready for his or her operation by keeping an eye on the EW system. When the last step of the “Boarding Pass” has been marked as completed, the patient is ready for his or her operation and may be transported to the operating theatre department as soon as the operating theatre can find an available time slot. The patient remains in his or her department until the operating theatre is ready to start operating on the patient, thus avoiding being unnecessarily transported to the operating theatre – or being forgotten.

Whilst the current procedure has in principle eliminated the need for telephoning and faxing requests to the operating floor to schedule surgical operations, the reality of the situation is that clinicians occasionally need to communicate by telephone because the new, current procedure does not function with 100% reliability. Clinicians on both sides of a request for scheduling an operation, may have reason to suspect that a request visible in the EW interface is not necessarily accurately represented. For example, clinicians suspicious that a patient shown in the EW system as not ready to be operated on, is actually ready to be operated on, or that an operation shown in the EW system as being in progress, is actually completed, contact their counterparts on the opposite side of the scheduling request to verify patients’ information and status. This means that verbal negotiation and telephone contact is still required to facilitate the coordination and scheduling of operations, although only as a way of double-checking the information displayed by the EW system.

6.2.1.3. Transferring Patients between Departments

The EW system has been extended and configured so that it now supports transferring patients between departments, however the new process has apparently not been authorized organizationally but is used in parallel with the old, manual process, which is still in force. The current, manual process depends on clinicians who negotiate transferring patients between departments either in person or over the telephone. The great majority of patient transfers originate in the ED, as this department is usually the starting point of a patient’s trajectory through the hospital; the ED typically initiates the transfer agreement process as it is hospital policy to limit the duration patients’ stay in the EM to 48 hours. Patients must either be transferred to an appropriate specialty department for further treatment or released within 48 hours of registration.

The EW system supports the new transfer work process for transferring patients with a column called “Next Stop”. When a department that wishes to transfer a patient to another department, and the two departments involved in the transfer are in agreement, the transferring department changes the setting of the “Next Stop” to “Marked to transfer”, indicating that the patient will soon be transferred to another department. Changing this setting has the effect of making the affected patient visible on the receiving department’s EW system, which enables the recipient department to anticipate imminent patient transfers. When hospital porters begin to actually transport the patient to the recipient department, the transferring department changes the setting of “Next Stop” to “Move”, which has the effect of removing the patient from the transferring department’s EW system, leaving the patient visible in the recipient department’s EW system alone.

As previously stated both work processes are in use at the present as the organizational implementation awaits a final agreement between the interested parties, who are the hospital management and the senior
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physicians. Replacing the old manual process of transfer with the new process supported by the EW system is awaiting their final approval and when that takes place, the new process becomes “official” policy.

6.2.2. Flexibility in Work Practices

A dictionary definition of flexibility is “(1) the quality of bending easily without breaking, (2) the ability to be easily modified (3) willingness to change or compromise”. Clinicians sometimes make statements regarding the way the whiteboard affects the flexibility of the work practices and procedures that have been included in the EW system. All of the above definitions of flexibility have some relevance in this context and could in essence be summarized in a single statement as an attribute that describes the degree to which a work process is able to adapt to changing circumstances without losing its fundamental form and function.

6.2.2.1. Increased Flexibility in Work Practices

This section deals with perceptions by clinicians that the whiteboard has improved efficiency and flexibility in work practices. Collaborating between departments with respect to scheduling surgical operations has become easier for clinicians than before support for this process was implemented in the EW system. The new, current procedure for scheduling operations has largely eliminated the old need for manually negotiating the scheduling of an operation, enabling time savings for both the department requesting the surgical operation as well the operating theatre department itself. The new procedure has the extra advantage of eliminating the need for nurses in the operating theatre department to watch the department fax machine continuous to manually capture incoming fax requests for surgical operations. Requests now appear directly on the interface of the EW system in the operating department, saving more time for clinicians in both the requesting department and on the operating floor. The EW system in the requesting department displays information that identifies which patients are in the operation queue, even though these patients will be present in their own department. Physicians supervising department activities use the EW to prep for staff meetings and to provide a bird’s eye view of the situation in the department.

6.2.2.2. Less Flexibility in Work Practices

This section deals with perceptions by clinicians that the whiteboard has reduced efficiency and flexibility in work practices. The perception of the EW system having introduced a degree of diminished flexibility and efficiency in work practices emanates directly from statements made by clinicians. Some clinicians say that they still need to use paper documents to obtain an overview of a department, as the EW system is inadequate for this purpose. Other clinicians state that the EW system has not replaced the telephone as the means of communication between departments, as even where the EW system supports communicating between departments and clinicians, this support is not sufficient to eliminate the need to use the telephone to be completely sure of what has actually been agreed upon between departments. Direct contact over the telephone is still the most flexible and efficient way to negotiate and coordinate work between departments.
Even though the EW system supports physicians signing-off blood work, this support is inefficient, as there is no consensus between departments as to what signing-off really means. It is therefore highly problematic to actually know whether blood work has been signed off or not. An extra disadvantage of not being able to sign-off blood work is that blood work icons tend to accumulate on the interface and reduce the overview that the interface of the EW was intended to provide to clinicians.

The predefined and preformatted terms used in the “Problem” column were appropriate for the ED, who participated directly in the original development process, however the terms are not a good fit for many of the other departments in the hospital. Clinicians in other departments must use extra time to delete and insert new terms in the “Problem” column when receiving patients from the ED.

Departments use the “Boarding Pass” column’s seven-step plan when preparing patients for a medical operation, however patients are often ready to be operated on without anyone being able to know this, because anesthesiologists usually delay checking off the “pre-medication for anesthesia” point in the seven-step plan in the “boarding column”. The reason for this delay is that anesthesiologists usually pre-medicate patients in their home departments before patients are transferred to the operation theatre department. When anesthesiologists treat patients in patients’ home department they will not normally have access to the EW system via computer screens in those departments, thus making it impossible to update patient status in the EW system on a running basis. Anesthesiologists are forced to wait with updating patients’ status with respect to premedication for anesthesia, until they are back in the anesthesia department, which means that it often takes hours before the true state of a patient appears in the EW system. In the meantime, patients who are ready to be sent to the operating theatre, remain waiting in their departments because their status in the operation theatre’s EW system does not reflect their real status, and it is therefore not apparent to anyone that they might be ready for surgery.

The EW system also lacks an option to indicate when anesthesia is unnecessary, which means that anesthesiologists are forced to check off the pre-medication for anesthesia check point as if the patient has been pre-medicated even though this is not the case. The reason for checking a false positive is that unless this option is checked off, the patient will never appear in the EW system as ready to be sent to the operation theatre. In cases where patients do not require anesthesia, clinicians must therefore remember to make a telephone call to the operation theatre to warn clinicians there of the anomalous situation. This telephone call is occasionally forgotten endangering patients health and safety. There have been occasions where patients have been sent to the operating theatre, without having been pre-medicated for anesthesia, because it had been decided that anesthesia was not required. But when such patients begin to suffer pain, and demand anesthesia, anesthesia cannot be applied as pre-medication is absent. In such cases the surgical operation must be either cancelled or emergency procedures initiated if the surgery is already in progress. The situation becomes highly dangerous for the patient if the telephone call warning the operating theatre of the missing pre-medication is forgotten.
6.2.2.3. Actions that compensate for missing System Functionality

When using the EW system, clinicians may run into impediments to the smooth functioning of the system, and will try to compensate for these impediments by developing workarounds. Nurses find that the data displayed on EW system interfaces is constantly changing as other clinicians continually update patients’ data. Patients’ status may be modified in such a way that a patient’s data instantaneously disappears from a filter view. While the EW system saves historical data in its database, historical data is apparently inaccessible for ordinary users without special administrative privileges. As any computer display is transient in nature, the view of data displayed in the EW system interface at any given moment will only be available for the moment. Nurses often keep a less transient record of whatever the EW system screen displays at any given time by printing a screen dump on paper, which serves as a physical record of the status of the EW system screen. Such printed records must be discarded at the end of a shift, but serve as a backup of the screen display in case there is a system failure or there is a need to recreate the display appearance as it was at a given point in time for any other reason.

Prior to the implementation of the EW system, medical secretaries in some departments, for example in the operation theatre department, would prepare for the shift by writing an agenda that was called “the program”, or “the program for the day”. The program was printed on an A4 paper form, containing a tabular, matrix-like list of patients and their data, with one line per patient. Each line contained relevant information concerning the patient, the treatment planned for that day, the name of the responsible surgeon or physician, and so on. The used programs would not be discarded at the end of the shift, but would be physically stored in a binder on a shelf at the end of a shift, and would henceforth function as an easily accessible record of the department’s activities on that particular date and shift. Lower-level clinicians say that the new, current practice of listing the patients on the day’s program provides them with just a name; all other information relating to patients must be reconstructed by physically searching through other medical systems, which requires extra time and effort. The information provided by the EW system for the day’s “program” is claimed to be inadequate in comparison to the information available via the paper system it replaced when operation theatre clinicians are preparing patients for the operating table.

The practice of creating and permanently storing “the program” for the day was phased out at the same time as the EW system was implemented. However, clinicians feel that the loss of this paper trail or record of the day’s activities weakens their ability to reference historical data regarding past activities. Clinicians’ current work practice is to reconstruct historical events by searching for information in other medical systems when in need of historical information about past shifts. The present work practice is time consuming and produces imperfect results, as such searches are highly dependent on the quality of clinicians’ recollections with respect to the identity of which patients were treated on a given date in the past.

The “Boarding Pass” function of the EW system has a seven-point checklist, which is used by a patient’s home department in preparing a patient for undergoing a medical operation. The Boarding pass is visible in
the operation theatre as well as the patient’s home department, so that both departments can see how the process of preparing a patient for an operation is progressing. However, the need for paper schemas has not gone away, as the sub-processes involved in preparing a patient for an operation have not been included in the “Boarding Pass” function.

Any department in the hospital may schedule a medical operation through the EW system and each individual operation will have its own particular degree of urgency and should be prioritized in accordance with its degree of urgency to protect patients’ health and safety. The EW system lacks any way of visibly prioritizing operations to show the urgency with which operations must be handled. In order to create a proper prioritization of scheduled operations, nurses in the operating theatre department are forced to call the home departments of all patients listed on the EW for an operation that day to get an idea of the urgency of the listed operations, unless the department requesting an operation already has given this information. This part of the overall operation scheduling process remains therefore a manual procedure.

The operating theatre department seeks to perform as many surgical operations during the day shift as possible, except in circumstances, in which a patient’s health and safety would be severely jeopardized by postponing the operation. The operating theatre department’s staff is minimized during the evening and night shifts, and staff is expected to sleep or rest in one of the staff rooms, while waiting for possible medical emergencies that need immediate action. In such circumstances, clinicians cannot keep expected to continually watch the EW system for the sudden scheduling of urgent operations. For this reason, the practice of manually coordinating surgical operations with the operating theatre department is still in force in case of emergencies.

**6.2.2.4. Actions that compensate for the Omissions of other Clinicians.**

There seems to be an understanding amongst clinicians that physicians expect nurses to perform any of their tasks that a nurse is actually capable of performing, which applies inter alia to updating the EW system. The officially mandated procedure for signing-off blood work in the EW system prescribes that only physicians have the power to do so, however nurses often complete this task when requested to do so by physicians.

Because senior clinicians i.e. physicians do not update patient information in the EW system very much, nurses and secretaries need to spend time completing entries and reconstructing data in the EW system. This involves searching for relevant data in other medical systems than the EW system, and requesting information from physicians themselves.

At the end of a shift, surgeons may, through no fault of their own, have not been able to perform every single operation that was scheduled to have taken place at that shift. Surgeons often fail to indicate on the EW system, which is the only system that shows which operations have been scheduled to be performed, what operations weren’t performed during the outgoing shift, and which need to be the first operations to be performed in the following shift. This means that surgical nurses on the next shift need to reconstruct the order of priority of operations by searching the records of other medical systems as well as in the EW system itself to resolve the proper sequence of operations in the upcoming shift.
Another example is where an operation that has been scheduled and is visible on the operation theatre’s EW system display may show that the Boarding Pass’s seven-step checkpoints have not been completed. One or two checkpoints on the seven-point check list that need to be completed before transporting the patient to the operation theatre to perform surgery could be incomplete. The problem could be that as the patient’s home department sometimes neglects to update the patient’s data to its actual, current state, the “Boarding Pass” seven-point checklist might actually have been completed, but no one can know that the patient is actually ready to be sent to the operating theatre. Lower-level clinicians in the operation theatre know this is a possibility and will regularly contact a waiting patient’s home department by telephone to check whether a patient is actually ready to be sent up, even though it does not seem to be the case from looking at the EW system interface.

The EW system has two columns showing which clinicians have primary responsibility for a patient during a shift. There is one column for the responsible physician and one column for the responsible nurse. These columns are often empty or contain outdated information because clinicians omit or forget to set themselves up on their patients at the beginning of a shift. Some nurses will update a patient’s data with respect to themselves as well as the patient’s physician for the shift, but this is not done consistently, and these columns for that reason are not a reliable source of information about who on a given shift has the responsibility for which patients.

6.2.3. Factors that impair Use of the Whiteboard

This section describes situations in which clinicians meet barriers and factors that impede the efficient use of the EW system, such as when viewing or updating the EW system inhibits clinicians in paying attention to patients, or when departments have conflicting requirements for the smooth functioning of the same functions or procedures or when the EW system itself fails to perform or performs especially slowly.

6.2.3.1 Patient Care contra using Computer Systems.

A recurring theme is the tension or exasperation that clinicians feel when confronted with two conflicting demands: (a) the demand for providing patients with care and treatment and (b) the demand for providing healthcare systems with a continuous feed of data regarding the progress of ongoing healthcare work processes. There is that exasperated feeling that there is no point in feeding the machine with data, when feeding the machine takes time away from the real world task of treating and caring for patients. There is a sense that “doing the job you were hired to do” conflicts with the need to deal with computers. In the operating theatre, the computers that clinicians need to feed with data are located against the walls of operating rooms so that their monitors are facing inwards. This means that clinicians literally turn their backs to their patients who are on the operating table in order to pay attention to computer systems, an action which clinicians find negatively symbolic and extremely uncomfortable. A widespread attitude regarding the dilemma of patient care versus computing is that clinicians’ primary responsibility is to care for patients and not computer systems,
and that the challenge many clinicians face in modern hospitals is keeping in mind that patients are what matters and not the formalities of work processes. Some clinicians feel that the constant use of computers in hospitals is leading to a general loss of the clinical feel for the condition of patients.

With respect to the EW system, a common attitude to resolving the conflict between attending to patient care versus computer systems is to give the EW system a lower priority than caring for patients. The task of registering data in the EW system is given a lower priority than other clinical activities with the result that EW system data is frequently inaccurate and outdated, and does not show the real status of patient care in departments.

6.2.3.2. Conflicts between Departments

One of the purposes of the EW system is to facilitate communication and collaboration between departments; there are however, a number of areas of conflict between departments with respect to shared attributes of the EW system. One of the major sources of conflict is the “Problem” column, which was originally developed by the emergency department to fit its specific needs and specifications. When a patient is in the pre-hospital stage, the initial contact with the hospital is through a practicing physician, the emergency services or the patient either him or herself. At this point in the patient flow, a final diagnosis is usually not available. The emergency department’s practice is to describe the patient’s medical problem in the “problem” column selecting one of several predefined options to describe the problem. Previously a “free text” option was available, which clinicians in the emergency department used to describe the patient’s medical issue as far as possible in ordinary words and/or the names of symptoms such as ‘stomach pain’, ‘chest pain’, ‘bleeding aperture’, etc. In conjunction with implementing the whiteboard system in the remaining departments of the hospital, the free text option was removed, much to the dissatisfaction of clinicians in the emergency department. The cause of their dissatisfaction was the feeling that losing ‘their’ free text option for the “Problem” column was an impairment of their work practice.

Another conflict is connected with the set of predefined descriptive terms used in the “Problem” column, were developed and refined in a developmental stage where the EDs were the only departments participating in the project. The predefined terms became naturally aligned with the wishes and needs provided by ED representatives to EW system designers. The current status of the EW system is that the system is no longer a developmental project restricted to certain departments but is a hospital wide system used by all departments, which means that the predefined terms for the “Problem column are also used by all departments. Departments other than the ED have found that the predefined terms available for the “Problem” column either are irrelevant or inadequate for their purposes. The conflict that has arisen between the ED and the other departments is that as the ED is satisfied with the current set of predefined terms they reject the idea of reconciling their needs and wishes with those of the other departments in order to reconfigure the set of predefined terms for the “Problem” column. Because of this lack of consensus between departments with respect to the use and meaning of medical
terms, clinicians are forced to change the content of the “Problem” column when a patient is transferred from one department as the predefined terms don’t always fit very well.

Different departments having differing practices with respect to signing off on blood work affects the overview provided by the EW system interface in the following way. As the intensive care department produces relatively many blood samples, these samples have a tendency to clutter up the EW system interface. Figure 3 (p. 15 above) shows a display of patients in which the first and last rows show patients having relatively many icons in the “Plan” column. These icons represent blood work that hasn’t been signed off, and expand the patient’s row vertically. There are often patients for whom many more blood work icons are visible than shown by this example and which consume even more screen space and the more screen space an individual patient occupies on the EW system’s interface, the less efficient the EW’s overview becomes. As different departments differ in their view of how fast blood work needs to disappear from the screen, a conflict has emerged between departments with respect to the representation of blood work in the EW system. The task of reconciling the work practices with respect to signing off blood work is an outstanding issue.

“Triage” has become a central element in the ED’s diagnostic practice and the EW system has a column called “Triage”, which contains a set of predefined terms for indicating the status and progress of finding a diagnosis. While the “Triage” column is a frequently used column in ED practice it is largely unknown in other departments. Until the EW system was implemented in all departments, the “Triage” column was physically placed close to the center of the viewport, but when implementing the EW system in all departments, the implementation group decided to place the “Triage” column to the far right side of the EW display, making it difficult for users to locate. The apparent reasoning for moving the position of the “Triage” column is that the ED is the only department that uses this columns and as it takes up valuable visible space on the screen, it was decided to move it for the benefit of the departments that didn’t use it. Clinicians in the ED are disappointed that a column they use so intensively and with which they were so satisfied has been concealed because they are alone in using it.

Changing filters - Some clinicians have high-level privileges that permit them to log onto large display screens outside their home departments; when they do so, they usually change the view or filter to one that suits their purposes. Clinicians typically leave the EW system interface as it is, without restoring it to its original state when finished with their tasks. The effect of this practice is that the department’s large display screen often has a logged-on user and a view that is inappropriate for that department’s clinicians and when local clinicians wish to use the large display screen, they are forced to perform a log off / log on operation to change the display back to a more appropriate view or filter. The repetitious changing of users and views on a department’s main overview display screen frustrates clinicians and wastes their time. Some clinicians state that this problem is such a source of frustration that prefer walking away from a large display screen when they see that a “wrong” user is logged on, rather than go through the procedure of changing the user and filter back to what it should be. This means that the large screens are often useless for local clinicians for extended
periods of time until someone finally takes the time to change the view to one that fits the needs of the department in which it is located

6.2.4. Attitudes to Organizational Change
While there is clearly signs of resistance to change in the organization with respect to the EW system, there are also signs of acceptance.

6.2.4.1. Resistance to Change
Clinicians with a higher rank in the hospital have a clear tendency to resist using the EW system; they call the EW system a “time-eater” and/or a “waste of time”. There is a tendency to resist the task of updating the EW’s patient information with respect to one’s own activities and status. This tendency shows up in several ways: for example clinicians, especially senior clinicians, ‘forget’ to update information with regard to the performing of their tasks. Some senior clinicians will on occasion order lower level clinicians to update information on their behalf, but sometimes not, in the latter case the information will go missing. The work practice of signing off on blood work, which requires a physician’s participation, is often deferred or neglected, resulting in a EW system interface cluttered with old blood work results, degrading the overview effect the EW system was intended to provide.

The lack of updated information, which stems from this type of resistance, causes patient information in the EW system to not accurately and consistently reflect patients’ real condition or status. The lack of updated information leads to several effects, for example, patients are often transferred to other departments with inaccurate and misleading information about their status and condition. Knowing that this is often the case, nurses and medical secretaries are often in doubt as to whether information in the EW system is up to date, and will therefore double check most of the patient’s information. Consequently lower-level clinicians are burdened with a greater work load than would have been necessary if senior clinicians were better at keeping the EW system updated.

Some clinicians state that using or updating the EW system has a low priority for them, or that is not used very much, or that it has a lower priority than other medical computer systems with respect to the amount of time and effort expended by them to get their data up to date. The lack of updated and valid data and lesser use of the EW system is self-reinforcing, as the impression that the EW system is inaccurate or misleading reduces the motivation to contribute data to the system, which in turn leads to a lack of the system being updated, which in turn leads to an increasing sense of the system being inaccurate and misleading.

There is some confusion as to who is responsible for what, as some (younger) physicians actually do contribute data to the EW system, but not consistently. Knowing this, nurses and medical secretaries are skeptical about the completeness of patient’s data and therefore feel compelled to validate patient data at critical junctures in the patient’s trajectory by double checking (as well as cross checking to the EPR) much of
the information contained by the system. This leads to lower-level clinicians performing the tedious task of verifying data already contained in the system.

Different departments use the EW system to different extents; certain departments such as the operating theatre department and the EDs use the EW system to a high degree while other departments, for example the intensive care department and the ambulatory departments use it very little or not at all. Clinicians in the intensive care department say that for that reason “there is never any panic” when the EW system “is down” with a blank or frozen screen. Some departments use the EW system to such a small extent that clinicians may work a whole shift without even noticing whether the system is running or not.

6.2.4.2. “No Way Back” to the old Paper System.

The EW system was gradually implemented in stages; the initial stage implemented the EW system in the EDs, the next stage implemented the system in all other departments of the hospital, and then the healthcare region. The operating theatre department pioneered the use of the EW system for supporting communicating and collaborating between the hospital’s departments, by suggesting the implementation of support for scheduling surgical operations. The department participated in the subsequent process of designing and developing support for the process of scheduling surgical operations, which eliminated the need for the old manual scheduling process. Other processes that are now supported by the EW system are ordering ergotherapy and physiotherapy as well as an experimental version of transferring patients between departments.

Clinicians in the ED and operating theatre departments have used the EW system for a longer time span than the rest of the organization, and their clinicians say that the increasing use of information systems in healthcare is inevitable. The EW system is now ingrained in their work practices to such an extent that going back to the way things were before the implementation of the EW system would require a total redesign of work processes in those departments. Clinicians say that the EW system has become the “nerve system” of their departments and “going back” would be “impossible” or that “no one wants to go back”. Although the EW system experienced a difficult start, things seem to be improving, and the anesthesia department and emergency departments are clearly committed to using and extending the use of the system. Clinicians in these departments assume that resistance to using the system will gradually diminish as clinicians in the other departments of the hospital become more accustomed to using the system. Another factor that tends to reduce over-all resistance to the EW system is staff turnover, for the reason that as older members of staff gradually leave the hospital for other jobs or simply retire, replacement staff will be met with the requirement to use the EW system as a natural part of their job descriptions, and will have very little reason to resist using a pre-existing system. For new staff, using the EW system will not feel like a change in work practice, as they will never have known anything else while handling work processes.
6.3. Analyzing the empirical Data using Diagnostic Mapping

The following section analyses the empirical data using the Diagnostic Mapping techniques described in Section 5.3. Qualitative Data Analysis Methods. As previously mentioned in Section 5.3.2. Potential weaknesses with the use of the Technique, the Diagnostic Mapping technique is a collective analytical technique which is being used in this study by this author working alone.

As described in the previous section, an analysis using the Diagnostic Diagramming technique revealed the existence of several problematic situations or issues in connection with using the EW system, the results of this analysis are listed in Table 1 on p.50. To put together a concrete foundation for specifying and designing relevant changes to the EW system, Diagnostic Mapping is a technique that can provide a way of identifying candidate problems and solutions for the problematic situations revealed by an Affinity Diagramming analysis.

Using the Diagnostic Mapping technique (principles explained in Section 5.3.2. Diagnostic Mapping) this step of the analysis began by reviewing the analytic results of the affinity diagramming activities to attempt to identify specific candidate problems. The candidate problems which emerged from this step were all inscribed on separate adhesive notes forming a preliminary list of candidate problems, which would then be subjected to more detailed analysis. The predicate preliminary emphasizes the candidate nature of the candidate problems as any given problem might end up being considered of greater or lesser importance, or considered of no significance at all, or might be reclassified as something other than a problem, perhaps a cause or consequence.

Diagnostic maps were constructed by taking white poster sheets and dividing them into rows and squares with a black marker, similar to the pattern seen in Figure 9, p.37 above. Columns were given the labels problems, causes, consequences and ideas for solutions. Each of the adhesive notes inscribed with a candidate problem was fixed to the problem column of a diagnostic map. Seven separate diagnostic maps were made as the initial analysis had identified seven problematic situations. The next step was to take each diagnostic map, and pose the question: why or what might be causing the problem and then ask the question what were the consequences of the specific problem. The intent of this step was to extract the essence of the problematic situation based on the same written material as produced during the affinity diagramming process. Each cause and consequence was recorded on an adhesive note and then fixed in the appropriate column of its respective diagnostic map. Although it had been hoped that some of the adhesive notes produced during the affinity diagramming could have been lifted directly over to diagnostic maps, doing so was not possible, and therefore all cause and consequences notes had to be produced from scratch. The diagnostic maps were completed by writing potential solutions to the problematic situation on adhesive notes, which were attached to the ideas of solutions column of the appropriate diagnostic map. The suggested ideas had either been generated cognitively by imagining possible ways of solving or alleviating the problem, or by borrowing or adopting ideas suggested by interviewees in the original interviews. The process was not entirely straightforward, as each diagnostic
map needed to be reviewed and examined in an iterative process over a time span of several days. The problems which became the subject of diagnostic maps were as follows, see Table 2 below:

<table>
<thead>
<tr>
<th>Identified Problems</th>
<th>Causes</th>
<th>Consequences</th>
<th>Ideas for Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3.1 - Dissatisfaction with predefined terms</td>
<td>Predefined terms created by one department</td>
<td>Inadequate description of patients’ “problem”</td>
<td>Redefine terms with input from all departments</td>
</tr>
<tr>
<td>6.3.2 – ED clinicians cannot properly describe problems</td>
<td>Option to describe “problem” in words removed.</td>
<td>Inadequate description of patients’ “problem”</td>
<td>Re-introduce option to describe “problem” in words</td>
</tr>
<tr>
<td>6.3.3 – Impossible for clinicians to see when anesthesia is unneeded.</td>
<td>The “Boarding Pass” 7 step process has no option for unneeded anesthesia.</td>
<td>A patient who suddenly needs anesthesia may not be pre-medicated for it.</td>
<td>“Boarding Pass” should have an option to reflect when anesthesia is unneeded</td>
</tr>
<tr>
<td>6.3.4 – Operating theatre does not know how urgent an operation is</td>
<td>There is no option for describing the urgency of an operation</td>
<td>Clinicians must discuss prioritization on the telephone or not know the urgency of an op.</td>
<td>Create a new visible “priority” option to communicate the priority of an operation.</td>
</tr>
<tr>
<td>6.3.5 – Bloodwork clogs up EW display obstructing EW overview.</td>
<td>Different departments have different practices for removing samples from EW display</td>
<td>EW overview is degraded as individual patients take up disproportionate share of EW display space</td>
<td>Departments need to agree about removal criteria. Or create a “+” to “unfold” a line if there are many samples</td>
</tr>
<tr>
<td>6.3.6 - Operations are delayed by lack of patient status information</td>
<td>Anesthesiologists wait with updating “Boarding Pass” until back in office</td>
<td>Patients’ “Boarding Pass” information does not reflect that a patient may be ready for operation</td>
<td>Anesthesiologists could take mobile computer devices on their rounds or communicate with assistants over the telephone.</td>
</tr>
<tr>
<td>6.3.7 – Higher-Level clinicians (i.e. Physicians) avoid updating EW system.</td>
<td>Basically unknown, but may be because of changes in protocol that conflict with traditional work roles</td>
<td>Patients’ status information is incomplete and inconsistent. Lower level clinicians must double check information content of EW system</td>
<td>Inventions where opinion leaders champion the EW system in relation to peer group. Or create new jobs where neglected work activities is key content of new job descriptions.</td>
</tr>
</tbody>
</table>

Table 2- List of Problematic situations analyzed using Diagnostic Mapping

The individual diagnostic maps will be displayed and explained in the following section.

### 6.3.1 Conflicts between Departments with respect to predefined Terms

*Problem:* Many departments are dissatisfied with and frustrated by the pre-defined terms available in the “Problem Column.”
Cause: ED was the only department involved in the initial project, and was therefore able to define terms for the “problem column” exclusively in terms of what was beneficial for the ED’s use of the EW system. The ED is the start of most patients’ trajectory in the hospital. Patients are usually released or transferred to another department within 48 hours of arrival. ED decides therefore how to describe patients’ initial condition.

Consequences: Departments receiving patients from ED need to change most select terms in the “Problem Column” as the terms used by ED are not useful for other departments. Furthermore, the pre-defined terms available as options in the column are not adequate for other departments’ purposes. When users are forced to deal with replacing inappropriate terms, valuable time is wasted and frustration arises.

Solutions: This is a management issue. ED refuses to negotiate with other parties with an interest in this issue with respect to new definitions for the “problem column”. The intransigence shown by the ED impairs the utility of the “problem column” for the whole hospital. Management needs to make a high-level decision to harmonize the vocabulary available in the “Problem Column”.

6.3.2 Conflicts between Departments with respect to “Free text”

Problem: ED clinicians are dissatisfied and frustrated by the lack of a “free text” option in the “problem column”.

Cause: The “free text” column, which was originally available in the EW system, was removed by request of the IT department because the IT department considers free text data in the “problem column”, to be problematic. The IT department apparently prefers having a limited number of predetermined phrases in data fields.

Consequences: ED clinicians previously used the free text option of the “Problem Column” to describe the problem in words, a practice which they, as clinicians, found to be extremely useful as many patients have no diagnosis when entering the hospital. Now ED Clinicians are compelled to use predefined terms that they feel describe patients’ condition very poorly.

Solutions: The “Problem Column” should be subdivided in two columns. One column in which ED clinicians are allowed to describe patients’ condition on arrival in free text. Another column in which predefined terms can be selected from a number of options. These predefined terms should be selected by mutual consent between departments to ensure a better overall fit.

6.3.3 Incomplete Information with respect to scheduling Operations - Anesthesia

Problem: As there is no way of indicating that a patient does not need anesthesia prior to an operation, patients who do not need anesthesia, are falsely shown as ready for anesthesia.

Cause: Not every patient needs to be anesthetized in connection with an operation. However, as the boarding process supported by the EW system requires patients to be pre-medicated for anesthesia, clinicians mark patients as pre-medicated when actually not, in order to complete the 7 step “Boarding Pass”, as the
“Boarding Pass” column lacks an option to indicate that a patient has not been pre-meditated for anesthesia and does not need to be.

**Consequences:** A patient, who is marked as having been pre-meditated, should not be anesthetized. In the event that a patient before or during an operation unexpectedly needs anesthesia, the “Boarding Pass” will not necessarily reflect the true condition of a patient with respect to pre-medication. Operating theatre nurses will need to use extra time to confirm patient status over the telephone. Nurses sometimes forget about this contingency, which puts patients at risk.

**Solutions:** This is mainly a technical issue. The “Boarding Pass” column should allow for indicating that a patient is or is not pre-meditated. This would eliminate the risk of having a patient receiving anesthesia when not properly prepared and pre-meditated. It also eliminates the need for nurses to confer with a patient’s home department with respect to this issue.

### 6.3.4 Incomplete Information with respect to scheduling Operations – no prioritizing

**Problem:** Operating theatre nurses have no way of knowing how urgent a particular scheduled operation is considered to be by the department requesting the operation.

**Cause:** The EW system has no option for allowing the scheduling or requesting department to indicate to the operating theatre the urgency or priority of a scheduled operation.

**Consequences:** A newly scheduled operation will immediately become visible in the operation theatre’s EW system upon scheduling normally on a first-in first-out basis. However, as there is no way for the operating theatre to see the urgency of the operation in the EW system, the requesting department nurses will need to telephone the operation theatre to supply this information. This information cannot be communicated via the EW system.

**Solution:** This is a design issue. Creating a “Priority Column” would provide the requesting or scheduling department with the ability to put a visible priority on patients scheduled for operating without the necessity of telephoning the operating theatre. The operating theatre would have a better awareness of the nature and urgency of the upcoming patient load.

### 6.3.5 Conflict between Departments regarding Bloodwork impairs Patient Overview

**Problem:** Clinicians lose their overview of patients in the EW system because of patients with excessive numbers of visible blood samples, who clog up the EW display.

**Cause:** Different departments use blood work/samples for different reasons and will “check them off” or “sign them off” as having been “seen” using different criteria. The intensive care department has patients “on behalf” of other departments in order to stabilize their condition, until it is safe to send them back to their home department. The intensive care department takes many more blood samples than other departments but
has a differing work practice with respect to “signing off” bloodwork, as they have many samples that may be deleted quite rapidly. Other departments like to keep bloodwork visible for extended periods, but have fewer of them.

**Consequences:** As the “home” department of patients that are being stabilized in the intensive care department are very slow to “sign” bloodwork “off”, “unseen” blood accumulate on the EW display, causing the patient’s “row” in the EW display to become ever higher, crowding out other patients from view. This degrades the quality of the EW system’s overview. In order to see all patients, clinicians must “page” the EW display up and down, causing frustration and dissatisfaction with the EW system. Patients “hidden” from view may be forgotten which may put them at risk.

**Solution:** The issue is related to protocol. Departments each have their own work practice with respect to handling bloodwork. Inter-departmental collaboration with respect to bloodwork could improve if departments could successfully negotiate a common protocol for handling the “signing off” of bloodwork. A negotiation of this type may require the mediation of a powerful third party to be a success as most departments seem to have conflicting viewpoints with respect to this issue. In the present situation, few departments are willing to make concessions to accommodate other departments, making it difficult to arrive at a solution. A purely technical approach would be to modify the interface so that all rows have the same height, and make it possible for users to notice if there are more samples in the row than are visible at one time. Allow the option to “unfold” the row and display all data, by clicking a “+” link or something similar to that.

### 6.3.6 Scheduled operations are delayed because anesthesiologists postpone updating EW

**Problem:** Scheduled Surgical operations are delayed when anesthesiologists postpone updating patients’ status

**Cause:** Patients who are scheduled to be operated must stay in their departments until ready. These patients cannot be called up to the operation theatre until all seven steps in the “Boarding Pass” procedure have been completed including pre-medications for anesthesia. Anesthesiologists actually visit their patients in whatever department happen to be residing in order to administer pre-medications for anesthesia. When on their rounds throughout the hospital, anesthesiologists have scarce opportunity to access the EW system in a convenient fashion and therefore usually wait with updating patients’ “Boarding Pass” status until they have returned to their offices and can access the EW system from their own computers.

**Consequences:** This practice delays status updates for hours at a time. A patient cannot be called up to the operating theatre unless all 7 Boarding Pass steps are completed, therefore some patients may actually be ready to be called up after having been pre-medicating by an anesthesiologist, but as their “Boarding Pass” status does not reflect this actual status these patients will remain waiting in their departments. Therefore the situation often arises that while patients are ready to be called up, and surgeons are ready to perform a scheduled operation, nothing takes place, wasting hospital time and resources.
Supporting Hospital inter-departmental Communication and Coordination of Work with Electronic Whiteboards

Solution: This may be called an “access to EW system” issue. Anesthesiologists do not feel capable of physically accessing the EW system while doing their rounds. To reliably access the EW system, they need other ways of physically accessing the EW than borrowing random computer devices in the departments they visit. Providing anesthesiologists with tablet computers, which could be carried on their rounds, could provide anesthesiologists with a convenient means of updating the EW in a timely fashion, thus avoiding unnecessarily delaying surgical operations. A solution could also be providing anesthesiologists with assistants for this task, who could follow anesthesiologist on their rounds and update the EW system in real time, alternatively be contacted via telephone or SMS for the same purpose.

6.3.7 Higher-level Clinicians i.e. Physicians avoid contributing data to the EW system

Problem: Higher-level clinicians i.e. physicians generally avoid updating the EW system with respect to patients information and status and their own as well.

Cause: Physicians have given no reasons for this resistance, but the reason might be that they have traditionally used secretaries and nurses to perform as many tasks as possible especially administrative and logistical tasks. Physicians were absorbed by medical issues and would update patients’ medical records by dictating information to their medical secretaries, who would then do the actual recording in the patient records. Lower level physicians, nurses, secretaries, did all practical work. The introduction of the EW system has apparently changed this protocol, and physicians are now expected to update the EW system, a task they avoid or perform inconsistently.

Consequences: Multiple consequences occur because of the above problem:

- Much information is completely missing from the EW system
- Information may be entered into the system in an untimely manner, i.e. where anesthesiologists postpone updating pre-medication info until returning to their offices.
- Information in the EW system is incomplete as some physicians update the system inconsistently.
- Medical secretaries use much time in reviewing EW system data and attempting to correct or/and reconstruct EW data so that information in the EW system more correctly reflect patients’ actual status than otherwise would have been the case.

Solutions: Protocol has changed, but physicians may either not have been aware of the change EW system would bring or disagree with the new protocol. Seen as an innovation acceptance issue, a solution would be to let respected and influential clinicians (opinion leaders (Rogers, 2003)) champion the system and lead by visibly contributing work to the EW system. Another solution would be to recognize the reality of the work/benefit disparity and make the updating of the EW a visibly separate task or job. Physicians should be able to dictate EW updates to secretaries or nurses who would perform the practical task of entering updates into the EW system (work-benefit disparity (Grudin, 1994A)).
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7. Discussion of the Results of Analyzing the Data

Section 3.1. What is the Goal of this Thesis described the goal of this thesis, the research question and provided a description of the case with which this thesis is concerned. Section 4. Existing Literature and Section 5. Research Design and Methods gave an account of theory and method, dealing with related academic work in the area, theories with respect to use of IT in organizational settings, and theories regarding the conduct of empirical studies, and the analysis of qualitative, empirical data. Section 6. Results explained the way in which the empirical work was actually carried out, and how the data was analyzed using the already described qualitative, analytical techniques. The current section presents a discussion of the results and implications of the empirical and analytic work that was carried out in the previous sections. As previous stated (p.63) in Section 6.3. Analyzing the empirical Data using Diagnostic Mapping:

“…an analysis using the Diagnostic Diagramming technique revealed the existence of several problematic situations or issues in connection with using the EW system, the results of this analysis are listed in Table 1 on p.50. To put together a concrete foundation for specifying and designing relevant changes to the EW system, Diagnostic Mapping is a technique that can provide a way of identifying candidate problems and solutions for the problematic situations revealed by an Affinity Diagramming analysis.”

Two different analytical techniques were used to analyze the data, and as the results were listed in two different sections, the discussion will be divided into two sections, where the first section will discuss the results of analyzing the data using the Affinity Diagramming technique and the second section will discuss the results of analyzing the data using the Diagnostic Mapping technique.

7.1. Discussing the Results of analyzing the data using the Affinity Diagramming Technique

It is plausible to categorize the EW system under investigation as a groupware application, and the type of tasks or work supported it as computer supported collaborative work or CSCW using concepts originating in Grudin’s framework (introduced in section 4.2.1. Defining CSCW and Groupware). Grudin visualizes IT systems as constituting a continuum with standalone computer programs used by individuals on one end and mainframe based information systems that are deployed as comprehensive enterprise systems in very large organizations at the other end, see Figure 5, p. 20 above). When considering how to categorize an EW system, it should be taken into consideration that clinicians employ EW systems for the purpose of retrieving, manipulating and storing information relating to specific patient healthcare tasks performed in collaboration with fellow clinicians. EW systems are neither as comprehensive as large enterprise systems nor as narrowly
defined as are standalone PC applications, being located somewhere in the middle of the continuum, in the same way as groupware. It seems therefore reasonable to categorize EW systems as a groupware applications, and the type of tasks or work supported by EW systems as computer supported collaborative work or CSCW. A consequence of extending the use of the EW system as a CSCW system to the rest of the hospital and region, the EW system becomes accessible from any computer in the hospital and region; abolishing the old, physical limitations associated with physically separated and isolated dry-erase whiteboards, as well as modern EW systems limited to one room or department. The EW system becomes an omnipresent system in terms of clinicians’ access to all patients’ data in any location, in other words a distributive system. The development and implementation efforts of the project participants resulted in the creation and deployment of a new healthcare system tool for clinicians’ use; a CSCW tool that facilitates inter-departmental communication and coordination of work from any computer in the hospital that extends the scope of the EW system in terms of supporting innovative ways of performing coordinative healthcare work in hospitals almost immeasurably. This distributive and inter-departmental property of communication and coordination of work using the EW system is an underlying pre-supposition in all of the points discussed in the subsequent sections.

With respect to the actual implementation of the system certain points can be made, for example Berg writes that it is unrealistic to expect a satisfactory result when implementing PCIS in organizations by merely “installing and using a new technology” (Berg, 1999, p. 94). This kind of approach to system implementation leads invariably to a system implementation inferior to what could be achieved using an iterative and user-participatory approach. In contrast to the foregoing, Healthcare Region Zealand chose an iterative and user-participatory approach to developing and implementing the EW system at NFH (Rasmussen, et al., 2010, p. 10). A generic EW system served as the point of departure for an iterative and user-participatory development process, in which real users (ED users) of the prototype were participants in the development process by “continuously provid(ing) the implementation group with feedback leading to iterative revisions of the system, its configuration and the associated work practices” (Rasmussen, et al., 2010, p. 10). This approach resembles user-participatory approaches described in multiple sources, as in (Bannon & Ehn, 2013), (Berg, 1999), (Simonsen & Hertzum, 2010) and the MUST approach (Bødker, et al., 2004). Support of the registration and admission of patients to hospital is an excellent example of a feature of utmost importance to the entire healthcare organization that was emerged because of user participation in the developmental process. However, a different consequence of user participation in the developmental process is that many features of the resulting EW system fit the work practices of EDs better than that of other departments, as it was the ED that supplied the user participants for the project. As work practices in other departments than the original ED differ materially from those of the ED, challenges surface with respect to the optimal functioning of the EW system in other departments than the ED.

The management and further development of the EW system is the responsibility of a steering group, whose members are drawn from various departments of the organization. One of the more crucial and
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interesting developments of the EW system unfolded when users in the operating theatre department put into words a vision of using the EW system to support the scheduling of operations, which entails the inter-departmental communication and coordination or work. The suggestion that the EW system should be able to support the scheduling of operations was eventually approved by the steering committee which led to the establishment of a project for realizing this vision. The project would involve, as participants, clinicians in the operating theatre, administrative users and the IT vendor. Using an experimental approach the project extended the EW system with a “Boarding Pass” function, which is a function that supports departments’ effort to prepare a patient for a surgical operation. The EW system is an artefact that is used to effectuate a process described by the protocol; the protocol being the instructions issued by the hospital which prescribes that all operations must be scheduled using the scheduling function supported by the EW system, and describes how to go about it. Using the term protocol in the singular is a simplification of reality as the EW system actually supports multiple functions and the protocol is therefore actually a collection of separate protocols, some protocols affecting all departments, such as registration of patients, other protocols affecting only an individual department. The protocol and artefact are two elements which combine to form the coordinating mechanism, which in turn combines with the real work of scheduling to form the collaboration between departments. The way in which this scheduling function was created exemplifies several theoretical principles: the first principle it illustrates is the above way of perceiving the distinctness of the artefact and protocol, the protocol being the manifestation of the agreement between departments and the organization controlling the content of the work practice (Section 4.2.3. Coordination Mechanisms as Protocol and Artefact). The second principle is illustrated by the “Boarding Pass” function, which is actually a 7 step checklist. The checklist is a manifestation of a protocol, which is designed to regulate and manage the process of preparing patients for surgical operations. The protocol is inscribed in the artefact of the EW system as a digital checklist, which is programmed as part of the interface (Bjørn, 2003). A change of protocol with respect to the 7 step checklist would entail reprogramming or at least the reconfiguring of the digital checklist component. The third principle it illustrates is that real use by real users reveals the existence of conditions that enable designers to add unanticipated opportunity-based change to a system (Orlikowski & Hofman, 1997). This kind of change is enabled by designers being able to learn from real use, and based on feedback and suggestion from real users’ experience, designing something originally unplanned, such as a function that supports the scheduling of surgical operations. The fourth principle is the cyclic iterative user-participatory process (explained in Section 4.2.6. Participatory Design). The function supporting scheduling of operations is a function that was added to the EW system as a result of further iterations of the system development cycle, which took place after the EW system originally was launched.

Another example of functions supporting inter-departmental communication and collaboration is the function supporting the transfer of patients between departments. This function supports departments in transferring patients to other departments of the hospital if a physician decides that it is in the best interests of
the patient to do so. Whether this particular supporting function was originally planned by designers or was inspired by the success of the operations scheduling function is not known to the author, so there is no way of judging whether the development of this function represents anticipated or unanticipated change. What the creation of this patient transfer function does exemplify is that the content of the protocol underlying the coordination mechanism (theory explained in section 4.2.3. Coordination Mechanisms as Protocol and Artefact) is an outcome of negotiation between interested parties. At the present moment in time, support for the patient transfer function is functionally available in the EW system, however the function does not control the actual transfer of patients between departments as patients are still being transferred in the traditional manner. The artefact is in place and works, but the coordination mechanism does not yet exist since the protocol has yet to be finalized organizationally. The reason for this is that the leading physicians of the hospital’s interested departments do not agree about which department involved in a patient transfer should be able to make the final decision to transfer patients between departments. This is an example that illustrates the non-trivial nature of creating an inter-departmental protocol governing the handing over of patients between departments and illustrates Berg’s description of the “politically textured” nature of the design and implementation process and how implementation of changes can be “sabotaged or resisted” if proper care is not taken in handling people with a stake in those changes. To resolve this issue, what needs to be agreed upon before protocol can be finalized is: which department should have the final say in determining whether a patient may be transferred from one department to another. Should it be (a) the department that the patient is leaving, or (b) the department to which a patient is arriving? Not until that protocol has been agreed will the hospital be able to effectuate the implementation of the EW system’s patient transfer function. A solution to the problem may require intervention from persons at a higher level in the system than the heads of departments.

The implementation group that handles the continuing development of the EW system is still active and has a number of unfinished points on its to-do list. The way support for the operation scheduling function and the registration/admissions procedure were developed have established a template for developing and implementing new features supporting communication and collaboration of work. The template points the way for further development of the EW system. For example, ordering physiotherapy and ergo-therapy treatments is now supported by the EW system. In addition an experimental prototype of a function supporting the logistics of ordering hospital porters will be launched, and will be tested in real use by a small group of hospital porters, as part of an iterative and user-participatory developmental approach.

Clinicians performing the complicated procedures involved in taking care of patients’ healthcare needs are highly trained and capable people, who are absorbed by meeting the requirements of healthcare work practices in the context of patient care and find it difficult to tolerate being ordered to contribute valuable time and attention to tasks which they perceive as having no obvious benefit for patients’ healthcare. In the context of contributing time and attention to systems, the work vs. benefit-disparity principle explained in Section 4.2.5. Work vs. Benefit Disparity seems to be manifested for example in the actions and attitudes of clinicians...
in the intensive care department who neglect or omit updating the EW system. Nurses in the intensive care unit omit updating the EW system saying that their needs are fulfilled by other healthcare systems, physicians in the intensive care unit hardly ever touch the EW system. The EW system is apparently of no use to them, so very little is contributed to it from that department. This is in contrast to the use of the EW system to support scheduling surgical operations – as clinicians in virtually all departments benefit from using the system in scheduling operations, there exists a better motivation for updating and contributing to the system. The work is represented by the action required to activate the scheduling protocol, while the benefit is being able to schedule operations, which is desirable.

Rasmussen identified effects on communication and coordination (Rasmussen, 2013) that also seem to be valid with respect in an inter-departmental context. Positive effects such as “distributed access to whiteboard information, quick and easy access to relevant information, the ability to retrieve previously accessed information” are present with respect to the fact that patient information is now available from any computer in the hospital, that is to say, access is distributed and inter-departmental. Negative effects are also present similar to “system deficiencies e.g. system properties that only allow three lines of text in comment fields, and the system’s lack of support for other input than text, e.g. symbols…” in the context of ED clinicians unfulfilled wish to be able to enter free form text, and other departments dissatisfaction with the pre-defined option for the “Problem column”. These are again problems having to do with the challenges of making a standardized system work which encompasses such heterogeneous work practices and artifacts.

7.2. Discussing the Results of analyzing the Data using the Diagnostic Mapping Technique

The affinity diagramming analysis discussed above and listed in Table 2, p. 64 above, identified a number of problematic situations that were subsequently analyzed using diagnostic mapping. The problems, causes, consequences and ideas generated by the diagnostic maps illustrate several general points.

As a preface to the actual discussion, a few words about the problem identification and resolution process can be said. The practical application of the iterative and user-participatory model, as it is the “real use” of the EW system in a production setting allows the problematic situations to become noticeable or surface and thus be brought to the attention of designers through the medium of user feed-back. The problematic situations form a point of departure for diagnostic mapping, facilitating the formulation of suggested causes and consequences, which in turn are used to evaluate and identify change. Changes identified in this manner help designers and developers in specifying and implementing the changes identified in the previous stage completing the iteration. Iterating carries on as far as time and resources permit leading to improvement of the quality of the system in each iteration, see Section 4.2.6. Participatory Design and Section 4.2.2. Socio-technical Approach, see also quote p. 22 above.

There is disagreement between the ED and the other departments with respect to the pre-defined terms used in the “Problem” column, it being difficult to negotiate a set of terms agreeable to clinicians in all
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departments. The conflict arises because of the nature of a distributed system that spans diverse knowledge domains, as it is possible to think of the various specialty departments of a hospital as separate knowledge domains with specialized terminologies, similar to the issues encountered by Schmidt and Wagner in the architectural field (Schmidt & Wagner, 2004). When different departments have a shared technology for communicating and coordinating work, there will be challenges in terms of supporting work practices with regard to the same object (the healthcare of the patient) for different departments that have different terminology and work practices. Patients will be transferred from one department to another while their health issue is being treated, and the shared technology has to be able to operate uninterruptedly despite the heterogeneity of the different domains’ terminology. The challenge is thus to be able to support the different departments’ divergent terminology with the same technology. The degree of standardization of the EW interface is quite high as all departments except the ambulatories and the operating theater use the same basic filter, and have the same columns. For example, the “Problem” columns is used by all departments, and there will be no easy solution to solving the conflict over the pre-defined terms, but the conflict will only be solved if at all, when an attempt is made to adapt the column to be able to contain heterogeneous terminology. A related example is the issue of the “Triage” column, which is hard to find, as it hidden behind the right edge of the screen, because of the standardization of the placement of columns in the EW interface. This puts the ED at a disadvantage as it finds its frequently used “Triage” column hard to find, on the other hand the placement of the column is in the general interest of departments, as the vast majority don’t need it, and for them it’s just a waste of screen space. The standardization of the “Triage” column is in the general interest of EW users but is accomplished at the expense of a minority of users. Both examples demonstrate the dilemmas and difficulties that can arise in connection with standardization of artefacts and terminology in an organization, and demonstrate the non-trivial nature of trying to standardize the cooperative use of artifacts and terminology across organizational units (Schmidt & Wagner, 2004).

The divergent practices with respect to removing bloodwork from the EW interface are examples of heterogeneous practices that intersect with each other as a result of a distributive technology. The intensive care department shares patients with their (patients’) respective “home” departments, and will return them as soon as circumstances permit. In the meantime, clinicians in both departments use shared technology to keep track of bloodwork for the same patients, applying heterogeneous practices to shared patient. The obstructing of the view of other patients on the EW interface has negative effects on the motivation of clinicians to use a system that seems to function poorly. It is known that one of the barriers to adoption is poor usability or view of the interface (Granlien & Hertzum, 2012) and the challenge is whether it is possible for the EW system to support practices which differ so much, when the EW interface discourages user and how to do so. Would it be possible to mitigate this barrier using organizational interventions directed at users, and influence users to accept the obstructed view and use the EW system despite its shortcomings? Would it be feasible to standardize the divergent practices of the intensive care department with respect to taking blood samples with the other
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departments in the hospital? In any case as long as things stay the same, the obstruction of view will have the negative effect of decreasing the intensity of usage of the EW system, and is an example of a system that risks losing degree of critical mass necessary for keeping it viable, see Critical Mass theory (Markus, 1987). In Section 6.3.5 Conflict between Departments regarding Bloodwork impairs Patient Overview a technical solution is suggested to mitigate the negative effects of too much bloodwork being exhibited on the display, however a technical approach could be difficult to accomplish as it would involve re-programming some of the code that produces the EW interface, which involves activating the vendor and requires acquiring elusive financial resources.

In connection with scheduling surgical operations the 7 step checklist lacks the option to indicate that no pre-medication is necessary, presenting the dilemma of standardizing a complicated procedure and inscribing/embedding it in an artifact, in a way that functions smoothly in all circumstances. Berg describes the fluid and pragmatic character of health care work, which is descriptive of the pragmatic way in which clinicians compensate for the lack of sufficient information about pre-medication when they decide to communicate with other departments over the telephone to ensure patient safety, since they are aware of the possibility of patients being signaled as pre-mediated for anesthesia, even though they might not be. Clinicians are aware that the coordinating mechanism is deficient, and make up for this deficiency in their own way. This is also an example of the challenge of being able to support the “interoperability” of the artifact (EW system checklist) with the work practices of the operating department and the “home” departments scheduling operation in a way that is safe for their patients. The solution to the problem is primarily a technological solution, as the digital checklist requires modification to bring it into line with the reality of operating theater practice. In the meantime clinicians seek to ensure patients’ safety by utilizing compensatory methods.

When anesthesiologists and other physicians avoid contributing data to the system, they may do so, for a number of reasons, however it illustrates the point that whenever people encounter a requirement to contribute time and resources to a system from which they seem to expect little benefit, people may begin to limit their contributions. As Grudin writes: “most groupware requires some people to do additional work to enter or process information required or produced by the application” and people commonly react to this imbalance or disparity by withholding their contributions, see Section 4.2.5. Work vs. Benefit Disparity. An exemplification of this principle is the task of pre-medicating patients, which takes place in patients’ own department and not in the anesthesiology department. Anesthesiologists travel from department to department and patient to patient without updating patients’ “Boarding Pass” information in the EW system in real-time. Technical difficulties may be the reason for this, however another reason may well be that anesthesiologists are discouraged from making the effort of updating the EW system because they see no benefit in doing the work until later. A technical solution such as using other equipment for the updates, perhaps such as small handheld computer devices, which anesthesiologists could carry with them at all times, seems attractive at first glance, but also adds complexity to the task of pre-medicating patients, as anesthesiologists would have to
learn to use a new device, with its peculiarities and remember to take it with them on their rounds. Yet another layer of complexity added to an already complex work situation. The solution where the task of updating the EW system is delegated to an assistant resembles the rewriting of a job description where the delegated task becomes the explicit work of another person (Grudin, 1994A, p. 96), but whether this solution is feasible depends on whether the hospital or healthcare region considers it financially responsible.

The same principle applies to physicians in general as they have traditionally made use of nurses and secretaries to update patients’ records where nurses and/or secretaries took dictation from physicians and subsequently made a permanent record of the data, this being secretaries’ and nurses’ explicit work (see preceding discussion). As a result of the introduction of new technology much of that tradition has changed and with the advent of the EW system physicians are actually expected to update patients’ information in the EW system, a change which is resisted by many physicians. This new expectation produces a perceived disparity between the work physicians should be contributing to the EW system and the benefit they receive, as the EW system is primarily seen as a logistical tool, having little to do with their primary concern, which is treating patients’ medical conditions. They feel that information in the EW system benefits other clinicians or the administration and there is no pay-back for contributing to the system.

A related point arising from the analytical results of the empirical data is that the viability of the EW system depends on maintaining a critical level of support or critical mass of supporters and contributors, see Section 4.2.4. A Critical Mass Theory of Interactive Media. The problematic situations brought to light by the affinity diagramming analysis and the construction of the diagnostic maps all have the characteristic of either reducing the motivation of users to contribute resources to the EW system or delaying the same. The danger that lies therein is that of a self-perpetuating, negative spiral of decreasing contributions of resources leading to the increased perception of the EW system being less valuable to use. The less users contribute resources to the EW system, the less benefit users will be able to obtain from it, which could in theory eventually lead to the discontinuance of the system. On the other hand the EW system is quite well established as the undisputed entry point of patients’ trajectory in the hospital, and is well positioned as the channel through which patients flow to the operating theatre, and is therefore an implausible candidate for being terminated by management. A plausible scenario is while the EW system may continue to function as support for work practices, which have already been developed and implemented, resistance in other departments and other contexts of use leave the EW system without the degree of critical mass essential for engaging clinicians and continuing the evolvement and further development of the system in other contexts. A conceivable result would be that the EW system ends up as a system which no one uses for purposes other than supporting the scheduling of operations, transferring of patients between departments and admitting patients to the hospital.
8. Conclusion

This study has investigated the use of the EW system found at the hospital at Nykøbing Falster by employing qualitative research and analysis methods. The study has provided some answers to the question of what impacts, challenges and consequences clinicians (say they) experience when using an electronic whiteboard system for inter-departmental communication (collaboration/coordination) and how these challenges may be met or approached (see p.22). The information collected by the study shows a number of impacts and challenges of which some of the impacts are challenges in themselves while other impacts are merely impacts. While it may be possible to invent or find solutions for these challenges, feasible and effective solutions are not necessarily easily forthcoming.

Fundamentally, the study found that the EW system as it now exists, is designed to and capable of supporting computer supported cooperative work, and the impact of its distributive nature and its presence in virtually all departments of the hospital is to facilitate the support of communication and coordination of work inter-departmentally for a variety of purposes. A further effect or impact is the relative ease with which clinicians may access stored and shared information about patients in a distributive fashion.

A more specific impact is that the EW system supports the ED’s patient admission and registration process which produces a standard entry point for patients’ hospital trajectory. The information gathered at the beginning of the process is stored and becomes available in a distributive way, as patients pass from department to department. However, as the EW system was developed in a user-participatory process with user-participants mainly from the ED, the specific way in which the system was configured means that the features of the EW system are in certain ways a better fit for the ED than for other departments posing a challenge for system use by clinicians from other departments than the ED.

A major impact is that the EW system now supports (and the hospital mandates its use) the ordering or scheduling of operations. Scheduling operations is a form of inter-departmental communication and coordination of work, which when supported by the EW system becomes more streamlined. However, the way in which support for scheduling operations has been configured, poses some challenges for its users. The digital seven-point checklist for managing the preparation of patients for surgery lacks an option for indicating that no anesthesia is necessary, for which reason clinicians employ supplementary manual communication and coordination to mitigate risks to patient safety. A technical solution to this problem is imaginable, but may be difficult to implement organizationally as it would require programming efforts. Another challenge is posed by traveling anesthesiologists, who omit updating patient status in real-time, thus potentially slowing the flow
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of patients through the operating theater. A theoretical solution to this challenge would be to equip anesthesiologists with portable computer devices, although this solution could be a challenge to implement, an organizational solution would be to create a separate job description for updating the EW system in real-time, a solution which could be difficult to implement in an environment of scarce resources.

A mixed picture is presented by support for the transfer of patients from department to department. The function exists and works in a technical sense, but has not been implemented organizationally. The function could have a major impact, but its implementation is being postponed. The challenge to its implementation is that the content of the protocol describing the inter-departmental coordination of work that will govern the practicalities of transferring patients cannot be finalized by the departments that will be involved as the interested parties have not been able to reach agreement on the specifics of the protocol. The case illustrates the complex nature constructing an inter-departmental protocol governing interoperability between departments with respect to inter-department tasks such as patient transfers. Any solution has to be organizational, and may require intervention from higher levels of the organization.

The capacity of the EW system to support inter-departmental communication and coordination of work has necessitated efforts to standardize the EW interface to facilitate the supported activities. One of the major impacts of standardization is that most departments use the same basic filter (view), with the exception of the operating theatre and the ambulatories (out-patient clinics). Standardization offers thus recognizability and predictability in the EW interface when moving from one department to another but also presents challenges, such as those represented by the “problem” column, the use of which is challenged by the need for the column to contemporaneously support the use of heterogeneous terminologies by specialty departments of a substantially different character. Another example of a challenge caused by standardization is the placement of the “Triage” column so far to the right that users have a hard time finding it. A reasonable measure which intends to conserve scarce screen space, but which however greatly inconveniences clinicians in the ED, the department that really uses it. A possible solution would involve tailoring filters (views) to fit individual departments more closely, but at the expense of reducing the beneficial effects of standardization.

A further impact is the ability of the EW system to display bloodwork results, which as the system is distributive, may be viewed or accessed inter-departmentally, a benefit for departments sharing patients, but which also creates a challenge similar to the above-described, as different departments exercise heterogeneous practices with respect to keeping bloodwork visible on the EW display. The heterogeneity of practice results in a backlog of blood samples that accumulate and obscure the display, reducing the quality of the overview provided by the display. Again, appropriate solutions may be hard to come by. A technical solution would be to make patients’ rows expandable using programmatic techniques, which however requires access to financial resources, which may be hard to come by. An organizational solution would be to standardize the handling of bloodwork, inter-departmentally, a solution which would likely run into similar difficulties with respect to
inter-departmental negotiations and consensus as previously mentioned in connection with support for transferring patients.

A perspective on the future of the EW system might take its point of departure in the impact of the EW system as a distributive system with the capacity to support inter-departmental communication and coordination and which has already been configured to support several important functions that are actually in practical use. The momentum in use of the EW system achieved by the implementation and use of these functions is considerable, and the hospital management is backing up EW system use by mandated use in several aspects. However, the above-enumerated challenges exercise a retardant influence on the motivation of clinicians to wholeheartedly adopt and support the system by contributing time and resources to the common good, thus harming the momentum of system use. More generally, as a new technology in the tool box of clinicians, the EW system competes with many other hospital systems for clinicians’ time and attention. While the introduction of this new technology is accompanied by a requirement for clinicians to contribute time and resources, it appears that not all high-level clinicians, physicians that is, have complied with this mandate. As it is furthermore said by clinicians in some departments that while the system is a very fine innovation, it is not used very much. These circumstances give rise to a potential scenario in which the EW system remains in solid use for those functions, which it already supports, but where its use atrophies in all other aspects, as disuse causes its momentum to stagnate.
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9. Definitions and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ED</td>
<td>Emergency department</td>
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<tr>
<td>EPR</td>
<td>Electronic Patient Record</td>
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<tr>
<td>EW</td>
<td>Electronic Whiteboard or Electronic Patient Status Board</td>
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<tr>
<td>NFH</td>
<td>Nykøbing Falster Hospital = Nykøbing Falster Sygehus</td>
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<tr>
<td>NFS</td>
<td>Nykøbing Falster Sygehus = Nykøbing Falster Hospital</td>
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<tr>
<td>PCIS</td>
<td>Patient Care Information System. Berg describes the terms as follows: “PCIS is a broader term than e.g. ‘electronic patient record’ but no sharp terminological distinctions are intended here. All these systems denote IT applications whose core users are doctors, nurses and other healthcare professionals.” (Berg, 1999)</td>
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<tr>
<td>Sorø</td>
<td>Healthcare Region Zealand’s headquarters is located in the town of Sorø, Zealand, Denmark</td>
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<tr>
<td>IMATIS</td>
<td>The Norwegian IT System Vendor, see <a href="http://www.imatis.com">www.imatis.com</a></td>
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10. Appendix A – Interview Guide

The following is a copy of the actual interview guide provided to all interviewees upon starting the interview. The same guide was provided to all interviewees.

<table>
<thead>
<tr>
<th>Subject/Theme</th>
<th>Interview-question</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>[1] – Interviewee’s role in the department</td>
<td>[1.1] – Please tell about the position you have in the department and the functions you perform.</td>
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<tr>
<td>[2] – Coordination of tasks</td>
<td>[2.1] – Please tell what it is you need the electronic whiteboards for in your internal (intradepartmental) tasks?</td>
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<td></td>
<td>[2.2] – What do you need the electronic whiteboards for in relation to coordinating tasks between two departments?</td>
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<td>[2.3] – What is your knowledge of the use of the electronic whiteboards in relation to interdepartmental coordination of tasks, not relating to surgical operations?</td>
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<td>[2.4] – What need is there for function that support coordinating task beyond that of scheduling operations?</td>
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<td>[3] – Specifically regarding the scheduling of surgical operations</td>
<td>[3.1] – Would you please describe the current procedure for scheduling surgical operations?</td>
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<tr>
<td></td>
<td>[3.2] – Would you please describe the future procedure for scheduling surgical operations supported by the whiteboard, if you have any idea about that?</td>
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<tr>
<td>[4] – Development of new functionality or patterns of usage</td>
<td>[4.1] – Would you please describe the process of agreeing a new work practice of process to be supported by the whiteboard when limited to a single department.</td>
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<tr>
<td></td>
<td>[4.2] – What is the process of agreeing a new function or process, for use in the entire hospital?</td>
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<td></td>
<td>[4.3] – What is the process for agreeing a new function or process that only involves two specific departments in the hospital?</td>
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<td>[5] – Significance for work practices</td>
<td>[5.1] – What significant changes in your practices have you noticed?</td>
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<td></td>
<td>[5.2] – To what degree were these changes predictable or unpredictable?</td>
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<tr>
<td>[5.3]</td>
<td>How much does your work depend on the use of the whiteboards, and how would it be to have to do without the use of the whiteboards at the present time?</td>
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### [6] – The Electronic Whiteboard system is implemented in all departments of the hospital

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<tr>
<td>[6.1]</td>
<td>What needs have emerged now that the electronic whiteboard system has been implemented in all departments of the hospital?</td>
</tr>
<tr>
<td>[6.2]</td>
<td>What are two or three advantages of having the whiteboards in all departments?</td>
</tr>
<tr>
<td>[6.3]</td>
<td>What are two or three disadvantages of having the whiteboards in all departments of the hospital?</td>
</tr>
<tr>
<td>[6.4]</td>
<td>What challenges have emerged as a result of having implemented whiteboards in all departments of the hospital?</td>
</tr>
<tr>
<td>[6.5]</td>
<td>Please provide two or three good ideas, now that the whiteboards have been implemented in all departments of the hospital?</td>
</tr>
</tbody>
</table>
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11. Bibliography


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