Glenn Munkvold

Making IT Work in Practice

Integrating the EPR-based nursing
record with nursing work

Thesis for the degree doctor scientiarum

Trondheim, November 2007

Norwegian University of Science and Technology
Faculty of Information Technology,
Mathematics and Electrical Engineering
Department of Computer and Information Science

NTNU

NTNU
Norwegian University of Science and Technology

Thesis for the degree doctor scientiarum

Faculty of Information Technology,
Mathematics and Electrical Engineering
Department of Computer and Information Science

ISBN 978-82-471-5014-6 (printed version)
ISBN 978-82-471-5028-3 (electronic version)
ISSN 1503-8181

Doctoral theses at NTNU, 2007:227

Printed by NTNU-trykk

Abstract

The Norwegian healthcare sector, like the rest of the Western world, faces major challenges related to the need to coordinate work within and across institutional and disciplinary boundaries. The main materialization of the ongoing efforts of streamlining healthcare services is the formalization of healthcare work through the Electronic-Based Record (EPR). In this thesis I explore one particular aspect of these efforts: nursing care and the formalization of nurse's written accounts in the EPR-based nursing record.

Nurses play an essential role in ensuring that there is a well-functioning organization and a seamless management of patient trajectories. With increased emphasis on integrated care as the standard model for delivering healthcare services, the contribution of the nursing profession to the overall delivery of care is increasingly acknowledged.

This thesis explores how nursing is documented in practice and how the EPR-based nursing module is integrated in specific nursing work practices. Empirically the thesis is based on ethnographically inspired fieldwork at the Department of Rheumatology at St. Olavs University Hospital in Trondheim and the Department of Special Psychiatry at the University Hospital in Tromsø. In both cases I have studied nurse's documentation practice and the integration of the EPR-based nursing record into their everyday work.

The thesis has a strong focus on how things are done in practice. The set of papers presented as part of this thesis make some of the work involved in formalizing nurse's written accounts visible and also present the EPR-based nursing record in practice. The main contribution of the thesis is a detailed, empirically underpinned exploration of the efforts of introducing the electronic-based nursing module in practice. I apply a process-oriented perspective on the nursing record that stresses how it is situated, its temporal nature, how it is regularly (re)negotiated and achieved in practice.

Integrating the EPR-based nursing record with the aim of improving information sharing is extremely difficult. In the Trondheim case it is demonstrated how efforts of formalizing nurse's work through the EPR introduced new types of informal elements. In fact, the informal, redundant and unstructured aspects of nurse's work that initially were considered to be a problem became essential for the new formalized practice to work. Similarly in Tromsø, the standardization of nursing plans unintentionally subverted the possibilities for interdisciplinary cooperation. Rather, it was the existing and heterogeneous (informal/formal and oral/written) documentation and communication practice that contributed to interdisciplinary work and made up and served as a premise for a good nursing plan.

The thesis contributes to theory by presenting a dynamic perspective on the nursing record as resilient, open and achieved in practice. The thesis contributes to the literature within Computer Supported Cooperative Work (CSCW) on informal documentation practices and expressions of redundancy by demonstrating how these are transformed when new technologies are being implemented. Also the thesis contributes to the existing CSCW literature by demonstrating the necessity of accommodating temporal differences that arise from separate and different intra-group processes.

The aims and goals related to the EPR change and expand over time and in relation to multiple stakeholders. For example, in the Tromsø case the nursing plan, which

started out as tool for nurses, gradually turned into a resource management tool. Such transformations of ambitions are typical in information system projects and should not come as a surprise - primary work transforms things into something different where technologies find new areas of application.

In order to succeed in integrating tools such as the EPR-based nursing record with work, one needs to move beyond simplistic strategies of replacing the existing information sources. The strategy to pursue is to find mechanisms that strengthen the relations between the parts. For practice this implies balancing rational aims and practical applicability when designing and implementing new tools. Also, it involves paying closer attention to what is non-common, for example what types of information sometimes remains specific for the various professionals, and why.

Methodologically, the interconnected and mutually dependent entities of material arrangements and practices of different professionals underscore the need for doing empirical studies in a work setting by following the whole process of implementing a new system (before, during and after). Also, in order to make research findings practically relevant, researchers should engage themselves in arenas that enable learning to take place, where knowledge can be shared and where local competence and capacity are cultivated. Rather than presenting a fixed set of requirements as implications for design, we should struggle to build relationships between politically contrasting interests, for example between vendors, managers and the users. Design implications are in this sense not fixed once and for all, but instead serve as a starting point for discussion, reflection and negotiated changes with various stakeholders

Papers

1 Berntsen K., Munkvold G. and Østerlie T. (2004) Community of Practice versus Practice of the Community, Knowing in Collaborative Work, in *ICFAI Journal of Knowledge Management*, 2(4), pp. 7-20.

2 Munkvold G. (2005) Practice-Based Knowledge Integration, in David Schwartz (Ed.): *Encyclopedia on Knowledge Management*, IDEA Group Inc., 2005, ISBN 1-59140-573-4.

3 Munkvold G., Ellingsen G. and Monteiro E. (2007) From plans to planning – the case of nursing plans. Accepted for publication and to be presented at *Group 2007*.

4 Munkvold G., Ellingsen G. and Koksvik H. (2006) Formalizing work – reallocating redundancy, in *Proceedings of the 2006 20th anniversary conference on Computer Supported Cooperative Work (CSCW)*, November 2006, Banff Canada

5 Munkvold G. and Divitini M. (2006) From storytelling to reporting - converted narratives, in *Proceedings of MCIS'06, the Mediterranean Conference on Information Systems*, October 2006 Venice, Italy.

6 Ellingsen G., Monteiro E. and Munkvold G. (2007) Standardization of work: co-constructive practice, *The Information Society 23, pp.1-18*.

7 Munkvold G. and Ellingsen G. (2007) Common Information Spaces along the illness trajectories of chronic patients. *Proceedings of the 10th European Conference on Computer-Supported Cooperative Work*, September 2007, Limerick, Ireland. pp. 291-310

Acknowledgements

It goes without saying that this thesis would not have been possible without the help and support from a living network of professional colleagues, healthcare practitioners and friends.

First of all special thanks to Professors Monica Divitini and Eric Monteiro, my main supervisors at the Department of Computer and Information Science, Norwegian University of Science and Technology (NTNU) in Trondheim. I am grateful for your patience, support and encouraging feedback at the various stages of my work. I still have a lot to learn from you both. Thanks to Professor Reidar Conradi at the same department for commenting on early versions of my work and letting me reside in and be a part of the software engineering group.

I am especially grateful to Associate Professor Gunnar Ellingsen at the University of Tromsø, for inviting me to Tromsø, working together with me in the field and writing papers together with me. Your expertise and accommodating manner has been an essential source of inspiration.

Among present and former colleagues and friends at the Department of Computer and Information Science in Trondheim, I would especially like to mention Knut Rolland, Gry Seland, Yngve Dahl, Sven Ziemer, Torstein Hjelle, Siv Hilde Houmb, Alan Munro, Gasparas Jarulaitis and Eli Morken. Throughout my stay at the department I have appreciated the informal and friendly atmosphere and benefited greatly from your insights and professional skills. I offer special thanks to Birgit Krogstie and my room-mates throughout these years, Thomas Østerlie and Kirsti Berntsen, for your generous companionship and for reading and commenting on numerous versions of my writings. I also acknowledge the English language advice and assistance from Senior Adviser Stewart Clark at NTNU who edited the last draft of the body of this thesis.

In addition I would like to thank the people at the Norwegian Centre of Electronic Health Records for providing an encouraging atmosphere while I collected the empirical material for this study. In particular I wish to thank Jostein Engesmo, with whom I cooperated closely at certain stages of my empirical investigations, and Associate Professor Arild Faxvaag, who took the initiative and helped me get access to the Trondheim case.

Thanks to Nord-Trøndelag University College for funding my research, and colleagues at the Department of Information Technology at Nord-Trøndelag University College in Steinkjer. I would especially like to mention three of the teaching staff, Robin Munkvold and Arnstein Eidsmo for always being helpful and flexible when giving courses together with me, and Knut Ekker for reading through and correcting the language in two of the papers.

I further want to thank the people that I observed and interacted with during my empirical investigations. In particular Hege Koksvik at St. Olavs Hospital in Trondheim and the staff at the Department of Rheumatology at the same hospital and the Department of Special Psychiatry at the University Hospital in Tromsø.

I also would like to take this opportunity to thank researchers within the broader academic community that have shared their reflections and commented on earlier versions of my writings. Here I would like to mention Professors Kristin Braa and Ole Hanseth and Associate Professor Torgeir Dingsøyr at the annual PhD seminars in Oslo (and Trondheim), Professor Lucy Suchman and Associate Professor Toni

Robertson at the Doctoral Consortium in ECSCW in Paris in 2005, Professor Stefan Timmermans at the International Workshop on Globalization, Identity and Standardization in Trondheim in 2005, and Dr Paul Luff and Professor Christian Heath and Dr Dave Randall who I met during a study tour in 2005.

Last but not least, I would like to thank my closest family for always being there and prepared to lend a hand whenever needed. In particular, to Laila for your love and unconditional support and to my two children: Malin and Fredrik.

Table of contents

1 Introduction

This chapter provides an overall picture of the thesis. I start by providing some background information on efforts to implement the Electronic Patient Record (EPR). I then present the primary focus of the thesis, which is the introduction of electronic-based nursing records in Norwegian hospitals. Subsequently the research question is presented and the overall study is framed empirically and analytically. Finally the contributions, in terms of papers, are presented, followed by a brief outline of the remainder of the thesis.

1.1 The Norwegian healthcare sector and the commitment to integrated care

The Norwegian healthcare sector, like the rest of the western world, is currently under strong pressure to address its growing healthcare needs. Between 1990 and 2001, gross health expenditure increased from NOK 56 to 121 billion while public expenditure, as a part of total expenditure, increased from around 13% in 1980 to 17% in 2001 (Nørgaard, 2003). From 2000 - 2003, health expenditure, as percentage of gross GDP, increased with approximately 1,5 percentage points (WHO, 2003), an increase slightly stronger than the rest of the Norwegian economy.

Despite this growth in health expenditure, public resources are still scarce. There is a shortage of healthcare professionals, the patient population is increasingly becoming better educated (and demanding) and the elderly boom is progressively putting pressure on the sector to progress and improve its services. For example, it is estimated that by 2015 the number of elderly people in Norwegian hospitals will have doubled, and by 2025 around 3600 additional hospital beds are needed to keep up with the elderly boom. This amount equals the total number of beds offered by the five biggest hospitals in Norway today (Petersen, 2005).

Adding to this picture is one dominant trend, namely the emergence of chronic diseases as a major health threat. According to the World Health Organization, chronic diseases are by far the leading cause of death worldwide:

> *"chronic diseases will take the lives of approximately 35 million people this year – more than 60% of the 58 million deaths worldwide" (WHO, 2005).*

People suffering from a chronic disease are confronted with disabilities in their daily life that require help from numerous healthcare professionals in different settings. Patient problems are typically long-term, multiple and complex and various healthcare professionals, with different areas of expertise, are involved in the treatment and care.

Norway is among the European countries with the highest rate of chronically ill patients (Fricker, 2003) and this group is increasingly becoming an essential area of commitment for the Norwegian government (NOU, 2005). The permanent and compound nature of chronic diseases has made the authorities particularly attentive to ensure that there is a continuous and high-quality interaction among the different actors involved in the overall delivery of treatment and care (NOU, 2005). Expressions like shared care, integrated care and continuity of care are commonly used to denote this commitment of creating coherent and effective healthcare services within and across disciplinary and institutional boundaries. Given a healthcare service that is becoming increasingly fragmented across technical, organizational and

professional boundaries (see Strauss et al., 1985), huge investments are being made to stimulate the establishment of larger integrated electronic-based information systems for rationalization and quality improvement of healthcare services. Infrastructural arrangements such as the electronic patient record (EPR), standards, procedures, classification schemes and the like, are expected to enhance information sharing and coordination of work so that patients are given a coherent service where every professional perspective is accounted for (Grimson et al., 2000).

1.2 The Electronic Patient Record – expectations and current status

The main materialization of the ongoing efforts of streamlining healthcare services is the formalization of healthcare work through the EPR. Broadly the EPR is assumed have three types of effects (see Svenningsen, 2003). First, it is expected to improve the overall quality of data and information by reducing errors in registration and errors caused by redundancy (which are two of the most common errors related to the paper-based record). As described by the Norwegian Nursing Organization:

> *"A paper-based patient journal contains a lot of redundant information. There is in particular a tendency for different professional groups to document the same information in their part of the journal respectively. This redundancy causes both an extra workload and the risk of making mistakes due to inconsistent data (...) By introducing electronic-based one aims at reducing redundancy as much as possible and rather tries to reuse the information when relevant" (Mølstad et al., 2007 p.20)*

Second, the EPR is expected to improve accessibility of patient-relevant information and thus has the potential to improve intraorganizational communication and interdisciplinary work. As described in Norway's national strategy for IT development in the health and social services sector for the period 2004 – 2007:

> *The achievement of possible efficiency gains through the development of EPR demands a multi-professional approach (The Ministry of Health and Social Affairs, 2004 p.16)*

Third, when the EPR is implemented in all healthcare institutions, the potential premises for continuity is at its peak, as patient information easily can be exchanged across institutions:

> *A thorough and general introduction of EPR is presumed to have the most potential gain of all the ICT measures in the health and social sector. EPR throughout the whole of the health services is a premise for continuity of patient care in general and in particular for patients with chronic complaints or complex needs (The Ministry of Health and Social Affairs, 2004 p.15).*

So far, in the Norwegian healthcare sector, these prospects are far from being realized. Despite being among highest ranked countries in Europe, with an EPR-coverage of more than 90% in both in the primary healthcare sector and in hospitals (Dehli and Snøfugl, 2005), stories of success are mainly found in the primary healthcare sector. In hospitals on the other hand, the anticipated effects seem far from being realized. Lærum et al. (2001) for example concluded that physicians in Norwegian hospitals used EPRs for far fewer tasks than what was supported by the systems. Similarly, Lium and Faxvaag's (2006) investigation of hospitals where the paper-based records were removed completely, found that clinical personnel (physicians and nurses) used the EPR primarily for retrieving, and less for generating and storing information. This tendency of lack of use in hospitals is by no means

particular to the Norwegian healthcare context, but merely resembles a more general concern – fully operating and integrated EPRs hardly exists (Goorman and Berg, 2000).

According to Chaudhry et al. (2006), despite a growing number of EPR-related studies, our general knowledge about EPR-effects on key issues, such as quality and efficiency, is still rather limited. Poissant et al. (2005) even argue that the anticipated EPR-effects, such as for example reduced documentation time are unlikely to ever be fulfilled. One main problem with current EPR-research is its predominant focus on efficiency gains for specific healthcare workers and/or systems (Chaudhry et al., 2006; Poissant et al., 2005). Less attention has been on the broader implications of implementing the EPR and how expectations and perceived effects might differ across contexts. For example, documenting might be more time-consuming for one group of professionals, say nurses, at the same time it might have positive effects for others, like e.g. physicians. Similarly, the updating of the patient record done by nurses during daytime might ease the burden on nurses working on the evening or night shift.

Issues like these have raised the awareness towards non-technical issues - how the EPR is socially constructed and achieved as a result of negotiation processes (Bowker and Star, 1999; Lachmund, 1999; Hanseth and Monteiro, 1997). Herein lies a fundamental recognition that the EPR will always be made to fit local needs and requirements when put into use. What might be predicated by designers and inscribed into the EPR as appropriate use will later on be modified and changed by the users themselves (see Berg, 1999a). EPR-related research has thus increasingly become more attentive towards *how* the EPR is being *integrated* with existing localized work practices (see Berg, 1997; Hartswood et al., 2003; Svenningsen, 2003; Ellingsen and Monteiro, 2003b; 2006; Ash et al., 2004).

1.3 Nursing care as the key to making connections

In this study I explore one particular aspect of healthcare work; namely nursing care and the formalization of nurse's written accounts (i.e. the EPR-based nursing record). The nurses play an essential role in ensuring a well functioning organization and a seamless management of patient trajectories. As Allen (2004) puts it:

> *"it is nurses who weave together the many facets of the service and create order in a fast flowing and turbulent work environment" (p.279).*

Given the premises as presented in the previous sections, which all implicitly point towards integrated care as the standard model for delivering healthcare services, the contribution of the nursing profession to the overall delivery of care is increasingly acknowledged. For example, in Norway in 2001, the nurses became legally obligated to document their actions through the act on personal health. At the same time the first official acknowledgement and commitment towards the nursing record could be witnessed in national plans and initiatives (SHD, 2001a; 2001b). This commitment was further reinforced in the succeeding action programme for 2004-2007 (SHD, 2004) and in the latest annual national implementation programme the EPR-based nursing record is marked as one of six prioritized objectives:

> *Wider use of EPR for documentation of nursing in health enterprises and the municipal health service (SHD, 2005)*

The main materialization of these ambitions of more integrated healthcare services is the formalization of care through the nursing record in general and nursing plans in

particular. Nursing plans are expected to ensure a seamless flow of information within and across professional and institutional boundaries. As Voutilainen et al. (2004) put it:

> *"its [the nursing plan's] primary purpose is to ensure the individuality and continuity of care (…) When documentation is accurate, individual, pertinent and up-to-date, it promotes consistency and effective communication between nurses and the other team members involved in care."(p.72)*

So far however, the literature reveals a nursing community whose actual compliance to a structured documentation process is rather low (Björvell et al., 2002; Sexton et al., 2004; Lee and Chang, 2004). According to Waters (1999) a main problem is that the nursing process is just too time-consuming to document. Lee and Chang (2004) on the other hand contend that current models of care seem to be more significant for nursing as a profession and less relevant for patient care. Svenningsen (2003) again, argue that the computerized nursing record seems to dissolve the boundary between nursing and the medical agenda.

As for the more general EPR-related studies presented in the previous section, it is studies like these that have brought to the fore non-technical issues as reasons for the, hitherto, relative lack of success of formalizing nurse's written accounts. However, still we know relatively little about the effects of the EPR-based nursing record in practice. In the context of Norwegian healthcare, this is hardly surprising as the integration of the nursing module into the EPR is still in an early phase.

> *"There does not exist any overview on how far we have come in the implementation phase. There are huge differences [between the different hospitals]. I think a lot of hospitals have started the transformation and believe a lot will be done this year (email response from a representative from the Norwegian Nursing Organization - 11 January 2007)*

The situation in Norway is far from unique. According to Urquhart and Currell (2005) the general knowledge about the effects of the EPR-based nursing in the western world is still rather limited

1.4 Research questions and expected contributions

The formalization of nurse's written accounts and the integration of the nursing record with the EPR bring to the fore three main issues that are particularly challenging[1]. First, the nurses are the largest group of professionals in the healthcare sector. For example in 2005, they constituted approximately 45% of the total workforce in Norwegian hospitals (Jørgenvåg, 2006). Implementing the EPR for such a large group is in itself an immense challenge.

Second, the 'holistic nature' of the profession has made the nurses draw extensively on informal and personalized recordings of work at the expense of formal, written documentation and specific facts (see Hardey et al., 2000). Making their written accounts relevant for the EPR thus involves making visible what historically has been invisible and informal. However, within the community itself, it has turned out to be

[1] I will return to, and elaborate in more detail on the challenges related to the computerization of nurse's written accounts in Chapter 3.

extremely challenging to settle on a common model for documenting nursing actions (see Bowker and Star, 1999).

Finally, other professionals have considered nursing as irrelevant for the patient record and thus their written accounts have been among the first to be removed when patients are discharged from hospitals (Star and Strauss, 1999). With integrated care increasingly gaining ground as the standard model for delivering healthcare services, this apparent lack of emphasis given to their written accounts is thus rather surprising. As Bowker et al. (2001) put it:

> *"The nursing profession acts as a distributed memory system for doctors and hospital administrators. Ironically, in so doing, it is denied its own official memory"*

In this sense, the formalization of their written accounts is also a matter of making their actions relevant for a broader context of potential user-communities.

With this as my point of departure, in this thesis I seek out to explore how nursing actually is documented and how the EPR-based nursing module is integrated in specific nursing practices. This makes the overall objective of the thesis the following:

> ***Explore the role and function of the nursing record in practice and how the relationship between tools for documenting and the work practice changes when the formalized EPR-based nursing record is being introduced in particular nursing practices***

More specifically this includes exploring the following questions:

RQ:1. How is nursing documented and communicated in practice?

RQ:2. How is the nursing record used across time and space, such as in interaction with other professionals and across institutional boundaries?

RQ:3. How is the EPR-based nursing record being integrated with the existing work practice?

The thesis has a strong focus on how things are done in practice. Any move to introduce a new tool in existing work practices entails an effort, typically a quite intense one, from the ones whose work is being influenced. The formalization of nurse's documentation practice is thus studied in depth. I do not aim to provide all encompassing answers but rather, as Svenningsen (2003) puts it, "*dig into selected areas of this practice [medical practices] in order to raise the level of specificity*"*(p.10)*. In doing so I apply a process-oriented perspective in which I particularly seek to make visible the emergent and reciprocal shaping of technology and work practice during moments of transformation.

The thesis aims to contribute to *(i) a better understanding of the mutual relationship between tools and work and (ii) providing input to the ongoing efforts of designing and implementing an EPR for nurses.*

Through detailed, empirically underpinned exploration of efforts of introducing the electronic-based nursing module in practice, the thesis particularly seeks to contribute to our understanding of the ongoing efforts of implementing electronic-based documentation tools for nurses in hospital settings. This also includes contributing to the design and implementation of cooperative technologies in hospitals settings more generally. For example issues and concerns that might arise when new tools are being implemented. How work and documentation practices are transformed in the process

and what means are initiated to resolve difficulties in integrating new tools with existing work practices? Also, through the specific focus on technologies for cooperation, the thesis seeks to contribute to similar discourses in the Information systems community in general and the Computer Supported Cooperative Work (CSCW) -community in particular.

1.5 Theoretical perspective

A main focus in this thesis is on the tension between representations of (cooperative) work, such as nursing plans, and the way work unfolds in everyday practice (see Bowker and Star, 1999; Fitzpatrick, 2000; Hardey et al., 2000; Ellingsen and Monteiro, 2003b). Theoretically I apply a perspective on the nursing record in practice that does not merely consider it to be a technical or neutral device, ready to be put into use, but rather as socially constructed and achieved as a result of negotiation processes (Bowker and Star, 1999; Lachmund, 1999; Hanseth and Monteiro, 1997). This makes it imperative that the nursing record is studied in use. It entails a firm analytical and operational understanding of the rich and complex communication and cooperation that takes place around particular patient groups. For example the long traditions of professionalization and specialization of healthcare work (see Strauss et al., 1985), the prevalent existence of highly local and informal ways of coordinating and interacting (see Nygren and Henriksson, 1992; Heath and Luff, 2000) and the rather complex division of labour characterizing modern healthcare institutions (see Atkinson, 1995).

In order to handle the complexity in play, the thesis draws on Science and Technology Studies (STS) in general and Actor Network Theory (ANT) in particular (see Sismondo, 2004; Latour, 1987; Law, 1992; Callon, 1986; Monteiro, 2000; Walsham, 1997). The usefulness of ANT is particular its emphasis on the interaction between the social and technical. ANT thus provides an opportunity to explore how various heterogeneously distributed human and material arrangements contribute to the delivery and documentation of healthcare services.

Material arrangements, such as the nursing plan, are essential for the cooperation and coordination of work that takes place around specific patient groups. This is also a key issue in the field of Computer Supported Cooperative Work (CSCW). CSCW is a design-oriented discipline that stresses the relationship between representations of cooperative work and the way it unfolds in everyday practice. CSCW literature is literally filled with examples of how this gap is being handled in practice (see Suchman, 1987; Schmidt and Bannon, 1992; Heath and Luff, 2000). The thesis draws on and intends to contribute to this strand of CSCW literature.

Finally, with the fundamental aim of the EPR being how to enable experience sharing among a distributed group of users, the thesis is inspired by the practice oriented literature on work and knowledge sharing (see Wenger, 1998; Walsham, 2001; Brown and Duguid, 2000; Orr, 1996; Boland and Tenkasi, 1995).

The theoretical perspectives grounding this thesis will be described in more depth in Chapter 2.

1.6 Research results

The overall study is based on my experience and fieldwork from four different implementation efforts in four hospitals. Empirically the papers included in this thesis

are primarily drawing on data from the two most extensive case studies, which are at the Department of Rheumatology at St. Olavs Hospital in Trondheim and the Department of Special Psychiatry at the University Hospital in North Norway (Tromsø). In both cases the overall aim was to formalize and structure the nurse's documentation of work. However, the actual EPR systems and the strategies for implementing them differed, which of course was an important motivation for choosing exactly these two cases. A main distinction was that in the Tromsø case international classification schemes for nursing were implemented as part of the EPR. In Trondheim on the other hand, the degree of formalization was less rigorous, with no integrated classification schemes being employed (I will return to this case and research setting in Chapter 4).

Based on the efforts of the nursing practitioners that I have had the privilege of following, the thesis has resulted in seven papers. Except the first paper, which primarily is a theoretical paper, all the papers try to disentangle nurse's documentation practice and the efforts of integrating the EPR-based nursing module as part of everyday work. The papers are the following:

1 Berntsen K., Munkvold G. and Østerlie T. (2004) Community of Practice versus Practice of the Community, Knowing in Collaborative Work, in *ICFAI Journal of Knowledge Management*, 2(4), pp. 7-20.

2 Munkvold G. (2005) Practice-Based Knowledge Integration, in David Schwartz (Ed.): *Encyclopedia on Knowledge Management*, IDEA Group Inc., 2005, ISBN 1-59140-573-4.

3 Munkvold G., Ellingsen G. and Monteiro E. (2007) From plans to planning – the case of nursing plans. Accepted for publication and to be presented at *Group 2007*.

4 Munkvold G., Ellingsen G. and Koksvik H. (2006) Formalizing work – reallocating redundancy, in *Proceedings of the 2006 20th anniversary conference on Computer Supported Cooperative Work (CSCW)*, November 2006, Banff Canada

5 Munkvold G. and Divitini M. (2006) From storytelling to reporting - converted narratives, in *Proceedings of MCIS'06, the Mediterranean Conference on Information Systems*, October 2006 Venice, Italy.

6 Ellingsen G., Monteiro E. and Munkvold G. (2007) Standardization of work: co-constructive practice, *The Information Society 23, pp.1-18*.

7 Munkvold G. and Ellingsen G. (2007) Common Information Spaces along the illness trajectories of chronic patients. *Proceedings of the 10th European Conference on Computer-Supported Cooperative Work*, September 2007, Limerick, Ireland. pp. 291-310.

The papers have been written with different co-authors at various stages in my work. The sequence of them, as it is arranged above, also resembles the order in which the actual work has been done. It has been an enlightening journey, with contributions from a network of people and arrangements that go far beyond the author-names on the papers. This thesis is thus the outcome of a prolonged and heterogeneous effort involving a vast number of actors to whom I owe a debt of gratitude.

The relationships between the research questions and the papers are illustrated in the figure below.

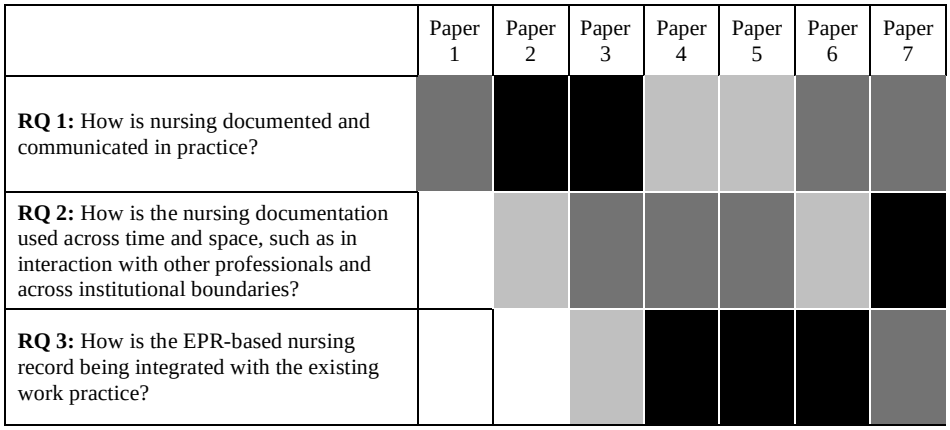


Figure 1: The contribution of the various papers to the research questions – the strength of the individual papers in relation to the individual research questions is denoted by the darkness of the colour.

The figure should be read as follows: the darker the colour the stronger the contribution to the individual research questions. For example, Paper 1, which basically is a theoretical paper, contributes only to research question 1 (RQ1). Paper 2 also primarily contributes to RQ1, but is also addressing issues related to RQ2. Paper 3 is partly based on empirical data from both before and during the implementation of the EPR-based nursing module. Its contribution is strongest in relation to RQ1 and weakest in relation to RQ3. Papers 4, 5 and 6, which all are based on empirical material from the overall implementation process, contribute strongest to RQ3, while Paper 7 more specifically contribute to research question 2.

The sequence of papers also denotes another important aspect. That is the analytical perspective (see Chapter 2). I have, from the outset, had a strong focus on how things are done in practice and the role of material artefacts. All papers are addressing issues related to the materiality of knowing (see Orlikowski, 2006; Hanseth, 2004). However, Papers 1,2 and 5 depart from practice-based theories of knowledge sharing (see Wenger, 1998; Boland and Tenkasi, 1995), whereas Papers 3, 4, 6 and 7 are primarily dealing with the CSCW literature on formalization and coordination of work (Suchman, 1987; Luff et al., 2000).

Empirically there has been a drift from a single tool perspective (Paper 2) towards looking at work as an accomplishment of a network of material artefacts, structures and people (see Paper 3).

More details on the papers will be presented in Chapter 6.

1.7 The structure of the remainder of the thesis

The remainder of the thesis is organized as follows. Chapter two elaborates more extensively on the theoretical basis of this thesis. In Chapter three I present some of the challenges related to the computerization of nurse's written accounts and summarize the efforts of implementing the nursing documentation within the Norwegian healthcare context. In Chapter four, the two cases upon which this thesis is based are outlined. Chapter five presents the research design, followed by Chapter six where I summarize the results (the papers) in more detail. In Chapter seven the implications are outlined and finally I conclude the thesis in Chapter eight.

2 Theory

The thesis is an in-depth investigation of the formalization of nurse's documentation practice. Three theoretical aspects have been fundamental to this end. First, my work has been greatly inspired by the literature on the social and situated nature of knowledge and working (see Wenger, 1998; Suchman, 1987). I thus start by presenting this view, and in particular its usefulness for understanding the relationship between knowledge-sharing and information system usage. My focus here is not on knowledge in itself, but rather on how people work, how they communicate and coordinate actions. Knowledge in this sense is shaped in practice.

Second, infrastructural arrangements, such as the EPR, are crucial for the cooperation and coordination of work that takes place around specific patient groups. This is also a key issue in the field of Computer Supported Cooperative Work (CSCW). CSCW is a design-oriented discipline that stresses the relationship between representations of cooperative work and way it unfolds in everyday practice. CSCW literature is literally filled with examples of how this gap is being handled in practice (see Suchman, 1987; Heath and Luff, 2000; Orlikowski, 1992; Gasser, 1986; Star and Strauss, 1999; Schmidt and Bannon, 1992; Ellingsen and Monteiro, 2003b; Tjora, 2004). My work is inspired by this strand of CSCW literature and this is also an area were this thesis aims to make a contribution.

Third, the existing CSCW literature is predominantly emphasizing "tools" and "support" and has to a minor degree focused on how the relationship between the two might induce change. This thesis seeks to contribute to bridge this gap. In doing so I draw on science and technology (STS) studies in general and the literature on Actor Network Theory (ANT) in particular. Here, the use of the EPR-based nursing record is conceptualized as a co-construction in which the tools are both shaping and are being shaped by the local work practice (see Timmermans and Berg, 1997).

2.1 Reconciling the tension between codifying and representing work and the way work unfolds in practice

Contemporary visions of seamlessly integrated healthcare services have put rather strong pressure on the sector to become more uniform, standardized or mirroring 'best practices'. The codification of knowledge and integration of computer-based systems in existing healthcare practices represents one fundamental element in this respect (Grimson et al., 2000; Monteiro, 2003). At the same time, in practice people work in an ad-hoc fashion, adjusting their actions according to the situation at hand and the contingencies that may arise (see Suchman, 1987; Heath and Luff, 2000; Orr, 1996). As such the delivery of care is as much driven by a need to customize services to special needs and local circumstances. As Orr (1996) puts it:

> *"We are left, then, with a possible conflict between work as doing ... and work as activities explicitly described or prescribed" (p.10).*

From a knowledge-sharing perspective this tension is commonly referred to as that between narrative forms of knowledge and codified forms (see Brown and Duguid, 2000; Boland and Tenkasi, 1995; Orr, 1996; Walsham, 2004). Nursing work is a vivid example in this respect, characterized as it is by its perception of not being standard but sensitive to specific customers needs (Alvesson, 2001).

The potential value of codifying knowledge is extensively debated in the literature (see Nonaka and Takeuchi, 1995; Cook and Brown, 1999; Walsham, 2001; Carlsen, et al., 2004; Fitzpatrick, 2003; Boland and Tenkasi, 1995; Blackler, 1995; Alvesson, 2001; Gherardi, 2000). Critical remarks have in particular been related to the idea of knowledge being something that can be objectified and easily shared and combined (see Blackler, 1995; Walsham, 2001; 2004). According to Fitzpatrick, (2003), strategies of supporting knowledge sharing, even in large-scale communities, should rather focus on the interactive, human-to-human processes in which knowledge is nurtured locally or across settings. This contradicting view underscores how knowledge is always crafted in practice and intrinsically tied to its context (see Cook and Brown, 1999; Walsham, 2001; Fitzpatrick, 2003; Carlsen, et al., 2004). Commonly referred to as Communities of Practice (COP) (Wenger, 1998), it demarcates a shift away from knowledge as an entity towards knowledge as a process of communicating and coordinating actions. Accordingly, knowledge sharing is assumed to evolve in networks and through sense-making processes. As Boland and Tenkasi (1995) put it:

> "*[a process of] sense-making, in which the unique thought worlds of different communities of knowing are made visible and accessible to others" (p.359)*

Orr (1996) provides an illuminating example in this respect through his account of a group of Xerox repair technicians that were able to disentangle and solve copy machine problems by meeting regularly in informal common areas and trading stories and insights around their work on the machines. According to Orr (1996), these activities were an essential part of becoming, being and remaining a good technician. It was how the technicians learned and improved their skills, how they formed bonds as a community of practice and how they cultivated knowledge and expertise amongst themselves. The technicians were able to construct a shared understanding out of bountiful of conflicting and confusing data, highly situated and highly improvizational. What was learned and shared was closely connected to the conditions in which it was learned.

One the one hand the 'codified' perspective tends to downplay to the level of non-existence the contextual side of knowledge (see Fitzpatrick, 2003). Similarly, the practice perspective tends to disregard the role of codified representations of knowledge (Nonaka and Takeuchi, 1995). This thesis is not an attempt to engage in a debate for or against the one or the other. My focus is rather on how the two come together in practice. Of course all representations of work will inevitably lose detail compared to the way work is accomplished. That is their purpose. The question to pursue is rather whether these representations of work accomplish what they are supposed to do, which is to serve as a platform to raise an information system from. As such, in this thesis I focus on how work is achieved, communicated and coordinated in practice (see Wenger, 1998; Suchman, 1987). I will return more explicitly to this in Section 2.3 by drawing on Science and Technology Studies (STS) in general, and concepts from Actor Network Theory (ANT) in particular (see Latour, 1987; Sismondo, 2004).

Briefly, the STS-related literature emphasizes how individual knowledge entities are intrinsically tied the particular artefact in which they are recorded and specific situations they are being used (see Hanseth, 2004; Orlikowski, 2006). Knowledge sharing thus always involves a process of transformation. As Winthereik and Vikkelsø (2005) put it: *"information simply cannot be transmitted between settings without also being changed" (p.47)*. Implicitly this implies that individual knowledge

entities are always embedded in a broader context of human actors and relevant material artefacts. Individual knowledge entities are thus, as Timmermans and Berg (2003a) suggest are, *"viewed as one actor among many in changing configurations of social and technical elements" (pp.103-104).* In this sense a shift away from knowledge as entity towards a focus on how work is achieved in practice is emphasized in this thesis (for similar approaches see Berg, 1997; 1999b; Hartswood et al., 2003; Ellingsen and Monteiro, 2003b; Winthereik and Vikkelsø, 2005; Vikkelsø, 2005).

In terms of knowledge sharing this makes it relevant to attend to how and what is accomplished by bringing together various knowledge entities in practice. For example, in practice, information from the electronic patient record, nursing plans, clinical specific systems and other systems are often copied and printed out on paper to become usable in everyday work (Hardey et al., 2000; Ellingsen and Monteiro, 2003b).

2.2 Work as a cooperative enterprise

The idea of codifying and sharing knowledge assumes a cooperative activity. This is also an essential idea behind the EPR. Designing and using EPRs thus fits well into the agenda of Computer Supported Cooperative Work (CSCW), a field whose primary concern is the design and use of computers to support cooperation (Schmidt and Bannon, 1992; Grudin, 1994a; Carstensen and Schmidt, 1999).

CSCW - the turn towards the social

The turn towards practice, as briefly discussed in the previous chapter, has been very influential for the development of the CSCW. It has in particular aimed at compensating for an apparent lack of focus on the social aspects of work. A main focus has been the tension between formal representations of (cooperative) work, such as plans, procedures and schedules, and way work unfolds in everyday practice. As Suchman (1987) argues, plans are not complete abstractions of action, but rather "*artifact[s] of our reasoning about action*" (p.39). Furthermore, on the notion of shared knowledge, Schmidt (2000) claims that:

> *"the notion of 'shared knowledge', which spontaneously crops up in CSCW contexts, ignores the work required to make knowledge 'shared'" (p.144).*

A main objective in CSCW is to make room for adaptable and efficient use of tools by balancing the level of system control with flexibility in use. This has to be done based on a deliberate portrayal of the details of existing work practices. Accordingly so-called workplace studies (Luff et al., 2000) have increasingly become an important approach and contributed significantly to CSCW. To mention but a few; Gasser's (1986) demonstration of how people work around systems in ad-hoc fashions to compensate for errors and glitches; Ciborra's demonstration of how rigid and inflexible collaborative systems inhibit improvisation (Ciborra, 1999); the work on articulation work (Star and Strauss, 1999; Schmidt and Bannon, 1992) and common information spaces (Schmidt and Bannon, 1992; Bannon and Bødker, 1997; Bossen, 2002), which is placed at the core of the CSCW agenda; Heath and Luff's exploration of face-to-face interaction in computer mediated environments (Heath and Luff, 1992a); The notion of awareness (Dourish and Belotty, 1992) and coordination

(Schmidt and Simone, 1996), which both have contributed directly to the design of cooperative systems (or groupware) (see Gutwin and Greenberg, 2001).

Among these various topics, two are of special interest to this thesis. These are *Common Information Spaces* (CIS) and *Redundancy*.

The notion CIS was originally proposed by Schmidt and Bannon (1992) as a response to the somewhat objectified perceptions of how information is made common or shared among actors whose work activities interleave:

> *Cooperative work is not facilitated simply by the provisioning of a shared database, but rather requires the active construction by the participants of a common information space where the meanings of the shared objects are debated and resolved (p.22).*

Within CSCW the notion of CIS is typically used as a framework for analysing cooperative work. It has a specific focus on interrelationship between actors and artefacts and aims at refining our understanding of how artefacts support coordination and articulation work in cooperative settings (Schmidt and Bannon, 1992; Bannon and Bødker, 1997; Randall, 2000; Bossen, 2002).

CIS comes in many forms and is used in various contexts (see Bannon and Bødker, 1997). More recent developments have particularly emphasized its strength as a framework to analyse problem-solving activities in heterogeneous work settings (Bossen, 2002; Rolland et al., 2006). Typically these involve places and situations with a high degree of inter-communication and "*where the meanings of the shared objects are debated and resolved*" *(Schmidt and Bannon, 1997 p.27).* CIS is handled in more depth in Paper 7.

Redundancy has also become a topic of interest to the CSCW community. Generally, redundancy and overlapping information sources are considered potential sources of error and thus obvious candidates for removal. However, various CSCW-relevant studies have pointed out this might not always be the case. Rather they are considered sources for reliability in cooperative work (Perrow, 1984; Hutchins, 1995; Ellingsen and Monteiro, 2003b; Tjora, 2004; Cabitza et al., 2005). The redundant character of artefacts and information contributes in making components robust since if one "*component fails for lack of knowledge, the whole system does not grind to halt" (Hutchins, 1995 p.223).*

Within healthcare, more recent work on redundancy includes Tjora's discussion of redundancy in relation to medical emergency call centres (AMK) in Norway (Tjora, 2004), Ellingsen and Monteiro's (2003b) comparison of redundancy in different medical settings and Cabitza et al. (2005) who consider redundancy in relation to how nurses coordinate both internally, among themselves, as well as with physicians and across healthcare units. In all of these studies, redundancies are considered a significant source of reliability in cooperative work. For example, the way information from different sources may be compared in order to ensure proper information quality and the way redundancy enables people to pay attention to a broader work context, far beyond their primary work setting. This has specifically been demonstrated in this thesis (see Papers 3, 4 and 5).

CSCW and facing the broader context

While important for our understanding of the role of technology in cooperative settings, contributions within CSCW have also been criticized. Broadly, two types of critiques can be identified in the literature. First, contributions within CSCW are predominated by a focus on *singular technologies and small-group interactions* (Aanestad, 2002; Ellingsen, 2003; Grudin, 1994b; Bannon, 1998). For example paper artefacts, shared information displays and monitors (see Heath and Luff, 1992b), shared electronic workspaces (Olson and Olson, 1996), non-digital editable large displays (Olson et al., 2002), regular off-the-shelf products (Grudin, 1994b). As Bannon (1998) points out:

> *"…many adherents of this view tend to focus on small teams or homogeneous groups with convivial work relations, and thus pay little attention to settings in everyday organisational life where issues such as power and politics play a large role" (p.41)*

The lack of focus on the broader context issues can in fact be traced back to the initiation of the CSCW-field as an autonomous research domain (see Grudin, 1988). A prominent example in this respect is Orlikowski's (1992) portrayal of the implementation of Lotus Notes in a consultancy firm. Orlikowski (ibid) demonstrates how an inconsistency between the systems design and company culture, policies and reward systems, resulted in a system that was not used as intended. Another, equivalent example is provided by Bowers (1994). Based on a study of the implementation of a network devoted to run CSCW-related applications in a governmental organization in the UK, Bowers (ibid) call upon the CSCW-community to move out of the laboratory and into real use contexts.

Second, the CSCW field has been centred on *existing* work practices and the consequences of eliminating them (see Heath and Luff, 2000; Nygren and Henriksson, 1992; Tjora, 2004; Hutchins, 1995; Ellingsen and Monteiro, 2003b). This has been a fundamental aim in most workplace studies and corresponds well with a relative prolonged CSCW-tradition:

> *"One of the striking features of the CSCW literature is the way many designers try to respect the ways people actually organise and use information" (Kling, 1991 p.84)*

No doubt workplace studies have been extremely important for the development of CSCW. Yet, there are relatively few that actually address and provide insight on the transformation itself. New technologies will inevitable influence the way work is performed and, when put into use the technology itself will change according to the same logic.

CSCW and the relationship between the technical and the social

Based on a review of 188 IT-related research papers, Orlikowski and Iacono (2001) found that alarmingly little consideration were given to the IT artefact:

> *"the lack of theories about IT artefacts, the ways in which they emerge and evolve over time, and how they become interdependent with socio-economic contexts and practices, are key unresolved issues for our field and ones that will become even more problematic in these dynamic and innovative times." (p.133).*

This relative lack of focus on the IT artefact is identified by several authors (see Benbasat and Zmud, 2003) and is also characteristic for CSCW.

New technologies are not merely neutral devices ready to be put into use. Rather they are embedded in a sociotechnical context and achieved as results of negotiation processes (Bowker and Star, 1999; Lachmund, 1999; Hanseth and Monteiro, 1997). As Timmermans and Berg (2003a) suggest: *"technology might do things, but what it does and how it accomplishes something remains an open empirical question"(pp.103-104).* If then the technology is evaluated independently of the social context, there is a risk of failing to explain the fluid relationship between the social and the technical.

As mentioned in the previous section, the CSCW literature is predominated by a focus on either "tools" or "existing practice" and has to a minor degree focused on how this relationship might induce change - both in the work practice and in the tool itself. Berg (1999b) refers to this as the transformative potential of the tool:

> *"The mutual activities of tools and staff members are made possible through their interrelation, and, at the very same time, this interrelation affords the emergence of an overall activity that surpasses the individual contributions that both could be discerned to have" (p.385)*

Based on an in-depth empirical study, Berg (ibid) illustrates each minute part of a work process aiming at documenting a patient's fluid balance, which is a sum of what fluid goes in and what comes out. By observing and recording each minute detail of a particular process the separate elements are identified. This 'hybrid' comprises everything that is needed for the activity to proceed including several people, various artefacts, routines and experiences.

Berg (ibid) emphasizes the 'process' where the technology (e.g. EPR) continuously interacts with the work practice as a co-construction. In the healthcare context, there is a growing body of CSCW-related work that analytically draws on such an approach (see Berg, 1997; Winthereik and Vikkelsø, 2005; Ellingsen and Monteiro, 2003b; 2006; Aanestad, 2002; Rolland et al., 2006).

2.3 Conceptualizing the relationship between the social and the technical

Giving voice to the material artefacts – Actor-Network Theory

The hereditary roots of the co-constructed approach reside in a broader theoretical landscape called Science and Technology Studies (STS). STS is an interdisciplinary field whose fundamental claim is that technology (and science) are entirely constructed in social activities (Pinch and Bijker, 1987; Williams and Edge, 1996; Latour, 1987; Sismondo, 2004). While the broader STS field embraces a handful of approaches, far beyond the scope of this thesis, the particular approach inspiring my work is Actor-Network Theory (ANT) (Callon, 1986; Latour, 1987; Law, 1992; Monteiro, 2000; Walsham, 1997). For an excellent historical overview of STS, see Sismondo (2004).

ANT stresses the relationship between formal constructs, or rules, and human conduct. Within the IS-field, it can be positioned together with other, similar approaches that consider the tension between the technical and the social. For

example Structuration Theory (see Orlikowski and Robey, 1991) and Activity Theory (see Engström and Middleton, 1996; Engeström, 2000).

Whereas the literature reveals conflicting arguments on the potential contribution of the different theories to the relationship between the social and the technical (see Bratteteig and Gregory, 1999; Monteiro and Hanseth, 1995), ANT is argued to be the only one that really gives a voice to the technical, and thus contributes to theorizing the IT artefact (see Monteiro and Hanseth, 1995; Hanseth et al., 2004).

ANT is not a theory that tells us *about* the phenomena we are studying. Rather it tells us *how* to study it. It makes two essential claims in this respect. First, technology and/or society are not treated as explanatory resources, but rather as effects or outcomes (Law, 2004). In this sense, I do not depict effects caused by the EPR in this thesis, but rather the efforts (social as well as technical) of making the EPR work in concrete healthcare practice. Second, ANT provides a vocabulary to analyse the relationship between the technical and the social by seeing the 'world' as constituted by a heterogeneous network of actants (Latour, 1987; Law, 1992; Monteiro, 2000; Walsham, 1997). The term actant embraces all kinds of entities endowed with the ability to act, such as humans, artefacts, manuals, norms, routines and organizational arrangements. In this sense ANT is a symmetrical approach, as it does not give preference to the technical or the social in explaining social order (Latour, 2005).

The Actor-Network and aligning interests

Actors build networks. Where exactly to draw the border between what is inside and what is outside the actor-network is not an easy task however. According to Law (1987) the boundary of the network can be discerned by the identifying the nodes (actant) that make themselves relevant for the network. However, actors 'come and go' and thus the relevance of an actor in a network is not fixed but rather changes contingently depending on the interests of its constituting actors.

ANT focuses in particular on how actor-networks overcome resistance, or become stabilized (or not). A stabilized network is one whose interests are aligned and that acts coherently. This might materialize as technologies, artefacts, rules, a community of workers, etc. What ANT offers in this respect is a vocabulary to describe and analyse how stabilized networks are produced and/or maintained (see Latour, 1987; Walsham, 1997). Key concepts here are *translation* and *inscription*.

Translation refers to the process of negotiating interests. Walsham (1997) describes this process as an effort of creating a body of allies (human and non-human) through translating their interests to be aligned with the actor-network. A stabilized network is one in which the interests of the separate actors are aligned (for a more detailed description of this process see Callon (1986)).

Inscriptions on the other hand are the result of translating interests into material form. The term refers to the way technical artefacts might embody patterns of use (Monteiro, 2000) and is commonly denoted as an inscription device. An inscription device has two fundamental characteristics (see Latour and Woolgar, 1986). First it holds up in Euclidean space. It remains physically the same regardless of its geographical location. Second, it arranges a patterned set of relations. These relations inscribe a potential reality. Inserted into the right set of relations somewhere else, the inscription device points to and helps to produce the same reality. This resembles what is referred to as immutable mobiles (Latour, 1987). As I will return to below,

this term is further elaborated in later versions of ANT (see Laet and Mol, 2000; Moser and Law, 2006).

The strength of an inscription depends on the irreversibility of the actor-network they are inscribed into (Monteiro, 2000). Irreversibility denotes to what extent it is possible to return to a preceding point where alternative possibilities exists (Walsham, 1997). The hotel key example by Latour (1991) is a brilliant example in this respect. Latour (ibid) describes how interests are translated and irreversibility achieved. The desired behaviour among the hotel guests is gradually invoked through successive changes to a hotel key network.

Irreversibility might also denote a network of elements that has become black boxed. A black box is a network that has become naturalized into a context - made invisible by its own 'success'. Whether an entity is a black box or not depends on the stability of the actor network it is embedded into. A TV for example, is a black box as long as one only needs to attend to its inputs and outputs not its internal complexity. However, if it breaks, the 'black box' will for sure reveal some of its 'latent secrets'.

Recent developments in science and technology studies – the performative turn

In more recent ANT achievements, commonly referred to as the 'performative turn' (Law and Singleton, 2000; Law, 2004; Laet and Mol, 2000; Berg and Timmermans, 2000), there is a distinct shift away from the singular towards the multiple. For example, rather than focussing on the singular, stabile and immutability of entities, emphasis is on how entities are performed in different ways by different actors. It is an ongoing process in which entities constantly change both in "*content [and] in its surrounding network of relationships*" (Rolland et al., 2006 p.498) and in heterogeneous contexts, it is this mutability that produces sameness (see Laet and Mol, 2000).

The thesis is inspired by these more recent contributions to ANT and draws particularly on the literature that discusses the reciprocal relationship between formality and informality (see Berg and Timmermans, 2000; Law and Singleton, 2005). The opposite of a formal practice is an informal practice. Yet, as Berg and Timmermans (2000) describe formality and informality define each other:

> *"The order and its disorder…are engaged in a spiralling relationship – they need and embody each other" (p.37).*

A formal work practice defines borders for its hegemony. What is beyond its borders is therefore informality.

> *An object [the formal work practice] is a presence. It is present, here and now. But, whatever the form of its presence, this also implies a set of absences [the informal work practice]. The present object implies realities that are necessarily absent, that cannot be brought to presence; that are othered. So, to put it slightly differently, an object is a pattern of presences and absences (Law and Singleton, 2005 pp.342-343)*

To instantiate my practical point, establishing a more formal work practice inevitably will induce changes in the informal practice, perhaps requiring an even more informal practice. Or to put it to an extreme, what if efforts of producing formality always simultaneously produce the opposite (informality). As Berg and Timmermans (2000) have observed in their work with formalized medical protocols:

> *"[T]he two orders [referred to, i.e. two alternative clinical treatments] we have described produce the very disorder they attempt to eradicate" (p.45)*

For the purpose of this thesis, the distinction between formality [order] and informality [disorder] has been particularly valuable for analysing the efforts of formalizing nurses written accounts.

3 Formalizing nurse's written accounts

Current efforts of integrating nurse's written accounts with the EPR are closely related to contemporary visions of improving efficiency and quality in the healthcare sector. For the nursing community this involves making visible what historically has been invisible. Visibility is the only way to make their practice available for the EPR.

Given the research focus presented in Chapter 1 and the theoretical basis for the thesis presented in Chapter 2, in this chapter I present more specifically challenges related to the computerization of nurse's written accounts. I distinguish between functional and political discourses. The functional perspective stresses how the process of formalizing nurse's written accounts and integrating them into the EPR is in essence a matter of aligning EPR-embedded models of care and work. The political perspective on the other hand emphasizes how the same process is a matter of negotiating interests. In practice these are highly interdependent and thus converge. The main, and most concrete materialization of this convergence is the nursing plan and its embedded terminology. The chapter ends with a brief presentation of the efforts of establishing a foundation for the nursing record within the Norwegian healthcare context. An undertaking that, until recently, had received rather limited interest outside the nursing community itself. Yet, in more recent national healthcare standards and policies, the contribution of the nursing profession to the overall healthcare service is increasingly acknowledged. The written accounts of nurses in this sense have increasingly become more relevant for a wider audience (other professions, managers, vendors, etc).

3.1 From informal to formal

The nursing practitioner takes on many roles and responsibilities and has to master a whole range of skills as they are the only group of healthcare professionals on call 24 hours a day, seven days a week. Work has traditionally been based on a narrative practice as a primary method for communicating information. Informal and personalized recordings of work have been used extensively at the expense of formal, written documentation and specific facts (Manias and Street, 2000; Hardey et al., 2000; Fitzpatrick, 2000). This lack of formality has resulted in a practice that draws extensively on a large body of heterogeneous and redundant information sources, which more often than not is referred to as causes of reduced quality and low efficiency (Baldwin and McGinnis, 1994; Sensmeier et al., 2003; Hannah et al., 2006). As Sexton et al. (2004) put it:

> *"(…) the information presented may be irrelevant, repetitive, speculative or contained in other information sources" (pp.37-38)*

This lack of formality together with the ongoing efforts of implementing EPRs in the healthcare sector has meant that the nurse's documentation practice has gained a lot of international attention lately (Lee, 2005; Getty et al., 1999). Formalization and computerization is expected to improve efficiency and quality (see Lee and Chang, 2004; Voutilainen et al., 2004). As Hellesø and Ruland (2001) suggest:

> *"Information technology has gained a larger and more fundamental role in the management, distribution and storage of information in healthcare. The patient record and electronic nursing documentation is expected to reduce redundancy and increase access to up-to-date information as an integrated part of the EPR" (p.799)*

However, as argued in Section 1.3, the literature reveals a nursing community whose actual compliance to a more structured documentation process is rather low (Björvell et al., 2002; Sexton et al., 2004; Lee and Chang, 2004). This lack of success in formalizing nurse's written accounts seems to rely on a multitude of issues and arguments. Broadly these can be categorized into two interdependent categories; the functional and the political discourse.

3.2 Functional discourses – models of care versus practice of care

From a functional point of view, a primary concern is how to bridge the gap between work practice and information system functionalities. Technically, a system to support the nursing practitioners should aim at, as Berg (1999b) indicates, "*affording an increase in complexity of the work practice without a simultaneous increase in complexity in individual interactions*" *(p.391).*

The written record typically has a specific and narrow purpose. For the nursing practitioners this is a dilemma as the narrative, at times provisional nature of their written accounts makes it extremely difficult to distinguish what nursing actions to include and what to exclude from the official written record (see Manias and Street, 2000; Hardey et al., 2000; Fitzpatrick, 2000). This dilemma of reconciling written accounts with work is not specific to the nursing community. The literature on use of healthcare technologies is literally filled with examples of technologies that do not work as expected, or are not used as anticipated (see Ash et al., 2004).

According to Goorman and Berg (2000) the main problem with current EPR-designs is that the underlying models upon which nursing care is conceptualized is based on "*projections of nurses' and doctors' work as it should be performed (…) rather than depicting how work is actually performed*" *(p.3)*. This gap between models of care and practice of care is what I denote as the functional discourse. Within the healthcare related CSCW literature it can also be identified as a commonly used focus, both empirically and analytically (see Heath and Luff, 2000; Ellingsen, 2003; Hartswood et al., 2003)

In nursing, nursing process model provides an ideal structure for the documentation process. It is commonly used as a framework for designing a more structured, EPR-based nursing record (see Ehnfors, 1994; Wilkinson, 2001; Hellesø, 2000). However, the apparent lack of success of making nurses adhere to a more structured documentation process implicitly indicate that an unwanted discrepancy is enforced by the models on which the EPR is based and the actual work practice. Allen (2004) responds to this problem by identifying eight interrelated tasks that together represent an expression of what nurses actually do in practice. Subsequently a reformulation of the nursing agenda is proposed that moves away from contemporary perspectives on nursing as patient centred and emotional, and rather focuses on their role as healthcare mediators (ibid). Implicitly, this entails putting more emphasis on the complex, heterogeneous and cooperative nature of nursing - the type of work that traditionally has been invisible and considered irrelevant for the nursing record.

The focus on the nurse's role as healthcare mediators resembles what is commonly referred to as articulation work (Schmidt and Bannon, 1992; Gerson and Star, 1986). Articulation work is fundamental for any kind of cooperative activity as it is this that preserves the flow of work in any distributed activity:

> *All tasks involved in assembling, scheduling, monitoring and coordinating all of the steps necessary to complete a production task. This means carrying*

> *through a course of action despite local contingencies, unanticipated glitches, incommensurable opinions and beliefs or inadequate knowledge of local circumstances. (Gerson and Star, 1986 p.76)*

To ensure a continuous and integrated delivery of healthcare services, the articulation work done by nurses is crucial and, as Allen (2004) argues, it is this type of work that the EPR-based nursing record should be founded on rather than ideal nursing process models. This tension between work and models for representing work (i.e. as represented in EPRs) serves as a basis for the functional discourses.

3.3 Political discourses – negotiating interests

As pointed out above, the nurse's contribution to treatment and care has historically been invisible (Allen, 2004; Bowker and Star, 1999; Bowker et al., 2001). Their written accounts have been among the first to be removed when patients are discharged from hospitals (Star and Strauss, 1999). Given their role in ensuring a well functioning organization and seamless management of patient trajectories, this lack of importance that is given to their written accounts is rather surprising (Bowker et al., 2001). Politically, this is emphasized as being a problem of reconciling the cultural and historical context of the nursing profession with, e.g. other healthcare professionals. Rafferty (1996) provides a fitting description in this respect:

> *" Nursing freedom to expand intellectually and, I would argue, politically hinges upon its power relations with kindred disciplines, such as medicine and social work, as well as its wider social attitudes towards class, gender and mind/manual labour (…) nursing identity is not 'pure' but the product of a mixed marriage" (p.188).*

As intermediaries the nursing practitioner in particular, is located in the middle of a collective and heterogeneous enterprise. To be fully recognized and valued, they must thus be able to communicate their activities clearly to all stakeholders. One the one hand this implies, as Star and Strauss (1999) put it: "*to disembed what has previously been deeply embedded, invisible work done by nurses, and make it visible to the medical record*" *(p.20)*. On the other, doing so is a process filled with negotiations and tradeoffs related to what aspects of nursing actions to disentangle and make visible and what to leave silently in the background (Timmermans et al., 1998). As Bowker et al. (2001) suggest:

> *"(…) a record helps to build a knowledge base for the development of scientific nursing and for teaching. In addition (…) it allows both the integration of nursing informatics into medical informatics and the recognition of heretofore invisible nursing work by hospital information systems, accounting information systems, and the electronic medical record (…) On the other hand, visibility has inherent dangers. Many nurses feel that the classification does not properly reflect the process-oriented -- and indeed "invisible"-- nature of their work. Further, such a representation risks exposing nursing to process re-engineering which could result in the reassignment of the 'unskilled' portions of nursing work" (pp.1-2)*

From a political point of view, this diversity of expectations makes the formalization and integration of their written accounts into the EPR, an ongoing process of negotiating nursing interest with the interest of various stakeholders (see Bowker and Star, 1999). Ellingsen and Monteiro (2003a) provide an interesting example in this

respect. They demonstrate the investments involved in establishing an EPR in Norwegian university hospitals. The process is described as being complex with numerous stakeholders and competing agendas, in which large-scale initiatives tend to be privileged at the expense of small-scale bottom-up approaches.

3.4 Convergence and its materialization – nursing plans

The efforts of formalizing and computerizing nurse's written accounts is deeply embedded within a broader clinical context of professionalization, institutionalization, codification and standardization of terminology and practice (see Berg and Timmermans, 2000). The functional and political are in this sense intrinsically intertwined and shaped as a collective enterprise through the relations and actions of its participating actors (Casper, 1998). Deciding the structure and content of EPR-based nursing records thus is not only a matter of defining, but also matter of obtaining and integrating - a mutual constitutive process between various representations of work and work itself. Star et al. (1997) refer to this as the process of convergence:

> *"the double process by which information artefacts and social worlds are fitted to each other and come together (…) information artefacts undergird social worlds, and social worlds undergird these same information resources" (ibid).*

In nursing, the main materialization of this convergence, are the nursing plans. Nursing plans are expected to ensure a seamless flow of information within and across professional and institutional boundaries (see Voutilainen et al., 2004), which then also places them at the core of current ambitions of creating more integrated healthcare services.

A nursing plan is essentially a canonical overview of probable nurse-related problems for a particular patient group combined with relevant interventions and outcomes. With its embedded terminology, it is an example of what Timmermans and Berg (2003b pp.24-25) denote as procedural and terminological standards.

Procedural standards refer to the ongoing effort of standardizing medical work through entities such as clinical guidelines, protocols and nursing plans. The overall objective is to establish 'best practice' that "*delineate a number of steps to be taken when specified conditions are met*" (Timmermans and Berg, 2003b p.25). Procedural standards are in this sense assumed to (i) increase quality of care as they "*maximise the likelihood that the same thing is being done to each patient"* (Coiera, 2003 p.146) and (ii) reduce costs:

> "*Over the past three decades, public and private purchasers turned to managed care plans to stimulate greater hospital competition and reduce hospital expenditures and costs" (Devers et al., 2003 pp.419-420).*

Terminological standards refer to canonical terms that allow stability of meaning across time and place. They enable large-scale planning opportunities for its users as well as for national health authorities and international health organizations. Within the clinical context the international classification of diseases (ICD) is maybe the most common and well-known example in this respect. Terminology standards in nursing on the other hand, is a relative new phenomenon. The first initiative originates back to the early 1970s when the North American Nursing Diagnosis Association

developed NANDA, the first official classification system for nursing diagnosis (McCloskey and Bulechek, 1994).

Among the most significant nursing terminology systems in use today are NANDA, Nursing Intervention Classification (NIC), Nursing Outcome Classification (NOC), International Classification for Nursing Practice (ICNP) and Clinical Care Classification (CCC)[2] (Mølstad et al., 2007; Hellesø and Ruland, 2001). Among these NANDA, NIC and CCC have been translated into Norwegian by the Norwegian Nursing Organization (Mølstad et al., 2007).[3]

The growing interest in classification schemes for nursing has stimulated another, international, effort. In cooperation with the International Council of Nurses (ICN), the International Informatics Association – Nursing Special Interest Group (IMIA-NI) has initiated a project to unite different nursing classification systems and enable mapping of nursing terms with other healthcare terminologies (Saba et al., 2003). The effort has resulted in a reference terminology model for nursing – ISO 18104 that was approved in 2003. It is, as indicated by its name, primarily a reference for terminology for system and software developers. It represents an interesting initiative for the current efforts of designing and implementing EPR-based nursing plans.

3.5 Norwegian efforts in creating a foundation for an EPR-based nursing record

In Norway the very first national attempts to develop a foundation for an EPR-based nursing record was the SykIT-project. SykIT was initially a part of the Norwegian Medakis-project (see Ellingsen and Monteiro, 2003a) - a collaborative effort, including the five regional hospitals and a software vendor (Siemens). Initiated in 1996, Medakis had as its main objective the development of an EPR that incorporated all clinical patient-information in one uniform computer-based system (i.e. DocuLive - EPR).

Disturbed by the lack of attention given to the nursing module in Medakis, SykIT was initiated by the directors of nursing in 1998. A main objective was to define a structure and build up a standardized vocabulary for ´the content of an EPR-based nursing record (see Hellesø and Ruland, 2001). The most important outcome of SykIT was the selection of the VIPS model as the standard model for structuring the nursing record. VIPS is an acronym for well-being, integrity, prevention and safety (main objectives in nursing care). The model is based on a system of keywords that covers the whole nursing process (see Ehnfors, 1994). It thus serves as an ideal basis for facilitating registration and retrieval of data. At the core of VIPS is the nursing plan, which, as described in the previous section, includes the possibility to incorporate international standardized classification systems such as NANDA, NIC and NOC.

Despite these 'early' efforts, the acknowledgement of nurse's written accounts was not really evident in national plans and initiatives until 2001-2002. This in particular included the health reform (see Lægreid et al., 2005; Hagen and Kaarbøe, 2006) and the act on personal health from 2001. This latter initiative (i.e act on personal health) was in fact the first time the nurses legally became obliged to document their actions. Also important was the establishment of KiTH (Norwegian Centre for Informatics in

[2] See e.g http://www.sabacare.com/ (Last accessed May 2007)

[3] Terminology standards in nursing are elaborated on in more detail in Paper 6

Health and Social Care), which had been delegated the task of specifying requirements for the EPR on behalf of the Ministry of Health and Care Services. In close cooperation with the Norwegian Nursing Organization, KiTH launched the first requirements specification for an EPR-based nursing record in 2003 (KiTH, 2003).

Today all the three vendors of EPR systems to Norwegian hospitals have included the EPR-based nursing module in their system. Two of them have explicitly based their design on VIPS, whereas the third has used VIPS merely as an 'inspiration'. The systems are currently being implemented in Norwegian hospitals.

4 The two cases selected for this study

This chapter presents the two cases upon which this thesis is based. The first, and longest, study took place in the Department of Rheumatology at St. Olavs University Hospital in Trondheim, while the second took place in the Department of Special Psychiatry at the University Hospital in Tromsø. In conjunction with performing these case studies, I have also made shorter visits to other hospitals. However as no concrete empirical material from any these visits is used explicitly in the attached papers, these will not be elaborated on. Still the visits certainly have influenced my understanding of the broader context of healthcare and the efforts of implementing an EPR for nurses. I will thus briefly touch upon them when presenting my research approach and reflecting on method in the next chapter.

4.1 Case selection

The thesis is based on empirical data from two independent cases. The first, and longest study took place in the Department of Rheumatology at St. Olavs University Hospital in Trondheim, while the second took place in the Department of Special Psychiatry at the University Hospital in Tromsø. Both cases comply with characteristics as outlined in Chapter 1. This includes two aspects in particular. They both handle patients that suffer from some sort of chronic disorder, which implicitly involves complex and long-term care with input from several healthcare professionals. Also, in both cases the new electronic-based nursing record was replacing the old paper-based documentation practice.

Originally the plan was to follow only the Trondheim case. However, for various reasons and because the project was delayed considerably, I gradually tried to get access to other arenas in which the EPR-based nursing module was being introduced. As I will return to in the following two sections and in the next chapter, the case in Tromsø turned out to be the most interesting candidate in this respect. Also, given the main aim of the study, which was to explore how the relationship between tools for documenting and the work practice changes when an EPR-based nursing module is being introduced (see research question in Section 1.4), it was important for me to get access to an arena in which the EPR-based nursing module was well integrated and used in practice.

The figure below outlines the two cases and the relation between them.

Figure 2: The two cases that have served as an empirical basis for the thesis. The whole process was followed in Trondheim, while in Tromsø I primarily followed the practice during and after the nursing module had been implemented.

As illustrated in Figure 2, in Trondheim the whole transformation process was followed, while in Tromsø I primarily followed the practice during and after the introduction of the system. As I will discuss below, in Trondheim the nurses struggled to integrate the EPR-based nursing record as a part of their documentation practice. This was particularly related to their use of the EPR-based nursing plan, which when I last, formally, visited the unit in December 2005, still was a matter of considerable

concern. In Tromsø on the other hand, the implementation of the system seemed less problematic.

Related to the overall aim of this thesis the discrepancy between the two cases and the way they unfolded makes them complementary. Through the Trondheim case I was able to follow the whole process of implementing the system (before during and after), while the Tromsø case provided the best data in terms of how the new system was actually integrated and used (in the methods chapter I will elaborate in more detail on how the two projects unfolded and the reasons for getting involved in the Tromsø-case).

The figure below presents a brief overview of the context for the two cases, which in the following two sections will be described in more detail. Also, in the methods chapter I will elaborate on how the two projects unfolded and the reasons for getting involved in the Tromsø case.

	Trondheim	Tromsø
Hospital level figures		
- Healthcare region	Mid-Norway	North Norway
- Hospital name	St.Olav Univ. Hospital	Tromsø Univ. Hospital
- Number of employees	8700	4500
- Number of beds	1360	619
- Inpatients per year	60 000	29 000
Units where I did my fieldwork		
- Type of disorder	Rheumatic	Psychiatric
- Type of treatment	Medical and surgery	Environ. therapy and medical
- Number of employees in total (approx)	25	50
- Number of nurses (approx)	20	45
- Number of patients per year (approx)	650	60
- Average hospitalization-length	8 days	6-8 weeks
The project and the nursing module		
- EPR module (replace paper record)	Yes	Yes
- Underlying doc. model for the system	VIPS	12 function areas
- System / Vendor	Siemens DocuLive	DIPS
- Main functionality	Reports and nursing plan	Reports and nursing plan
- Integrated classifications schemes	None	NANDA and NIC

Figure 3: A summary of the two cases where the empirical investigations were carried out.

4.2 The Trondheim case

The hospital and Department of Rheumatology

St. Olav University Hospital is located in the Mid-Norway health region. The hospital is one of the largest in Norway and roughly covers a population of 630 000 people. The hospital has around 8700 employees and 1360 beds spread over a large site. It treats around 60 000 patients per year (inpatients, both somatic and psychiatric) and acts as a national centre of excellence for a number of medical conditions.

The hospital is currently being rebuilt, with around 80% of the current buildings being replaced by new ones. This large-scale transformation of buildings, including technological infrastructure and organizational transformation, is carried out in two phases and will result in approximately 197 500 square metres of new floor area, making it the largest hospital in Norway. The first building phase, which started in

2002 and ended in 2006, included three large hospital buildings of roughly 90 000 square metres and had an estimated cost of roughly NOK 6 billion (approx. EUR 740 million). The second phase, which is due to be completed in 2015, will include the remainder of the buildings and has a cost-framework of approximately NOK 6.3 billion (approx. EUR 780 million).

My fieldwork took place in the Department of Rheumatology, which is due to be moved to a new location sometime during the second phase of the large-scale construction project. Currently the department is situated on the top floor of the six storey cancer building at the far end of the hospital area next to the river Nidelva.

Unlike most units in the hospital, the Department of Rheumatology has its own reception to assist patients, guests and other visitors. The reception is physically placed in the centre of the floor, separating the outpatient clinic from the remainder of the units. There are four units in the department; an outpatient clinic, a centre for mothers with rheumatic diseases, an inpatient unit and a day unit. Put briefly, the primary purpose of the outpatient clinics is to consult and examine patients that do not need to be admitted to the hospital. It has approximately 4000 consultations per year. The centre for mothers with rheumatic diseases gives advice and guidance to women and their relatives on how to handle a rheumatic disorder in everyday life. The inpatient unit (including the day unit where patients are admitted and discharged the same day) offers medical investigation and treatment, as well as professional guidance and education to patients that suffer from a rheumatic disorder.

Patients and types of nursing care

Rheumatic diseases are chronic conditions, a major cause of morbidity throughout the world and a substantial influence on health and quality of life. More than 300 000 people are diagnosed with a rheumatic disease in Norway today. The malfunctions of the musculoskeletal system, which often result in inflammations of the joints- or arthritis, are a primary focus of rheumatology. Rheumatic diseases are heterogeneous, often with a fluctuating but progressive course, and with potentially severe disabling outcome and reduced life expectancy. There are more than 200 different types of rheumatic diseases, however in this department the main focus is on chronic inflammatory rheumatic diseases such as inflammatory joint diseases, spondylarthropathies and connective tissue diseases.

People suffering from a chronic disease are often confronted with disabilities in their daily life and require help from several healthcare professionals in different settings. Patient problems are typically compound and complex and thus various healthcare professionals, with different areas of expertise, are usually involved in treatment and care. Well-functioning communication routines are thus considered crucially important in order to provide a high-quality coordination and flow of work and the patient record is considered crucial to this end. However, the long term and chronic nature of the disease implies a record that contains a substantial amount of information. Hence, distinguishing usable from unusable information is not an easy task. For this reason a lot of information is communicated orally in meetings and informally while working.

My study was related to the work at the inpatient ward, where patients are admitted both for medical treatment and surgery. The ward has 16 beds and is organized as a primary care unit. Approximately 650 patients are admitted per year, with an average hospitalization-length of 8 days. Three physicians and approximately 20 nurses work there together with the physiotherapist, occupational therapist and a social worker.

The nurses in the inpatient ward have many tasks. The nature of the disease typically requires different types of nursing input at different times. Therefore the nursing input to care can vary, from the very essentials of nursing such as help with the activities of daily living, to post-surgery observations, pain management, maintaining tissue viability, patient education, reviewing symptoms, management of drug regimens, management of intravenous drug therapy, providing access to other healthcare givers, and counselling patients who are anxious, depressed or have psychosocial problems. The complex needs of the patients demand that the nurses have a mastery of a whole range of nursing skills.

The project – the introduction of the EPR-based nursing module

Initiated by the nationally established Medina and Medakis projects (see Ellingsen and Monteiro, 2003a), the University hospital has been the arena for a large-scale EPR-implementation effort. Aiming for the 'paperless hospital', huge investments have been made to establish a common EPR infrastructure that cut across organizational, departmental and professional boundaries. The Siemens DocuLive has been, and still is, the agreed upon technical solution to this end. The very first version was introduced in 1998, and still new modules and versions are being implemented. Currently the system is in daily use in all eight hospitals in the Mid Norway health-region.

The EPR-based nursing module was officially made available in DocuLive in October 2004 (approximately six months later than originally planned). The module includes a mixture of separate reports and a structured nursing plan. Through a large-scale project of introducing the system in all hospital units, the old paper-based nursing documents are gradually being replaced. Still some units, both in the hospital and in the broader health region, that have not yet completed the transition.

As mentioned, my fieldwork primarily was related to the introduction of the nursing module at the Department of Rheumatology. I followed two interrelated projects in the inpatient unit; the introduction of the EPR nursing module and a locally initiated effort of improving the handover conference. Main objectives in both projects were to eliminate superfluous, redundant information sources and inefficient working routines. This was to be achieved by (i) establishing electronic, written accounts of the nursing documentation and (ii) formalizing nurse's work related to handover conferences by partly replacing the oral report with a written report. The overall change process took approximately one year. And gradually, as the two projects progressed, they also merged. The handover project became intertwined with the EPR project (see also Papers 4 and 5). The overall process is illustrated in the figure below.

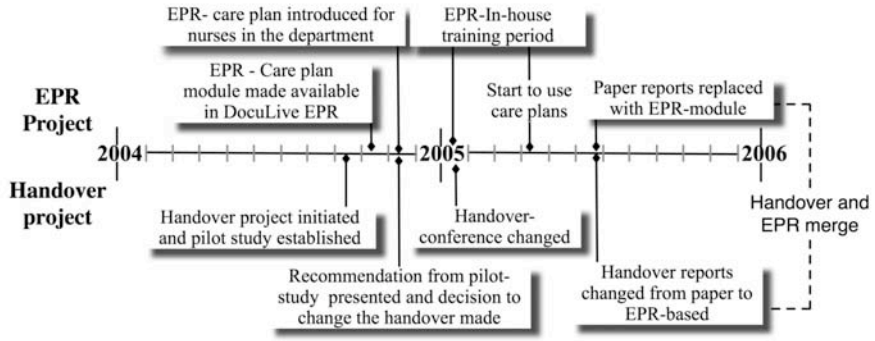


Figure 4: Timeline illustrating the relation between the handover project and the EPR module. Notice how the two merged in June 2005.

My initial objective was to focus only on the EPR project. However, for various reasons the nurses had problems integrating the EPR-based nursing record in general and nursing plans in particular as a part of their documentation practice (see Paper 3). For example, differences among the staff in computer skills, lack of resources allocated to the project, in-house training that was delayed several times due to problems of combining it with the rotation scheme and a lack of specifications about how to actually use the system. In fact, at the time when I ended my empirical investigations, the project was still ongoing and increasingly lagging behind the original schedule. Because of the delays, I gradually focused more on the handover-project.

Milestones in the handover project are illustrated beneath the timeline in Figure 4. Basically the underlying idea was improve the way information was handed over between working shifts by drawing more extensively on the official written documentation during the handover conference (see Papers 4 and 5). The project was a locally initiated project and because of the slow progress in the EPR project it gradually became the focus of my fieldwork. Also, due to the close relationship between the two projects this slight shift of focus was relatively unproblematic. In fact some considered the formalization of the handover conference to be a necessary step in transforming the nurse's documentation routines. As stated by the tutoring nurse at a fairly early stage:

> *(…) my hope for the EPR is that we become better in thinking problem, intervention, evaluation [main elements in nursing plan]. This will help us systematize and improve our thinking (…) to have a high-quality oral report might lower he quality of the written documentation. My opinion is that by gradually structuring our written accounts, we eventually will have to learn to use the written documentation in a different way (tutoring nurse).*

Two of the papers in this thesis address the relationship between oral practices and the written documentation in the context of the handover conference (see Papers 4 and 5).

The nursing module in Siemens DocuLive

The system itself, the nursing module, is based on the various documents found in the old paper-based nursing record. Not reproduced copies of the old paper, but digitalized and customized according to the specifics of the tasks to be supported. For

example in the paper-based nursing record, documents like the nursing report, the admission note, and so on were all put in one and the same form (named G2), whereas in the new electronic-based record separate forms have been created for different tasks (e.g. nursing problem form, nursing intervention form, nursing outcome form, admission note, nursing discharge summaries, various letters and letters from notes, etc). The EPR-based nursing record has in this sense become more fragmented with separate documents being tailored specifically to particular tasks. The current version of the nursing module includes more than a dozen of different types of forms to fill in. In addition a nursing plan module has been included in the system.

An example of the interface is provided in the figure below.

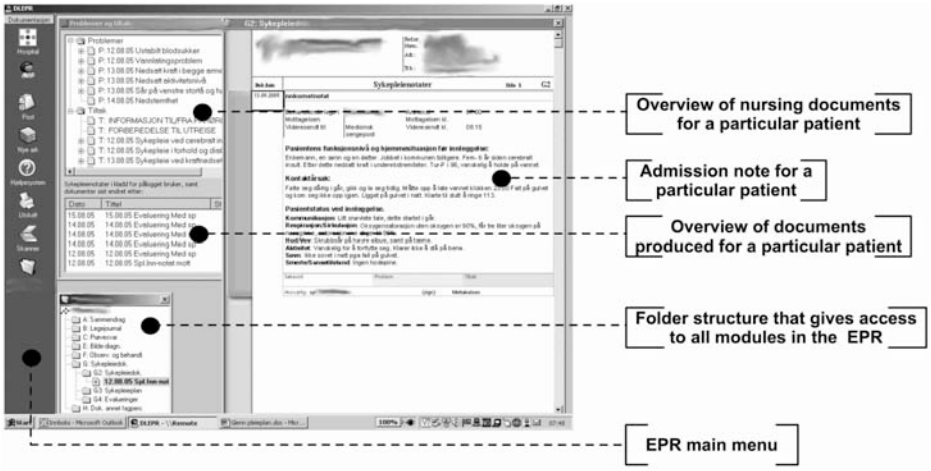


Figure 5: An example of the EPR interface. In this case the nursing module is activated and the admission note for a particular patient is opened

In the window in the lower left corner the overall folder-based structure of the EPR can be discerned. The nursing record is what is called chapter G in the list. The window in the upper left corner is an overview of a nursing plan (problems, interventions and outcomes) as well as all the documents that have been generated on one particular patient (lower part of the window). Finally, the window on the right illustrates an admission note for the patient whose record has been opened.

Compared to the old paper-based record, the degree of codification has increased. For example, in the old paper-based record, individual entries were written as a narrative. In the electronic version on the other hand, the entries had been divided into separate fields and forms to make the record itself more uniform. On important feature in this respect was the integration of elements from the VIPS model (see Ehnfors, 1994). In addition to a system of keywords, VIPS is designed to include classification schemes such as NANDA, NIC and NOC (see Section 3.4). However in this particular implementation of the system, classification schemes were not included. Rather, the system was based on VIPS keywords that were incorporated in the different types of documents. For example, the admission note has a certain list of keywords 'fine-tuned' for that specific task, the transfer-note another set, and so on. The idea is that the users should choose from the list of keywords, the ones that best resemble the issue that is being documented. For example the keywords in the G3-intervention form includes participation, support, information/education, environment, drug handling, and so on.

One main advantage with the keywords is that they make a potential link between the individual documents and thus provide an opportunity to group separate documents together. However this is primarily feasible for similar types of documents because VIPS contains a different set of keywords for different types of documents. For example in the figure below, in the problem-document, the keywords 'Hud/vev' (Eng: skin/tissue) and 'respirasjon/sirkulasjon' (Eng: respiration/circulation) are selected, while in the intervention document the keywords 'egenomsorg' (Eng: self-care) is selected.

Regardless of type, the layout of the interface is more or less the same for all types of documents. Fields like heading, date, responsible nurse and so on can be found in them all, while additional fields related to the particulars of the task to be supported distinguishes one type of document from another. Several fields have to be filled in, some limited by the choices provided by the system (e.g. VIPS keywords) while others can be filled in as free text. The figure below illustrates the interface of the document where patient problems and interventions are recorded (both are forms that are included in the nursing plan module). The link between the two documents can be discerned by the title of the problem section also appearing in the intervention section. The use of background colour red is used to emphasize this link.

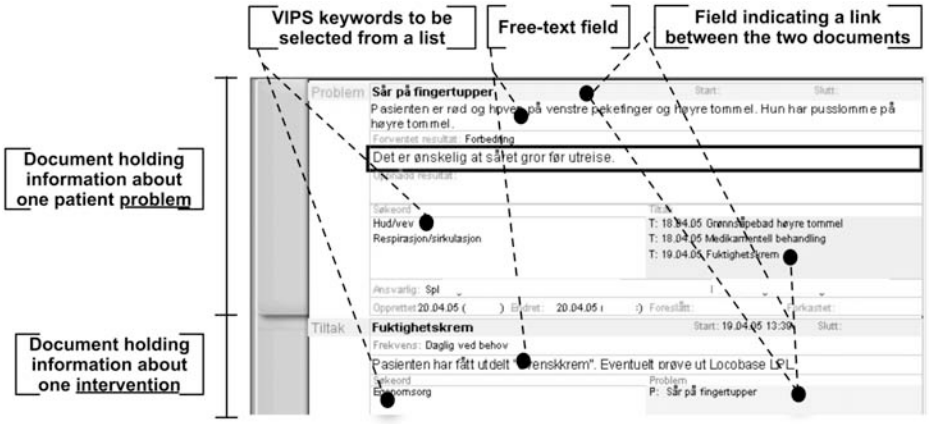


Figure 6: The part of the nursing plan where problems (upper part) and interventions (lower part) are documented. The two are created and changed as separate documents.

Keywords are also used as templates to structure the parts of the form where free text can be entered (though this is not done in the figure above). Such templates are assumed to facilitate the process of entering free-text into the system and enable a more efficient reading of the record. The separate departments and units can themselves decide if they want such templates and what keywords to include in them. (i.e. adapt them according to their own local needs).

4.3 The Tromsø case

The hospital and the Department of Special Psychiatry

Tromsø University Hospital is located in the North Norway health region. The hospital is the smallest of the five university hospitals and covers a large, but sparingly populated area including the three northernmost counties and Spitzbergen.

The hospital has 4500 employees and 619 beds of which 461 are somatic and 158 are psychiatric. It receives approximately 29.000 inpatients per year (both somatic and psychiatric).

I did my fieldwork in the Department of Special Psychiatry, which is only unit in the health region with authorization to accept involuntary admittances of patients suffering from a psychiatric disorder. Geographically the department is located in the countryside, approximately 5 kilometres away from the rest of the University Hospital. Surrounded by green open spaces the place itself offers an undisturbed and calm atmosphere for the therapy typically required by patients suffering from a psychiatric disorder. Typically you can see patients, accompanied by a nurse, walking on the promenade outside the building.

The department has four inpatient units with a total of 38 beds and roughly 350 employees. In 2005 155 patients were admitted to the department. Professionally, its area of expertise covers old-age patients, drug addicts suspected to have serious psychiatric problems and aggressive patients where quite a few have been sentenced to psychiatric therapy. The department serves as a competence centre for the smaller and local healthcare units. Hence patients in need of specialized evaluation are sent here. In addition staff from the department offer guidance and give advice on approaches to psychiatric problems to local healthcare institutions as well as private trustees (legally appointed support persons for patients).

Treatment and care at the Psychogeriatric Ward

Among the four units in the department, my fieldwork is primarily done in the Psychogeriatric Ward. The ward is a closed one, meaning that nobody cannot freely enter or leave the place without explicit permission (e.g. key). It has 14 beds, all in private rooms. Admitted patients typically stay for 6-8 weeks, although in some cases hospitalization might continue for several months.

Patients in this ward are 65 or older and usually suffer from psychiatric disorder like dementia, anxiousness and the like. Many of them have been transferred to this department from strongly closed units where they nearly have broken down doors and walls. Such patients may constitute a danger for both themselves and other patients. Accordingly, several self-injuries are reported in the ward. A set of formal regulations regulates the resources needed to treat individual patients. Broadly these differentiate between patients that are voluntarily and involuntarily committed. For example, an involuntary patient will have to be treated and followed up one-by-one and is not allowed to leave the ward without being accompanied by a member of the staff. However, the kind of resources needed is not exclusively imposed through the regulations. More circumstantial constraints are as important. As illustrated in the example above, in some cases voluntarily committed patients may also be prohibited from leaving the department due to sudden and unexpected behaviour.

The diagnosis outlined above and the fact that medical treatment has little or no effect on the disorder entail a work environment whose activities are directed towards a interdisciplinary approach to care and treatment. Hence, in this ward environmental therapy and individual attention are considered crucially important in making a safe and stable situation for the patients. Furthermore, observations made by the staff are considered particularly important for the treatment that is given. For instance in feeding situation, in self-care, and so on.

Underscoring this interdisciplinarity is the composition of the staff. About 45 environmental workers work permanently in the ward, including nurses, unskilled workers/substitutes, social workers, occupational therapists and physiotherapists. In addition a staff of physicians and psychologists pay regular visits. Turnover at the ward is high with up to 5 new workers starting there each month. Many of these are unskilled and not trained in healthcare service.

The nurses are the only group of professionals that stay with the patients 24 hours a day, seven days a week. Their input to treatment and care is in this sense crucially important for a continuous and reliable healthcare service. Not only does this apply to the internal activities at the ward, as important are their ability to cooperate with external institutions like local nursing homes, home care and so on. For example, many patients are sent back to the referring institution when their mental state has stabilized. In order to ensure that they remain stable, it is of vital importance that knowledge about proper therapy and care is communicated to the local care provider. For that reason the patient is typically accompanied by a nurse from the Psychogeriatric Ward that ensures that essential information is communicated properly to the local care provider. Sometimes the nurses from the Psychogeriatric Ward even make several succeeding visits to follow up on the patient and the treatment regime that is offered locally.

The project - introducing the EPR-based nursing module

The introduction of electronic-based nursing documents in the Psychogeriatric Ward, as well as in the other three wards in the department, has been carried out in the context of a larger, hospital level implementation of a new EPR infrastructure. A decision to replace the existing EPR, in 2003, demarcated the start of a prolonged undertaking of creating an all-encompassing information infrastructure that cut across departmental and professional boundaries. Serving as a foundation for the overall effort has been the objective of establishing a 'paperless hospital'. In Figure 7 these hospital level initiatives are illustrated along with the local initiatives at the Department of Special Psychiatry.

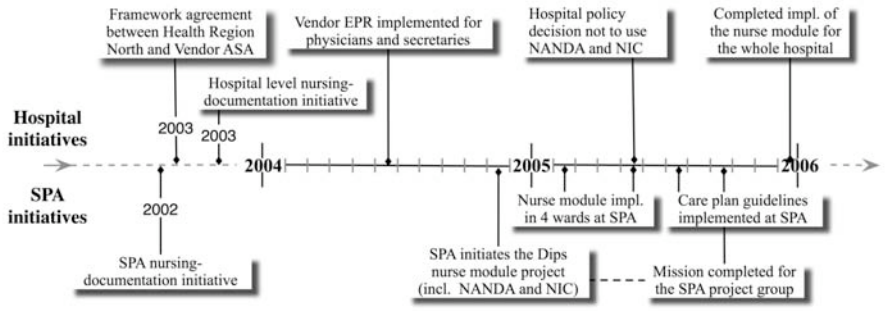


Figure 7: Initiatives at the Department of Special Psychiatry in the context of hospital level initiatives.

The department has been among the most enthusiastic and visible in the efforts of encouraging a stronger focus on nursing documentation within the hospital. A local

committee of nurses was established with a particular focus on patient records as early as 2002. The EPR nursing module was however not implemented before 2005.

Aligned with the increased political attention and efforts in the psychiatric sector, especially related to the need for improved quality (Action plan, 2005), the department was evidently highly motivated to implement the nursing module in its 4 wards. The expectations related to improved efficiency and a better overview of the process of planning were important. Not only should the system improve the care provided by nurses, as important was the way it could facilitate coordination of work across disciplinary and institutional boundaries.

The overall implementation process was carried through over a half-year period. Three people (two nurses and one secretary) were recruited internally to run the project. Two days a week they were able to have full attention to the implementation of electronic nurse documentation in the department's four wards. Although quite autonomous, this local project group coordinated their activities regularly with the central EPR project. After some months of in-house training the system was introduced in February 2005, both at the Psychogeriatric Ward as well as the three other wards in the department. In May 2005 this process had come to an end and all wards had started to use the new nursing module.

As illustrated in Figure 7, a general decision was made at the department to make use of the embedded classification systems available in DIPS. In practical terms this entailed the usage of NANDA and NIC. The decision was in conflict with the general policy at the hospital. However, because the Department of Special Psychiatry had started off using NANDA and NIC prior to the agreement on the general policy, they where allowed to continue as planned. This of course made them particularly interesting. Also, because the Psychogeriatric Ward was the first unit to finish the official in-house training and actively start using the system (including NANDA and NIC), they became an obvious candidate to focus the fieldwork.

The nursing module in DIPS-EPR

The DIPS-EPR was established in 1987. It was originally a locally established project at the hospital in Bodø. The system soon became popular, and in 1989, it was in use in several hospitals. Today the DIPS-EPR system is in use in roughly 50% of the hospitals in Norway.

The nursing documentation in DIPS-EPR is a module that provides functionality to write reports and produce nursing plans. The interface for writing reports is rather straightforward. Here the users can write free text. Yet a template of 12 predefined keywords or function areas (similar to the VIPS model), is embedded in order to structure the content of the report. These 12 function areas also make a link between the report and the nursing plan. In Figure 8 the report, including the function areas, can be found in the upper part of the interface.

The second part of the nursing module is the nursing plan (see Figure 8). For each patient there is only one nursing plan. Unlike the report it is highly structured. Organized according to the 12 function areas, it includes international codes for identifying NANDA diagnosis and related NIC interventions for a patient. NIC represents the measures that need to be initiated based on the NANDA diagnoses. For each NIC intervention there may furthermore be several ordinances. These are the practical actions that need to be taken related to the NIC intervention. Ordinances are written in plain text in the plan.

In the plan, NANDA diagnosis and NIC interventions are also being structured according to the 12 function areas. When writing a report, the patient's nursing plan is presented in the lower part of the screen (see Figure 8 below). The function area for a given NANDA/NIC code is shown as a number in the plan. This is supposed to make it easier the to decide what to include in the report. Meaning, when writing the report the user is expected to use the plan, its diagnosis, interventions and ordinances as a basis. Only deviation from the plan is supposed to be documented in the report.

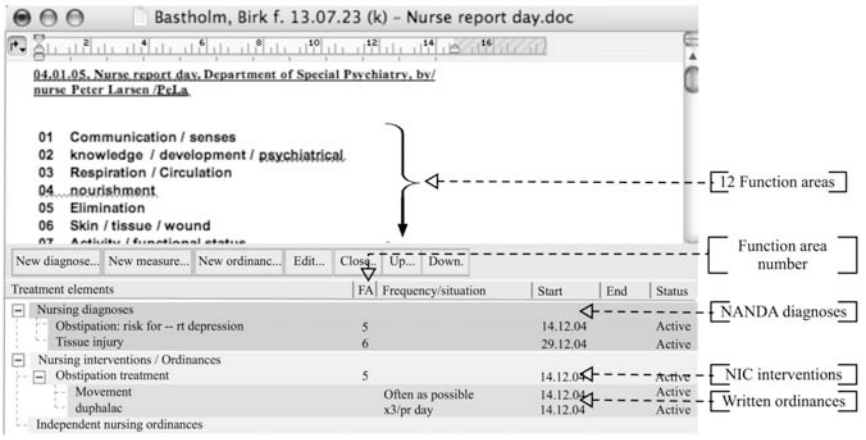


Figure 8: The interface of the nursing module. Each time a report is written, the current nursing plan is presented in the lower part of the screen. The function area number represents a possible connection between the report and the plan.

Despite this link between NANDA diagnoses and NIC interventions (through the function areas), there is no formal connection between the two in the system. This is because one diagnosis may require several interventions and one intervention may cover several diagnoses. An intervention will therefore constitute an autonomous in the plan. Furthermore a NANDA diagnosis and a NIC intervention may belong to, and cover, several function areas. Identifying the link between the two is not an easy task.

5 Research Method

The overall objective for this thesis is to "*explore the role and function of the nursing record in practice and how the relationship between tools for documenting and the work practice changes when the formalized, EPR-based nursing record, is being introduced in particular nursing practices"* (see Section 1.4*).* In this chapter I present how. First, the research approach is presented. Second, I describe how the data were collected and finally I provide some reflections on research method. In the latter section I will discuss issues and challenges related to participant observation as the main approach. For example issues such as gaining access, developing trust, analysis and so on.

5.1 Research approach

The interpretative approach

This study adheres to an interpretive research tradition (Walsham, 1995; 2006; Klein and Myers, 1999). This strand of research, which has its philosophical roots in fields such as ethnomethodology, phenomenology and hermeneutics, is often contrasted with the positivist, or natural science approach (see Myers and Avison, 2002; Orlikowski and Baroudi, 1991; Walsham, 1995).

In the literature the positivist approach is typically described as drawing on a formal language of definitions and accepted quantitative expressions. Reality is seen as objective in the sense that the relationship between the researcher and that being researched is detached from one another. The process of research is deductive and implies testing of hypotheses and theories. A fundamental objective is to identify, and test cause-effect relationships between entities by drawing on statistical methods. Generalization, which is the essential objective, entails contributing to theory and increasing the predictive understanding of specific phenomenon (see Lee and Baskerville, 2003).

The interpretive approach, on the other hand, is typically portrayed as informal and drawing on an unrestricted language. It is not to be confused with the term qualitative research (see Yanow, 2003). Qualitative research might be either interpretative or positivist, depending on the assumptions of the researcher (Myers and Avison, 2002). In contrast to the assumptions of positivist science, the interpretative approach denies the existence of an objective reality that can be discovered by researchers and replicated by others. Rather reality is assumed to be socially constructed (Myers and Avison, 2002). As expressed by Klein and Myers (1999):

> *"(…) it is assumed that our knowledge of reality is gained only through social constructions such a language, consciousness, shared meanings, documents, tools, and other artefacts." (*p.69*)*

The essential objective is not to identify causes of behaviour, but rather the meanings people assign to actions and events. The researcher perception of the phenomena being studied will simultaneously be shaped by his or her preconceptions (Walsham, 1995).

No predetermined relationship between information technologies and social contexts is assumed. Rather they shape each other reciprocally as a process. Interpretations are thus always considered to be subject to reconsiderations. The researcher, as Walsham (1993) puts it *"[Seek] an understanding of the context of the information system, and*

the process whereby the information system influences and is influenced by the context" (pp.4-5). Implicitly, this means that any interpretation and expression of an event needs to be positioned in its social and historical context in order to make visible how the current situation under evaluation emerged (Klein and Myers, 1999).

The interpretative tradition has been criticized for its lack of focus on validation. Questions have been raised regarding how to conduct such research and how to evaluate its quality (see Walsham, 1995; 2006; Klein and Myers, 1999). As a response, Klein and Myers (1999) have proposed a set of anthropologically and philosophically inspired principles to guide the researcher in conducting and evaluating such a study. The principles are based on the fundamental principle of the hermeneutic circle, whose primary message is that individual interpretations should be handled as parts in terms of the whole and vice versa (see Klein and Myers, 1999).

The first, and most fundamental principle is that of the hermeneutic circle, which, as discussed above, allows a development of a complex whole of shared meanings between subjects and/or between researchers and their subjects. The second principle involves placing and understanding the subject according to its social and historical context. The third refers to the interaction between the researcher and the subject, and how research material is socially constructed through this process. The fourth principle relates to abstraction and generalization. The fifth calls for sensitivity to possible contradictions between the theoretical preconceptions and actual findings, while the sixth principle calls for awareness towards multiple interpretations among participants. Finally the seventh principle, denoted the principle of suspicion, requires sensitivity to potential biases in the subject's narratives (Klein and Myers, 1999 p.72).

The principles do not necessarily apply to all kinds of interpretative research. Yet, as stated by the authors themselves "*their systematic consideration is likely to improve the quality of future interpretive field research in information systems*" (Klein and Myers, 1999 p.70). I will return to the principles below when discussing, and reflecting on method.

Research method

The methodological strategy of this study is based on the qualitative research paradigm (see Myers and Avison, 2002), which can be described as:

> *"any type of research that produces findings not arrived at by statistical procedures or other means of quantification" (Strauss and Corbin, 1998 pp.10-11).*

More specifically I am inspired by ethnography and to a large extent rely on participant observations as a primary method (Fetterman, 1998). The ethnographic approach has its early historical roots in the discipline of anthropology and has later migrated into other social sciences. In particular, the work that emerged through the Chicago school during in the 1920s has had a profound influence on the method as it is applied in the social sciences today (see Becker, 1998; 1999).

Ethnographically inspired approaches are considered particular applicable within design-oriented fields such as CSCW. A rather extensive body of literature exists that has contributed to the development of the IS field in general and CSCW in particular (see Suchman, 1987; Zuboff, 1988; Heath and Luff, 2000; Hutchins, 1995; Berg, 1997; Sellen and Harper, 2003). It is also within this context that this thesis is positioned and in studies within the healthcare context that draw on a similar

approach (see Aanestad, 2002; Ellingsen, 2003; Svenningsen, 2003; Winthereik and Vikkelsø, 2005).

An ethnographic approach allows an in-depth description of everyday life and practice. It bears resemblance to case studies in that it aims at investigating contemporary phenomena in their real-life contexts, typically by drawing on data collection methods such as observation, interviews and document analysis. Yet unlike case studies, in ethnography the principal data-gathering method is participant observation and the researcher typically spends a significant amount of time in the field. Duration is in fact considered to be both an essential attribute and highly valued aspect of the approach, while at the same time it is considered to be one of its major drawbacks (see Myers, 1999).

An ethnographer typically assumes inconsistency between what people say they do and what they actually do. People might provide accounts according to formal rules, standard beliefs or because aspects of their activities have become invisible, even to themselves. From an interpretative point of view, particular emphasis should thus be put on making visible the multiplicity of perspectives and contextual webs of meaning as they are presented by the subjects, both in their doings as well as in their speech (see Randall and Rouncefield, 2006; Forsythe, 1999). The empirical investigations of the ethnographer thus seek to discern "*patterns of human activity (…) typically the various forms in which people manage to do things in observable and repeated ways*" (van Maanen, 2002 p.102). This also entails awareness towards tools and material artefacts, which obviously is an important motivation for the acknowledgement and usage of the approach within fields such as CSCW.

Doing participant observation entails having to balance two roles; that of the observer and that of the participant (see Davies, 1999; Walsham, 2006). In observing a fundamental objective to succeed is gaining legitimacy and becoming a trusted member of the community. The researcher thus tries to get as close as possible to the people and practices being studied, without 'going native' (Hong and Duff, 2002). At the same time, through the visible presence of the researcher, he is implicitly participating in the activities and processes that he or she is observing. As a participant the researcher needs to beware of not to get too involved as he or she might go native and thus be unable to distance himself or herself from the ones being observed.

Balancing between the two roles is difficult and the researcher continuously needs to 'sense' the atmosphere among the subjects and when needed adjust his/her actions accordingly. The balancing between observing and participating has been particularly pertinent in my own fieldwork. In Trondheim for example I spent four weeks working at the department as a nursing assistant before I formally starting the empirical investigations. This initial effort of engagement turned out to be extremely valuable for my later involvement with the nursing practitioners at the department as well as other people involved in introducing the nursing module. Yet, during the fieldwork, I had shorter periods where I intentionally withdrew from the field. This was partly motivated by a lack of generating new insights but also because I had periods where I felt that my research agenda diminished and I was unable to distance myself from the ones that I studied (i.e. because I already knew the people well). For example there were moments when I felt that my own research agenda was about to be translated into something else through the needs and interests of the local project managers and nursing practitioners.

The turn towards practice makes the outcome of participant observation potentially more relevant for a broader community. In fact the strength of participant observation is that it typically has an immediate relevance not only to the research community itself, but also to the practitioners (Harvey and Myers, 2002). However, the researcher's descriptive accounts alone are often rather messy and incomprehensible. Pure descriptions that have been obtained by observing a work practice, typically do not speak for themselves. For this reason, the empirical data needs to be guided through some lenses in order to make them available and relevant to others. These lenses again are informed by the philosophical and theoretical assumptions of the researcher.

This thesis is philosophically based on an interpretative approach (as outlined above). Theoretically, in designing the research and collecting the data, Actor-Network Theory (ANT) has inspired me. Not in a strict sense but primarily to focus observation sessions and provide me with a vocabulary to talk about what I had observed and encountered. ANT has in particular been usable for discussing material heterogeneity and for looking at actors, the relation between them and how networks of action are being produced through these relations. In the papers explicit references to ANT is however not always to be found. Rather they have served as a basis for describing and analysing issues such as heterogeneity and distribution (see Paper 3), knowledge sharing (Papers 2 and 5), planning and redundancy (Papers 3 and 4) and standardization (see Paper 6). Examples of concepts that have been used are *closure, stabilization, alignment, actor, heterogeneity, inscriptions and negotiating interests.* Also, based on more recent developments in ANT, I have drawn on issues such as *performance, order and disorder, formality and informality* (see Berg and Timmermans, 2000; Moser and Law, 2006; Law and Singleton, 2000).

I will now present how data were collected and discuss my own role in the fieldwork.

5.2 Data collection

The empirical data upon which this thesis is primarily based, were collected during October 2004 - December 2005 in the Department of Rheumatology in St. Olavs University Hospital in Trondheim, and during May – December 2005 at the Department of Special Psychiatry in the University Hospital in Tromsø. Participant observation has been the primary approach on both cases. In addition I have carried out semi-structured interviews, had informal discussions with various people involved in the projects, analysed relevant documents and participated in various local project meetings and workshops.

The Trondheim case

In Trondheim my initial aim was to follow the implementation of the electronically-based nursing documentation at the Department of Rheumatology. The department had been selected as one of two pilot-projects in the university hospital. The project formally started in November 2004.

Collected data includes approximately 450 hours of observation and 31 interviews that on average lasted around 1-1.5 hours. Gradually, as the project progressed, I also audio-recorded relevant meetings such as handover conferences and forums where the EPR project was discussed. In addition I analysed various formal and informal documents and interacted continuously with the staff. I always carried with me a digital camera in order to capture the "non-movable" aspects of nursing (e.g. paper-

based medical record, the chart, smaller notes, nurses personal notes, etc), Also, various types of project documents and emails, relevant for the case, were forwarded to me by members of the staff. For example screenshots from the EPR system that had been described during and interview or had been discussed in a meeting (e.g. handover conference) were anonymized by one of the local nurses and forwarded to me later on.

Observations were carried out at all hours and in particular during handover conferences. Typically I would start observation sessions at the beginning of a shift, usually a handover conference. In order not to disturb the activity more than necessary I would always try to place myself discretely in the background. During the meetings I wrote down as much as possible about the activity and the discussions that were going on. In doing so also tried to write down the type of artefacts used, how they were used, by whom and in which situations. In between meetings I would either follow a specific nurse as he or she was carrying out the daily activities, or sit in the nurse's office where most of the documentation work was done. Here I would randomly follow the interaction between nurses and their use of the patient record. Also, at the end of a shift, I would observe individual nurses closely as they made the final recordings in the patient record and prepared to hand over information to the oncoming shift.

Handwritten fieldnotes were taken during the observations and transcribed immediately afterwards, usually later the same day. Also documentary material like the kardex, nursing plans, running notes, screenshots, personal notes, procedures and task guidelines was collected to supplement the observations. Occasionally, and in particular in complex settings such as pre-visits, handover conferences and the like, observations were followed up with informal interviews. I would typically contact one of the participants (usually a nurse) immediately after the meeting and make a later appointment. During these informal interviews I would typically have the interviewee explain and elaborate further on particular issues or things that I did not quite understand. For example sometimes I just wanted to get the nurse's point of view on an issue, while other times I would have them explain more concretely about specific artefacts and documentation tools.

Formal interviews were primarily conducted with nurses in the department, but also with project managers as well as representatives from the EPR vendor. A tape recorder was used in all formal interviews. Typically these interviews would not follow any predefined interview guide, rather I would prepare myself by making a list of topics to be discussed and ask more detailed questions depending on the issues that emerged during the interview. In all cases questions were related to the introduction of EPR-based nursing record and/or transformation of the handover conference. For instance expectations to the EPR nursing module, how they worked and used the handwritten record, handover experiences and what they regarded as essential information for the delivery of care. Gradually, as the project progressed, the interviews became more concrete and I asked more specific questions. For example how they used the nursing plans, why some preferred not to use them, how they documented their actions in an otherwise rather hectic working day. In these interview situations the interviewee would often demonstrate functionality in the EPR, or lack thereof, in order to clarify relevant issues.

Also some of the routine meetings (e.g. handover conferences) and arenas where the EPR nursing module was presented and discussed were recorded. I always made sure

to ask for consent (everybody present) prior to using the tape recorder. The first couple of times, the presence of the tape recorder undoubtedly had an influence on the interaction among the staff. As one nurse said in the early stages of the study, after a handover conference where the tape recorder had been used:

> *I don't think we have ever been as efficient in completing the meeting as today… the tape recorder obviously had an influence in the interaction. As soon as we had left the room, some of them continued to discuss patient cases (nurse in the inpatient unit)*

Gradually as the nurses became accustomed to me using the tape recorder, it did not seem to interfere as much as it did in the early stages. At one stage I even suggested to play back some of my tape recordings at a later stage to make possible a comparison between the old and the new situation, whereupon one nurse responded:

> "*Oh, I actually forgot about the tape recorder (…), well, anyway, I prefer not to hear the recordings afterwards. I just hate to hear my own voice." (stated by one of the nurses at the end of a handover conference)*

Tape-recorded meetings were particularly challenging to transcribe. One main problem was distinguishing background noise from the main discussions and interactions. On average I would spend roughly 12-15 hours on a one-hour tape-recording and typically parts of the interactions and discussions were difficult to understand because of background noise (i.e. discussions and when people talked in each others mouth). Having experienced these challenges in the early stages of the fieldwork, in the later stages I would use a notebook in addition to the tape-recorder. Notes were taken both to document discussions that I found particularly interesting as well as to sketch various artefacts in use during the discussions.

The Tromsø Case

The Tromsø case, which took place at the Department of Special Psychiatry, had many similarities with the case in Trondheim. For example the patient group was similar (i.e. suffering from a chronic disorder), the approach to treatment and care was highly interdisciplinary, an EPR module for nurses was being implemented, etc. At the same time the Tromsø case was different. For example, a classification scheme was being introduced as a part of the EPR. For this reason the field study itself became more 'focussed' than in Trondheim. From the outset a particular focus was to better understand the local efforts of integrating such a classification scheme. Also, in Tromsø, the fieldwork itself was in part carried out in cooperation with G. Ellingsen, who has a prolonged history of involvement with the University Hospital, both as an employee and as a researcher. Working together with Ellingsen was an excellent opportunity for me to follow and learn from a more experienced researcher.

For practical reasons, since I did not reside in Tromsø, a schedule was set up for carrying out the fieldwork. Empirical material was thus mainly collected during three field visits, each lasting one week. The first took place in May, the second in June and the last in August. In addition Ellingsen occasionally visited and interacted with the staff at the department in periods when I was not present.

Collected data includes approximately 80 hours of observation, of which around 50 hours were spent together with Ellingsen. 15 interviews were conducted, of which ten with both of us present. On average each interview lasted 1-1.5 hours (see also Paper 6 for more details on data collection). To complement the observations and interviews relevant documents and reports were collected. In addition screenshots were captured

and photographs taken of different parts of the ward. In between the three field visits we also stayed in touch with some of the nurses by means of phone calls and email. Primarily to clarify and validate our empirical material, but also to follow up with new questions that had come up during our analysis. For example in the beginning of November 2005 Ellingsen, together with a nurse, browsed through 94 paper-based reports to see whether the number of words had been reduced in the electronic reports and if the character of the reports had changed.

Observation sessions were primarily conducted in the on-duty room, where the nurses wrote their report (3 times a day), discussed patients and coordinated activities. The room was full of forms, lists and schedules that in sum indicated its importance for the daily work activities. From here we were able to follow discussions among the staff as well as the nurse's usage of DIPS. Typically as the nurses were about to write the report, we would ask if we could watch. The nurses were always positive when being observed and asked about their interaction with the system. With both of us present in the on-duty room we were able to cover different actors and activities simultaneously. For example when the nurses were writing the report, we always observed different nurses. When concurrent discussions and activities occurred we would centre our attention on separate interactions.

We also observed activities in other parts of the ward, for example in handover conferences, interdisciplinary kardex meetings, treatment meetings and the like. We did not, however, spend any time observing the interaction between nurses and patients. Here we rather relied on stories told by the nurses. Handwritten field-notes were written up as soon as possible, and usually on the same day as the observation session. We both made individual notes during these sessions and later on shared our notes between ourselves.

The respondents in our interviews included several nurses, a physician and a psychologist from the Psychogeriatric Ward as well as three of the staff involved in managing the local EPR project. We also interviewed one representative from the Norwegian Nursing Organization, the project manager for the overall introduction of DIPS at the university hospital and two environmental workers from another ward in the same department.

Like in the Trondheim case, interviews were carried out without any formal interview guide but rather based on some topics that had we had prepared in advance. A tape recorder was used in all interviews to make it easier to concentrate on the interview situation rather than being occupied with taking notes. For example sometimes the respondent would make a prolonged and detailed explanation on an issue. Then, to avoid interruptions, we would write down questions and rather bring it up again later on in the interview. All interviewees responded positively to the usage of a tape recorder. However a couple of nurses seemed to speak more freely when it had been switched off.

One important advantage of being two instead of one in interview situations was the ability to be attentive and keep the discussion going. Typically the two of us would alternate on keeping a close attention to the respondents and keep the dialogue going. This gave the other researcher a chance to sit back and reflect on the different topics being discussed and later on, follow up on issues worthy of note.

5.3 Reflection on method – process and analysis

Generally the overall process of collecting and analysing data has been open-ended and iterative with the early phases being more explorative than the later ones. In this section I offer some reflections on how the research has been carried out and written up. I will in particular discuss issues such as gaining and maintaining access, how the empirical material was collected and the how analytical categories have surfaced and evolved during the process. In doing so I draw on work by Walsham (1995; 2006) on how to carry out fieldwork and analyse data, and the set of principles for the conduct and evaluation of interpretative research as proposed by Klein and Myers (1999). Here it should be recognized that I have already touched upon several of these issues in the preceding chapters and will revisit some in the subsequent chapters. For example, the principle of contextualization (Klein and Myers, 1999 pp.73-74), which in part is discussed in the next section, is also addressed in Chapters 1, 3 and 4. Similarly the principle of abstraction and generalization (ibid pp.75 -76) has been addressed in the theory section (Chapter 2), where I outlined the relationship between tools and work and how it could by conceptualized as a co-construction.

Getting access to the field

Getting access to the field was rather different in the two cases. In Trondheim I had to struggle for some time to get access to the field. I started to seek out people and local places where medical informatics was a central theme. In particular I engaged with people that, at that time, were involved in the Kvalis project[4] and a local research centre working with information technology in healthcare (DigiMed). The people involved in these two projects were later on involved in the establishment of the multi-disciplinary research unit at NTNU called Norwegian EHR Research Centre (NSEP)[5]. One of the key actors in this community was a physician with a strong interest in medical informatics. He had taken an initiative to allow non-healthcare workers to spend some time working in a hospital unit in order to get first hand knowledge about what healthcare work really was about. His concern was particularly related to the lacking of knowledge about healthcare work among computer scientist researchers. Because of this initiative, in February 2004 I started to work at the Department of Rheumatology as a nursing assistant. I worked there for four weeks. Formally I was there as a healthcare worker (i.e. nursing assistant). However my real intentions inevitably became apparent to the staff. In the later stages of my stay the local workers 'teasingly' started to refer to me as '*Glenn, the computer guy in white*'.

During my time working as a nursing assistant I was told about the upcoming EPR project and invited to take part as a researcher. Eight months later, in late November 2004, the EPR project formally started (six months later than originally planned). However, assisted by a local nurse I was granted access and started my fieldwork a month earlier. This made it possible for me to follow the whole process, before, during and after the introduction of the EPR-nursing module. I had my first day observing work in the department on 21 October 2004. I stayed there, more or less permanently, for about ten months, followed by five months with occasional visits. During this period the project was further delayed due to local difficulties such as problems in coordinating the in-house training and lack of resources to manage the

[4] See http://kvalis.ntnu.no/ (Last accessed May 2007)

[5] See http://www.nsep.no (Last accessed May 2007)

project. In fact six months went by before the nurses really started to use the new system. These recurring impediments put me in a difficult situation. My fieldwork was delayed as I still lacked empirical data on the system worked in practice. Consequently I searched for alternative places where the EPR-based nursing module actually was in use. Several alternative places were considered, among which the Tromsø case was considered the best alternative.

The Tromsø case was set up differently than the Trondheim case. There I was invited to participate in the project as a researcher. The invitation was put forward by Gunnar Ellingsen, a researcher whose research interest was closely related to mine and whom I had interacted frequently with for some time. Ellingsen has a prolonged history of involvement with the University Hospital in Tromsø, both as an employee and as a researcher (see Ellingsen, 2003), and was enthusiastic about doing fieldwork related to the ongoing efforts of establishing an EPR for nurses at the University Hospital. At the time of my arrival he had set up the whole project, which of course made my entry more 'comfortable' and straightforward than what was the case in Trondheim. Also, the process of gaining access and legitimacy was easier thanks to Ellingsen's know-how and standing in the university hospital.

Developing an understanding of the field

Working as a nursing assistant equipped me with first hand experience about healthcare work in general and nursing in particular. Also, as mentioned above, due to the rather slow progress in Trondheim, I made several efforts in finding alternative places where similar efforts were undertaken. For example, in addition to Tromsø, I made two shorter field trips to two smaller hospitals in the Mid-Norway health-region (Molde and Kristiansund). In both places they had actually started to use the new system. However, as opposed to the fieldwork in Tromsø, which was longer and resulted in concrete contributions (Paper 6 and 7), I have not explicitly made use of the empirical data from Molde and Kristiansund in any of the attached papers. Still, the experience gained through these field trips implicitly helped me frame and focus the following empirical investigations in Trondheim and Tromsø. In particular when the nurses formally started to use the new EPR-based nursing plans in Trondheim in April 2005.

During my first visit to Tromsø we (Ellingsen and me) spent a considerable amount of time attending meetings and talking to people that had key roles in the EPR project. An important objective in this phase was to make plans for our empirical investigations and arrangements made for the remainder of our field study. The head nurse at the Department of Special Psychiatry was particularly accommodating and helpful in this phase of the project. We were introduced to the different units and conducted interviews with some of the key personnel in the implementation project. Also, during this visit, together with all the head-nurses at the university hospital, we were invited to take part in an invited talk about NANDA, NIC and NOC given by a representative from the Norwegian Nursing Organization. During this event the group of head nurses agreed not make use of NANDA and NIC (though they were open to include it at a later stage). However, the Department of Special Psychiatry, who already had decided to integrate NANDA and NIC and started the process of implementing the system, was 'allowed' to continue as planned. This, of course, made the department even more interesting for our empirical investigations.

Developing trust relationships

For the purpose of gaining access, both the local physician in Trondheim and Gunnar Ellingsen in Tromsø were important as gatekeepers (see Davies, 1999). Yet, as Randall and Rouncefield (2006) argue, getting access involves much more than only gaining entry to a work setting. It denotes a cluster of challenges, including issues such as gaining acceptability, gaining legitimacy, getting a chance to hang around, etc.

On a day-to-day basis, gaining access and obtaining good observational data, presuppose a certain level of trust relationship between the observer and the ones being observed. For the researcher, maybe the most important attributes to possess are social skills (Walsham, 2006). Translated into my own fieldwork, this included things like being honest, behaving as usual and, maybe most importantly, adapting to the local community culture. The most observable and straightforward code of behaviour were things like cleanliness, wearing the nursing uniform (in Trondheim), and the like.

In the Trondheim case, the time I spent working as nursing assistant, was important in gaining legitimacy and becoming a trusted member of the community (Hong and Duff, 2002). Yet still, when returning to the department six months later, a practical challenge was how to ensure that everybody knew the purpose of my presence. For practical purposes, as none of the staff were present simultaneously due to the working shifts, getting this information through was rather difficult. Hence I pursued several strategies to this end. First, to get approval I had to submit a formal project plan to the chief physician, and sign an oath of secrecy. Second, I made a one-page project description that was distributed to the all the employees. Third, when being asked, I would give a broad description of what I was doing. Typically I would say something like "*I am trying to understand how you document what you do, in order to improve the EPR"*. As people usually would accept this general description, I would hardly ever try to explain the project in details. Besides, I found it extremely difficult to translate the details into the local language of the staff. Fourth, when possible, I would let another member of the staff explain the project. For example in one the first handover conferences I attended, the head-nurse presented me as follows:

> *"Oh, yes, for those of you that haven't heard, Glenn is here, he is interested in how we use the nursing record" (Head-nurse)*

Typically it was primarily in the initial phases of the fieldwork that I had to justify my presence. Gradually I could carry out the observation sessions without being too interrupted. As long as I dressed up in the customary white collar nursing uniform, I could observe the daily routines and participate in various meetings without being enquired about my presence. I was even offered office space, in the department, where I could easily withdraw from the field to transcribe field-notes or the like.

Although the level of trust relationship seemed appropriate, I often had to 'negotiate' with the members of the staff to get access to particular and otherwise unavailable information sources or settings. For example, even though I had signed the oath of secrecy, I never got an user-account and direct access to the EPR. Rather I had to access it by looking over the shoulder of a nurse or the like. Hence, in order to obtain examples of particular screenshots, I relied on the individual nurse to make anonymized copies for me. Fortunately, a couple of the nurses were always ready to lend a hand when needed. Typically these were well informed, articulate and easily approachable nurses that, gradually, became important for me as key informants.

Occasionally, I found myself in situations where I felt was not interacting well enough with the staff, or not having good enough access to really understand what was going on. When such situations occurred, I would deliberately make a move in order to improve the interaction. This essentially involved varying the level of involvement as in balancing between observing as a participant and participating as an observer (see Davies, 1999; Walsham, 2006; Hong and Duff, 2002 for the distinction). I pursued several strategies to this end. For example if a nurse had trouble with the computer I would offer help (because I had the skill to do so). Typically this involved handling minor things such as copying text, undeleting text, pressing <ctrl-alt-delete> if an application had crashed or the computer had locked. In other situations where I lacked the competence or when sensed that the atmosphere was tensed because of me looking over their shoulders, I invited myself into the working process of the staff. For example once I helped to sort out and prepare documents for patient consultations at the outpatient clinic. In doing so the ones that I observed became much more relaxed and I found it much easier to interrupt and ask questions about their doings. Not only questions related to the task I had been assigned, but also questions of more general concern, such as their use of the EPR, what was being recorded in the paper record, and so on. Also, while observing work in the inpatient unit, I pursued a similar strategy of offering help. For example I helped move the patient around in the hospital, I helped prepare lunch and dinner for the patients, make coffee, etc. Once I even offered to act as a patient for a group of nursing students that needed practical experience in inserting venflon, A painful experience for me as none of the three nursing students were able to locate the vein. Still it made possible another, and enhanced level of interaction.

Making fieldnotes

During observation sessions I would typically make notes in a small notebook. This was hardly considered a problem as most of the nurses also carried with them, and regularly used small notebooks themselves. I made more extensive notes in the beginning, than in the later stages of the fieldwork. However, I always made thorough notes when observing particular types of interaction. For example when observing the way the EPR-based nursing module was used during handover conferences, when the nurses wrote the report, the way information was copied and merged from and into various smaller paper-based artefacts, how various artefacts were used in meetings and during discussions, etc.

As far as possible, I tried to establish writing routines and spent, at least, one hour per day to write down things that had happened during the day. Broadly I made two types of notes. First I captured and wrote down interactions among the staff well as their interaction with various artefacts, including the EPR (as described above). This also involved writing down and sketching things that could help me bring back the context at a later stage (including taking photographs). A couple of examples of such contextual recordings are illustrated in the figure below. The figure on the left is a cluster of photographs that was taken at different stages of the fieldwork, while on the right is a drawing of the on-duty room in Tromsø, where the nurses wrote the reports.

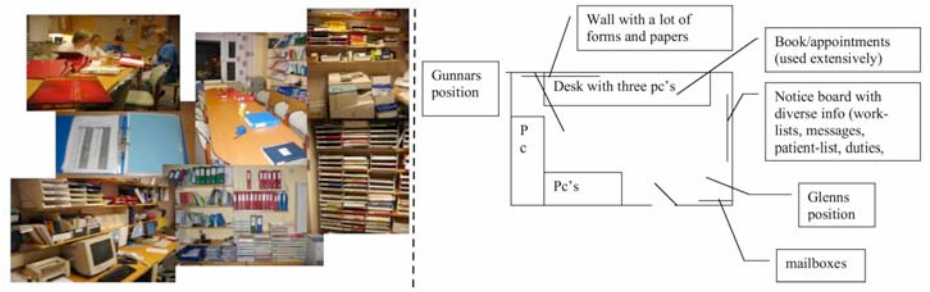


Figure 9: Examples of photos taken and contextual sketches made during the fieldwork

Second, I would occasionally make methodological remarks, in particular when I 'sensed' that that my presence influenced the interaction among the nurses. For example, I once attended a meeting between members of the staff at the department in Trondheim and a nurse from another unit. The purpose of the meeting was to share experience related to the introduction of the EPR. As the visiting nurse and I were not properly introduced beforehand, during the meeting I sensed that she (the visiting nurse) was uncomfortable with me being present (she confirmed this uneasiness during an informal chat after the meeting). Below are the fieldnotes I made:

> *"When attending meetings together with [members of the staff at Dept. of Rheumatology] I need to be properly introduced to the ones I do not know before the meeting starts, (…) today, I was not and the visitors obviously felt uncomfortable with me being present. Not knowing who I was or what I was doing there. As soon as I got the chance I explained my role to her, afterwards she seemed much more relaxed"*

Occasionally observations would be supplemented with interviews immediately after the observation session. The interview would always spin around issues that had been recorded while I observed. This strategy was progressively used throughout the fieldwork, and in particular in situations where I made minute notes on nurse's interaction with the EPR. I also carried out informal interviews in situations where I needed further clarification on the content and function of situations and/or artefacts that had been used. As these were concrete artefacts that I had observed in use, the responding nurse would be imposed not to provide normative answers, but respond in accordance with the way the artefacts actually were used. Typically during these sessions, the responding nurse would say '*well, this form should actually be not be used like this, but rather like this*". I followed up this by asking questions related to the way the artefacts actually were used and by whom (and not how they ideally should be used). In addition to me taking notes, a tape-recorder was always used during these sessions. The notes were primarily taken to make it possible to synchronize the gesticulations (e.g. direct indications made on the forms that was described) made by the nurse with the tape-recording.

The combination of observation and interviews was useful to explore and clarify observational data. In addition they provided access to situations and events that otherwise were not easily accessible. For example in Tromsø, one nurse gave us a detailed and concrete description of a special patient case through an interview. On a later fieldtrip, the very same nurse was interviewed once more. This time she provided us with detailed information on the same patient case and explained how the nursing plans in DIPS had evolved throughout the period (i.e. when we were not

present). This nurse was particularly well informed, articulate and accommodating, and for our purposes became a key informant.

Growing analytical categories

Throughout the empirical investigations, data collection and analysis have shaped each other mutually. The overall process of collecting and analysing has been open ended and iterative, with the earlier stages being more explorative than the later ones. Analytically I have more or less been working on a continual basis. For example I always used my personal Apple iPod to tape the interviews. While working up the empirical material I thus found it convenient to listen to the recordings over and over again. For example I would listen to interviews while taking the bus back home after work, in my leisure time while hiking, on trips, and the like. Also I would normally carry a notebook with me in order to be prepared whenever the 'brain decided to be productive'. Typically the good ideas would pop up outside working hours. Sometimes I even scribbled down things on any item ready at hand. For example, parking receipts, napkins, newspapers and as SMSs to myself.

Regularly during the fieldwork, data was presented and discussed with key informants in order to validate its content. Also several of the informants have read transcripts in order to approve and verify its content. The construction of empirical material has in this sense been accomplished by and through interaction with the subjects (Klein and Myers, 1999 p.72). Also, through my interaction with the field, the problem and focus of the project has undergone continuous changes. For example, in Trondheim I had to change my initial focus and research plan as the EPR-project was frequently postponed. Fairly early in the process I thus reviewed the research objective and focus (i.e. follow the whole process, including the work and documentation practice prior to the actual implementation of the system).

Concepts and analytical categories have surfaced from internal discussions, reading of field notes and through external presentations. For example in the Tromsø case, first level analysis and conceptualization (van Maanen, 2002) took place on a day-to-day basis. Usually when being left alone we (Ellingsen and me) openly reflected on our observations and discussed possible issues to pursue further. Also every day after having completed the fieldwork we typically would take some time to discuss things that had happened agree upon what to pursue the following day. General topics and issues grew out of these discussions and also had a huge impact on our fieldwork as we went along. In between the fieldtrips, fieldnotes from our observations and transcribed interviews were analysed. An important entity coming out of this work was one document of refined empirical data summarizing our fieldwork and specifying interesting topics. This document was later on used to focus subsequent investigations and in discussions with colleagues.

Early results have been presented internally to colleagues in the department at NTNU as well as externally at international workshops and conferences. In terms of my own learning process, I have found it particularly useful to invite and engage colleagues in writing papers. Moreover, in one Paper 1 of the nurses from the department was involved the writing process. All in all, these processes have been fundamental in developing interesting topics and analytical notions such as heterogeneity, redundancy and overview.

6 Results

The thesis includes the following seven papers.

1 Berntsen K., Munkvold G. and Østerlie T. (2004) Community of Practice versus Practice of the Community, Knowing in Collaborative Work, in *ICFAI Journal of Knowledge Management*, 2(4), pp. 7-20.

2 Munkvold G. (2005) Practice-Based Knowledge Integration, in David Schwartz (Ed.): *Encyclopedia on Knowledge Management*, IDEA Group Inc., 2005, ISBN 1-59140-573-4.

3 Munkvold G., Ellingsen G. and Monteiro E. (2007) From plans to planning – the case of nursing plans. Accepted for publication and to be presented at *Group 2007*.

4 Munkvold G., Ellingsen G. and Koksvik H. (2006) Formalizing work – reallocating redundancy, in *Proceedings of the 2006 20th anniversary conference on Computer Supported Cooperative Work (CSCW)*, November 2006, Banff Canada

5 Munkvold G. and Divitini M. (2006) From storytelling to reporting - converted narratives, in *Proceedings of MCIS'06, the Mediterranean Conference on Information Systems*, October 2006 Venice, Italy.

6 Ellingsen G., Monteiro E. and Munkvold G. (2007) Standardization of work: co-constructive practice, *The Information Society 23, pp.1-18*.

7 Munkvold G. and Ellingsen G. (2007) Common Information Spaces along the illness trajectories of chronic patients. *Proceedings of the 10th European Conference on Computer-Supported Cooperative Work*, September 2007, Limerick, Ireland. pp. 291-310

Before presenting a summary of the individual papers, I would like to underscore that they have all gone through a process in which preliminary versions have appeared in other settings than reported above. *Paper 1* was originally presented at the 27th conference on Information Systems Research in Scandinavia (IRIS) and included in the proceedings. Subsequently we were invited to submit a reprinted version of the paper to the ICFAI Journal of Knowledge Management. In 2005 the paper appeared in an Executive Reference Book on Knowledge Management called Effective Knowledge Management - Emerging Trends (Berntsen et al., 2005). A variant of *Paper 2* was presented at, and included in the proceedings of the NTNU Computer Science Graduate Student Conference in 2005. A shorter version of *Paper 3* was presented at, and included in the Proceedings of the international workshop on Plan-Based Health Records and Continuity of Care in Trondheim 2005. Also an abstract of the paper was presented at the doctorial colloquium at the European conference on Computer Supported Cooperative Work (ECSCW) 2005 in Paris. The findings in Papers 4 and 5 have been presented to the Department of Rheumatology in Trondheim (where I did the fieldwork) prior to the presentations at MCIS and CSCW. Preliminary findings reported in Paper 6 have been presented for the users in the Department of Special Psychiatry in Tromsø, research colleagues at the Norwegian Centre of Electronic Health Records (NSEP) and to the full executive board of the EPR vendor. Finally, an earlier and shorter version of Paper 7 was presented at the International Workshop on Infrastructures for Healthcare: Connecting Practices

Across Institutional and Professional Boundaries in Copenhagen, Denmark in June 2006.

The collection of papers has been selected to serve two main purposes. First, to portray the learning process I have gone through. The sequence, as it is outlined above, thus denotes the order in which he actual work has been done. Second to reveal how the contributions have evolved over time and across settings. The contributions are in this sense more evident in the later papers than in the earlier ones.

6.1 Paper 1: Community of Practice versus Practice of the Community - Knowing in collaborative work

Paper 1 is actually written prior to commencing the fieldwork. It is written together with two colleagues and is the outcome of prolonged discussions on, and a mutual interest in practice-based theories on knowledge. Since none of us were doing fieldwork in the same empirical context, the paper is primarily theoretical in which we draw on empirical examples from the literature. In addition to myself, the first author was studying a global company working on quality management certification, while the third author was studying a large-scale open source software development project. Concretely, in terms of writing the paper, I have explicitly contributed to the introduction, the parts of the theory that discusses practice-based theories on knowledge (Sections 3, 4 and 5) and the concluding parts of the paper.

The paper discusses how knowledge sharing across time and space is accomplished by drawing on examples from software development (Naur, 1992), technical service work (Orr, 1996) and medieval cathedral building (Turnbull, 1993). Two slightly different questions are asked in order to illustrate how our attention can be shifted from an emphasis on the community aspect of collaboration ('what' questions) to the practice part of collaboration ('how' questions). The questions are as follows: what is it that software developers, field service technicians and medieval cathedral builders do when they build software, repair copying machines and construct cathedrals respectively? Versus; How is software built, copying machines repaired and cathedrals constructed.

To demonstrate our point we first present Community of Practice (CoP) as a way to understand collaborative work. CoP, introduced by Lave and Wenger (1991), is based on a fundamental belief that dividing theory from practice is unsound and in that sense contradicts traditional theories of learning, where learning and working are conceived as separate processes. CoP is however a social theory in which codified representations of work are left unspecified (see Fox, 2000) We thus turn to alternative approaches that illuminate the technology and artefacts that are present in collaboration. Here we draw on Berg (1997) who uses ANT to illustrate the responsibility awarded to artefacts in the process of documenting a hospital patient's fluid balance. Also we draw on Hutchins (1995) who describes navigation as a joint accomplishment of artefacts and people. Finally we use Turnbull (1993) who sees a wooden template as a chief enabler of building gothic cathedrals without use of structural mathematics.

In the concluding part of the paper we discuss knowledge accumulation and transfer. Here again we stress the value of both the social and the technical in cooperative work.

Within the context of this thesis, the paper serves two purposes. First it exemplifies how practice oriented theories differ in their perspective on knowledge and working.

Second, it demonstrates practice-oriented approaches that conceptualize the material aspects of knowledge. As argued in the theory section, these latter issues have been particularly stressed in this thesis.

6.2 Paper 2: Practice-Based Knowledge Integration

Paper 2 was started while working as a nursing assistant at the Department of Rheumatology. However it was not finalized until after I had actually started the fieldwork and in that sense it was empirically and analytically validated during the initial phases of my fieldwork. Following up on Paper 1, this paper is an attempt to empirically demonstrate the material aspects of knowledge (or knowing) by providing a practice-based perspective on knowledge integration. I have written the paper alone.

The paper provides a limited, but explicit example of how separate knowledge entities are being integrated in practice. Following up on the perspective outlined in Paper 1, the paper seeks to move away from traditional abstractions of knowledge as tacit/explicit, individual/collective, and so on, and rather focuses on the processes of knowledge in practice. The material aspect of knowledge is emphasized in which applicability of specialization as located only within humans is questioned.

Empirically the paper draws on an example from the Department of Rheumatology in Trondheim. The example is the patient list, an A4-format template created by nurses and used in different settings in the hospital department. Its core users are the nurses, but other practitioners in the department also use it. The paper illustrates how the patient list serves different functions within the department and how, along with other actors, it structures and coordinates work in the unit.

In the literature these types of artefacts are commonly referred to as scraps (see Hardey et al., 2000) and from a practice perspective they are crucially important to bridge the gap between formal representations of work and the way work unfolds in practice (see Svenningsen, 2003; Fitzpatrick, 2000). Also, even though I have not explicitly mentioned it in the various papers, I have observed equivalent artefacts in use in all the different hospital units I have visited (i.e. Trondheim, Molde, Kristiansund and Tromsø).

In the analysis I describe how, from a practice point of view, integration is not a question about merging knowledge entities, but rather entails looking at how work is distributed, delegated and coordinated across time and space. Several mechanisms for integrating knowledge (and work) are identified. For example processes of tinkering, enacting, storytelling and circulating.

The paper is an attempt to apply a perspective on knowledge that stresses the relational interplay between artefacts and humans in accomplishing work. It is illustrated how the patient list functions as glue between official documentation requirements and the actual accomplishment of work. In this sense it demonstrates the importance of informal, unofficial documents, in achieving high qualitative and efficient delivery of healthcare services.

6.3 Paper 3: From plans to planning – the case of nursing plans

Paper 3 analyses contemporary efforts of establishing nursing plans at the Department of Rheumatology. The paper was triggered by an observation of nurses who struggled immensely in integrating the nursing plans as a part of their daily documentation practice. I designed this study and collected, transcribed and analysed the empirical

data. In writing this paper, I have explicitly contributed to the methods section, case description as well as the analysis/discussion and the conclusion.

Analytically this paper differs from Paper 2 in the sense that I move away from a focus on singular artefacts (e.g. the plan) and rather stress the heterogeneous network of artefacts that goes onto the practice of planning. Planning thus is considered a process, constantly changed, altered and negotiated in response to changes in the surrounding nodes that constitute its heterogeneous network.

Two examples are used to illustrate how planning unfolds in practice. The first portrays a nurse in the process of producing the written report. The second example looks at the collective effort of handing over information and the way responsibility is distributing among nurses on a shift. In both cases it is illustrated how, in the process of planning, information is being distributed across a variety of nodes. This I argue is done to both comply with formal requirements and as a way to delegate and coordinate work according to a local division of labour. The paper exemplifies how various, partly overlapping sources of information, continuously emerge and disappear in the planning-process.

Two topics are addressed in the discussion. The first reiterates the point on heterogeneity in the sense that a network of actors accomplishes the planning. The act of sharing information entities entails more then merely moving information entities. Rather the entities are being transformed in the process in order to comply with a specific sociotechnical practice. The second claim specifically addresses the notion of redundancy in relation to the process of planning. Redundancy is always in the making in the sense that it is continuously being produced through processes of questioning, negotiating and validating. It is these processes that enable people to make sense of the situation at hand and subsequently what makes the production of robust, working plans possible.

The paper contributes to the overall thesis in two ways. First, a perspective on plans is developed that emphasizes the process of planning rather than the plan itself. For this reason it is argued that the ongoing attempts to cram planning into one, singular artefact is misconstrued. Rather planning should be supported in a distributed manner - embedded in the many, existing information sources that are used in practice. Second, the danger of duplicated and redundant information sources is readily understandable – but exaggerated. Robust and effective planning in fact presupposes a certain level of redundancy. The paper provides two empirically based examples of this. Implicitly the paper should be seen as a critical remark to the dominant visions of creating an all-encompassing EPR, which simultaneously is expected improve quality and efficiency by removing redundancy and circumventing informal practices.

6.4 Paper 4: Formalizing work – reallocating redundancy

Paper 4 is empirically based on fieldwork from the Department of Rheumatology. It analyses the transformation from the old paper-based documentation practice to the new EPR-based documentation practice. The paper also draws on a concurrent project that aimed at formalizing nurse's work related to handover conferences. An important objective in the project was to eliminate redundant information sources and routines. In the paper I look at what happens to redundancy (and informal practices) when the work practice is being transformed.

The paper is the result of a rather prolonged effort of analysing the case in which the other two authors became involved in the later stages of the process. The second

author helped in particular with the theoretical section as well as in structuring the analysis, while the third author provided input to the method section and the last part of the case description where early results are presented.

Despite the proclaimed project success of reduction in overtime, improved quality of the written documentation and erased redundancy, the analysis demonstrates an opposite effect. The formalization of the nursing handover (and thus also a reduction in redundancy) in fact resulted in a reintroduction of redundancy, although at another time and place. In the transformed practice, work (and redundancy) had in fact moved to another time (i), into different artefacts (ii) or old artefacts that now were used/annotated differently (iii). Generally the paper concludes that attempts to formalize a practice by removing unstructured aspects of work, might introduce new types of informal and redundant elements.

The paper makes the following contributions to the overall thesis. First, although the literature reveals the importance of redundancy in ensuring a certain flow of work (see Ellingsen and Monteiro, 2003b; Tjora, 2004; Cabitza et al., 2005) we still need to have a deeper understanding of the implications of removing it. Second, the paper demonstrates how redundancy was hard to erase in the implementation process. In fact redundancy was not erased, but rather transformed into new artefacts and practices. Based on this observation, we argue that existing discourses in CSCW that has centred on how tools *support* work should be extended and also address how a network of people and tools (i.e material entities) may change as a co-construction. For example, in the paper it is demonstrated how informal routines, which were the initial problem, became part of the solution in order to make the new formalized practice work.

Like Paper 3, this paper is also to be seen as a critical remark to the dominant visions of creating an all-encompassing EPR, which simultaneously is expected improve quality and efficiency by removing redundancy and circumventing informal practices.

6.5 Paper 5: From Storytelling to Reporting - Converted Narratives

This paper is grounded on the same empirical data as Paper 4. I follow the transformation from the old paper-based documentation practice to the new EPR-based documentation practice and the concurrent project that aimed at formalizing nurse's work related to handover conferences.

I designed and carried out this study. In writing the paper the second author helped me to structure the text and improve the analytical parts.

The paper complements Paper 4 by exploring *why* redundancies and informal practices were so hard to erase. In short the apparent success of formalizing the handover conference not primarily due to the introduced system, but rather the nurse's ability to re-align their practice to maintain a seamless flow of work.

In the analytical parts of the paper we reveal the handover conference as an occasion for collaborative sensemaking processes. The nurse's efforts of producing narrative accounts signify a struggle to produce stability out of a highly fragmented record and a rather conditional practice. Even during processes of transformation these mechanisms seemed to remain. Tailored stories in the old oral handover conference became smaller isolated narratives attached to the places in the trajectory were navigation was carried out in the written handover practice. In other words mechanisms were established in order to preserve sensemaking as a part of the handover conference. An important feature in these sensemaking processes was

related to how they enabled the flow of work. Here we have identified that having a horizontal and vertical overview is crucial. The first denotes a collective consensus about the state of affairs on the ward aiding higher level processes like building trust, facilitating self-confidence, nurturing learning, reducing uncertainty and so on, while the second denotes the integration of various knowledge entities in order to enable individual nurses to understand the whole patient. Both types of overviews contribute to facilitate sensemaking processes as they reduce the amount of articulation work needed to get the work done.

The paper should be seen as related to existing contributions in the CSCW literature on the heterogeneity of knowledge and the simultaneous transformation of artefacts and work during processes of appropriation (Berg, 1999; Ellingsen and Monteiro, 2003b; Winthereik and Vikkelsø; 2005). The paper identifies how narrative accounts did not disappear on the transformation-process, but rather were converted and reappeared in the new practice. This reappearance is claimed to an effect produced by a need to balance the tension between flow of work and formal documentation requirements (see Paper 4).

More generally this paper is also a critical remark on the dominant motivation underpinning current EPR designs and implementation efforts, which aim at removing redundancy and circumventing informal practices (implicitly improving efficiency and quality). The paper illustrates that it is by no means given how efficiency and quality are achieved, and how knowledge is shared in specific nursing practices. We thus argue for a need to further explore the narrative (and collaborative) nature of nurse's work, as the design related implications of such an approach seem largely uncharted.

6.6 Paper 6: Standardization of work: co-constructed practice

Paper 6 is based on our fieldwork from the introduction of an electronic nursing plan in the Psychogeriatric Ward at the University Hospital of North Norway. Based on a theoretical perspective on standardization-in-practice (see Timmermans and Berg, 1997) the paper analyses efforts of standardizing nursing care through nursing plans.

I designed this study together with Gunnar Ellingsen. I have contributed to the paper in terms of collecting, transcribing and analysing the empirical data. In the actual writing of the paper I have explicitly contributed to the method section, the case description and parts of the analysis.

The implementation of EPR-based nursing plans was largely perceived a success as it improved both the documentation practice by providing better overview of the planning process and offered a better overview of the status of the patients. At the same time, the users experienced and complained that the application was not user-friendly. This was in particular related to the embedded classification schemes for patient problems/diagnosis (NANDA) and interventions (NIC), which included relatively wide categories. When put into use the nurses thus had to spend a significant amount of time searching for diagnosis and interventions. It is particularly this latter outcome that is analysed in the paper.

In the analysis we discuss in detail how structurally imposed classifications mesh with the everyday practice of healthcare delivery. Three main themes are discussed. First, we illustrate the invisible work of fitting categories. One main challenge here concerns the trade-offs in calibrating the level of *granularity* in classifications schemes and standards: a crude level of granularity (i.e. open categories) implies that

relatively little work is required when writing, yet a corresponding amount of work for the reader is required and *vice versa*. Second, we present how categories are being transformed in the process of using them. In this sense the users of classification schemes are not meek subjects of an imposed standard; they participate in altering and ultimately transforming that very standard. Without space for such a transformation, we argue, the standard would not work. Third, we show how the standardization of nursing plans unintentionally subverted the possibilities for interdisciplinary cooperation and abruptly invoked another rationality regarding the purpose of the nursing plan, namely as a resource management tool.

Finally implications for design are discussed. Here we develop a position in which we move from ”Implications for design” (see Dourish, 2006) to an “arena/ network-based perspective on interventions”. We illustrate our point by discussing both the content and context of the arenas we have engaged in. Here we demonstrate the contextual, contested and negotiated nature of these arenas in mirroring power relations and expectations towards our role as researchers.

There are two main contributions in this paper to the overall thesis. First it develops a theoretical perspective of the nature of standardization. The perspective identifies key mechanisms of transformative, co-constructive practices that constitute standardized work. It thus contributes to the analytically based, empirically underpinned, critique of an overly simplistic understanding of what is involved. Second, the paper provides operational and practical implications for system design and healthcare management.

6.7 Paper 7: Common Information Spaces along the illness trajectories of chronic patients

Finally, Paper 7 is also based on fieldwork from the introduction of an electronic nursing plan in the Psychogeriatric Ward at the University Hospital of North Norway. Findings are presented by drawing on the concepts of Common Information Space (CIS) (see Schmidt and Bannon, 1992; Bossen, 2002) and trajectories (Strauss et al., 1985).

I designed this study together with Gunnar Ellingsen. My input in producing this paper includes collecting, transcribing and analysing the empirical data. In the actual writing I have contributed to all parts of the paper. The second author has particularly contributed to structuring the overall text, written parts of it and contributed explicitly to the analysis and conclusion.

The nursing plan was expected to improve information sharing among the healthcare practitioners and in that sense contribute to their CIS. However, although the nursing plan was regularly updated, it was less used in practice than initially expected among the nurses. For example, the plan was used to a lesser degree in close cooperative settings such as during the admission of patients, in nursing handover conferences and in interdisciplinary meetings. We suggest that this can be ascribed to the temporal and evolving character of both medical information and work.

We analyse the case along three main dimensions. First, we explore what kind of information sources and artefacts are in use in cooperative settings that cut across professional boundaries. We elaborate on the nature of CIS (manifested by the points at which the work trajectories of physicians and nurses intersect) as situated, temporal, regularly (re)negotiated and achieved in practice. The nursing plan, we argue, is only one entity in a larger information infrastructure. Its particular value is in constituting the nursing perspective on the care process, as the medical kardex does

for the physician's perspective. Second, we discuss how medical data is not fixed and self-contained, but evolves over time during the patient's illness trajectory. To portray this evolving trajectory, the plan had to be linked with a variety of information entities and practices. We develop our argument by providing an example from the nursing handover conference, which is a setting where it is crucial to know how a patient is progressing. Finally, we illustrate the unpredictable nature of the plan. We analyse the trajectory of the nursing plan and stress its uncertain and contingent character and how it eventually became an infrastructural entity that appealed to a new reality. In our case, it increasingly became entangled with managerial concerns for resource management and control.

The paper contributes to the overall thesis by providing a temporal dimension on how knowledge is made common in heterogeneous work practices. A perspective on how to conceptualize CIS where various perspectives are accounted for is developed by drawing on the notion of trajectories.

Also, aligned with the critiques put forward above, in this paper we argue for a need to move beyond simplistic strategies of replacing the existing, redundant and informal information sources. The strategy to pursue is rather to find mechanisms that strengthen the relations between the different nodes. Implicitly this also involves paying closer attention to the non-common – that is, the information that remains local to the various professionals. In this respect, we call for the need to rethink 'implication or design' by focussing more on the process rather than the product.

7 Contributions and Implications

Overall, the main contribution of the thesis is primarily the detailed, empirically underpinned exploration of efforts of introducing the electronic-based nursing module in practice. The implications are thus in one sense already given in the various papers, through the description of the settings and particularities of the cases. Moving further and extracting implications beyond what is discussed there thus means balancing between claiming what might seem obvious and straightforward and making assertions that have not necessarily been explicitly demonstrated in the empirical material. Nonetheless, based on my own experience and through my work in the field, I now present implications that I find particularly relevant for theory, practice (i.e. design, implementation and use of the electronic-based nursing record) and method respectively.

7.1 Contributions to theory

Conceptualizing the nursing record in practice

The findings of the individual papers were briefly presented in the previous chapter. In all the papers I have emphasized the nurse's written accounts as locally embedded achievements. This rests on the assumption that the successful dissemination of a new tool, beyond its local context, depends inevitably on its local 'rooting' (See Aanestad, 2002; Timmermans and Berg, 1997).

Unlike the predominant, single entity oriented conceptualization of the nursing record as a passive information archive, I draw on a dynamic perspective in which it is considered to be resilient, open and achieved in practice (see Chapter 2). There are two aspects that are particularly relevant for the way I have conceptualized the role and function of the nursing record in practice (see Papers 2 and 3). First, rather than thinking of it as captured by any singular entity, I emphasize how it is distributed across a number of human actors and material artefacts. Second, instead of the traditional focus on the nursing record as an artefact, I focus on the practice of documenting, that is the process through which the actual record-keeping unfolds (see also Berg, 1997). Such a conceptualization allows one to study how the tool and the work practice shape each other reciprocally as a process and how the different material and human actors interlock and contribute to the delivery and documentation of healthcare. Empirically I have thus pursued the process of documenting as it unfolds distributed across a network of material/technological and human resources, and continuously through ongoing and negotiated additions, deletions and changes. In addition, in one of the cases I followed the whole process, both prior to and after the actual implementation of the EPR-based nursing records. This has made it possible to explore how the nursing record (and work) is transformed over time (i.e. from paper-based practice towards electronic-based practice).

With this as my point of departure, I will elaborate on the theoretical contributions of this thesis more specifically. As is evident in the various papers, I have in made an effort to contribute to the field of CSCW. The EPR-based nursing record and similar technologies that aid collaboration and coordination of healthcare work have become a significant setting for enquiries within CSCW (see Berg, 1997; Bossen, 2002; Hartswood et al., 2003; Svenningsen, 2003; Tjora, 2004; Cabitza et al., 2005).

Conceptualizing change – informal documentation and redundancy

Researchers within CSCW have a long tradition of respecting the ways people actually work and use information (see Kling, 1991). For example, research on redundancy has by and large centred on existing work practices (see Ellingsen and Monteiro, 2003b; Tjora, 2004, Cabitza et al., 2005). Consequently design for cooperative work has primarily been concerned about how to design tools to *support existing* work practices.

Yet, aims and goals related to medical technologies change and expand over time and in relation to multiple stakeholders. Primary work transforms into something different, and technologies find new areas of application. For example in Paper 6 it was demonstrated how the nursing plan started out as tool for nurses, yet gradually turned into a resource management tool. Also in the same paper it was demonstrated how the standardized nursing plan unintentionally subverted the possibilities for interdisciplinary cooperation. It was the existing ensemble of heterogeneous information sources that in fact played a pivotal role in interdisciplinary work.

In all the settings I visited (including the hospital departments in Molde and Kristiansund), the shared EPR-based nursing record was expected to make up for and replace many of the existing heterogeneous, redundant and informal information sources commonly in use and considered unproductive. In this sense the new system was assumed to support the documentation of nursing in a better way than the old system. However, as it turned out, the implementation of such a shared system is a complex undertaking and it did not produce the anticipated effects in any of the cases. Rather, new instances of fragmentation were introduced (see also Rolland et al., 2006).

In this thesis I make an effort to understand why and how new instances of fragmentation were introduced. Concretely the thesis contributes to the existing CSCW-related literature on informal documentation practices (e.g. oral interaction, scraps, and the like) and expressions of redundancy (see Ellingsen and Monteiro, 2003b; Tjora, 2004; Cabitza et al., 2005) by demonstrating how these are being transformed when new technologies are being implemented.

In Paper 4 it is demonstrated how the new instances of fragmentation that emerged when the EPR-based nursing record was implemented were partly old representations of work that, at the outset, were meant to be erased. However, these were not always erased, but rather moved, to another time (i), into different artefacts (ii), or old artefacts that in the new situation were used/annotated differently (iii). In fact the informal documentation practices (e.g. oral interaction and redundancy) became essentially important to make the new formalized documentation practice work in practice.

By this I do not contend that the official record and unofficial representations of work are opposites, rather the two are "*engaged in a spiralling relationship - they need and embody each other*" (Berg and Timmermans, 2000). A main reason for the 'unintended' effects (i.e. reintroduction of the informal documentation practices) was thus that the gap between documentation and flow of work was amplified (see also Svenningsen, 2003; Hardstone et al., 2004). In order to maintain the latter (i.e. flow of work) mechanisms in terms of redundant artefacts and oral practices were established. Only by (re)introducing mechanisms like these were the nurses able to maintain a certain level of overview, make sense of patient cases and come to agreement (see also next section).

Bridging the gap between CSCW and the design and use of large-scale IT-systems

This thesis has argued that the introduction of the EPR-based nursing record primarily contributes to the distributed nature of nurse's work, at the expense of the collaborative nature (see Paper 5). This tendency has also been reported by others (see Hardstone et al., 2004). It seems like large-scale IT systems, such as the nursing record, primarily embed functionality to facilitate documentation of work (formality) and lack functionality to facilitate flow and communication of work (informality). On this issue, Hardstone et al. (ibid) contend that lessons learned in CSCW have, so far, had relatively little impact on the design, implementation and use of large-scale IT systems. In the same way relatively little is done within CSCW to find ways of integrating informality in such systems.

This thesis makes an effort to contribute to bridge this gap. In Paper 5 the notion of overview was identified as a common theme and precondition for nurse's ability to coordinate and communicate actions. A rather straightforward concept, but still crucial to the process sharing knowledge and ensure continuity of care. Overviews are narrative in nature and typically materialize as stories and summaries of, otherwise, fragmented pieces of information.

Based on empirical data from the transformation of the handover conference in Trondheim, in Papers 4 and 5 it was demonstrated how maintaining the overview was as important before as after the change had taken place (i.e. implementation of the EPR-based nursing module and formalization of the handover conference). Although the handover conference drifted from being a highly collaborative effort to become an effort primarily emphasizing the distributed nature of work, mechanisms were established locally in order to maintain the collaborative aspects of the practice (i.e. nurture trust, foster learning, handle uncertainty and the like). These mechanisms materialized as various types of overviews. The overviews was delegated the role of approval – temporary closures fundamentally important to communicate and enable work to go on (see Bijker et al., 1987).

A main difference between the old and the new situation however was that the process of building the overview changed from that of tailoring to that of navigation. While in the old situation the overviews materialized primarily as oral accounts, in the new handover conference, smaller and more isolated overviews were attached to the specific places where navigation took place.

The notion of overview and how the process of building changed during the transformation represents one concrete example of a mechanism that contributes to bridge the gap between CSCW as a field and the design and implementation of large-scale IT systems. However we still need to know more about how they contribute to the work practice and how they change over time and across contexts. In this respect the shift from tailoring to navigation provides a relevant direction to explore further.

The temporal dimension of healthcare work – contribution to CIS

A main goal with the EPR-based nursing record is to create a common information resource where various nurses (and other professionals) can share patient information seamlessly within and across professional and institutional boundaries. The nursing plans in particular are the most concrete materialization of the ambitions of creating more integrated healthcare services. However, as argued in the previous section, the ambitions, aims and goals related to medical technologies change and expand over time and in relation to multiple stakeholders. Orlikowski and Yates (2002) denote this

as an "*ongoing constitution of multiple temporal structures in people's everyday practices*" *(p.687)*. Medical information (and work) thus can be said to be temporal and evolving. Strauss (1993) describes it as follows:

> *"(1) the course of any experienced phenomenon as it evolves over time (an engineering project, a chronic illness, dying, a social revolution, or national problems attending mass or "uncontrollable" immigration) and (2) the actions and interactions contributing to this evolution" (pp.53-54)*

The notion of "trajectory" has been suggested to conceptualize the chain of tasks associated with the course of the illness of a patient. The concept emphasizes that patients follow a trajectory that refers to a past, a present, and a possible future. This is illustrated by the way nurses (from a care perspective) continuously construct "histories" and "futures" when writing reports between nursing shifts (see for example, Papers 3 and 4). The term refers not only to the physiological unfolding of a patient's disease but to the total organization of work done over that course, plus the impact on those involved with that work and its organization (Strauss et al., 1985). The resulting patient trajectory will thus never be the result of consciously developed plans or a particular sequence of decisions. Rather, it is the emergent effect of the interlocking of entities doing subtasks (see Berg, 1997). For example, the nursing plan is a trajectory that is constantly changed, altered, negotiated in response to changes in the surrounding nodes that constitute the heterogeneous network of planning.

According to Reddy et al. (2006) research within cooperative settings have a long tradition of looking at how work is organized. Less attention has been devoted to how it is experienced along a temporal dimension. That is how work is perceived both in relation to objective and subjective perspectives of time (Orlikowski and Yates, 2002) and how it unfolds along different temporal dimensions such as the medical trajectory, the nursing care trajectory, the care plan trajectory, and so on. This thesis makes a particular contribution to CSCW in this respect. In Paper 7 a perspective is developed on how to conceptualize Common Information Spaces (CIS) in interdisciplinary and heterogeneous contexts (see Bossen, 2002). The nature of CIS, as where the work trajectories of physicians and nurses intersect (manifested by the intersection points of physician's and nurse's work trajectories), is presented as situated, temporal, regularly (re)negotiated and achieved in practice. It is demonstrated how a CIS in fact encompasses several disconnected trajectories (professional, medical and technological) and how each follows its own logic only with brief intersecting points. The temporal dimension of the multiple trajectories and how they evolve over time in the course of the patient's illness trajectory is emphasized in particular.

The current conceptualizations of CIS in heterogeneous contexts do not address the notion of temporality explicitly. There is thus a need to further the discourse on trajectories and temporality within cooperative work. For example how multiple trajectories evolve over time in the course of the patient's illness trajectory or how the trajectories of medical and nursing care information interleave or how distinct trajectories are connected through informal documents and expressions of redundancy.

7.2 Implications for practice

From integration of to integration with the existing set of systems and practices

The nursing practitioner is merely a node in a network of interconnected, and mutually dependent nodes of material arrangements, practices and different professionals. In the documentation process, he or she is involved in a continuous process of contextualizing and de-contextualizing information (see Schmidt and Bannon, 1992). In this process unofficial and redundant information entities are crucially important to preserve a certain flow of work and thus also in enabling an efficient, continuous and high quality delivery of care services (see Papers 3-5) Correspondingly it is this heterogeneity of information sources that finally constitutes and serves as a premise for a high-quality nursing record. In practice, the nursing record is thus as a multitude of relations in which information embedded in the formal system is constantly changed, altered, and negotiated in response to changes in the surrounding nodes that constitute its heterogeneous network.

This is why, when implementing new systems such as the EPR-based nursing record, we should neither depend on simplistic strategies of replacing the existing portfolio of information sources, nor regard the new system in isolation. Rather this thesis strongly suggests that the strategy to pursue is to integrate new systems into the existing portfolio of material and human entities, making sure to establish a robust connection between the existing nodes (see also Ellingsen and Monteiro, 2003b). This takes into account how the heterogeneous collection of people, artefacts, routines and practice contributes to the delivery of care services, and provides an opportunity to pay closer attention to the different perspectives and meanings surrounding the implementation of a new system.

From a focus on merging entities to a focus on embracing multiplicity

Notions like shared care, integrated care and continuity of care all express commitments towards creating coherent and effective healthcare services within and across disciplinary and institutional boundaries (Winthereik and Vikkelsø, 2005). The nurses play an important role in this respect as they are the ones " *who weave together the many facets of the [healthcare] service and create order in a fast flowing and turbulent work environment*" *(Allen, 2004 p.279)*. Their associated tool, the nursing plan, is bound to play a key role in strategies for integrated care:

> *"[T]he nursing plan's] primary purpose is to ensure the individuality and continuity of care (…) When documentation is accurate, individual, pertinent and up-to-date, it promotes consistency and effective communication between nurses and the other team members involved in care" (Voutilainen et al., 2004 p.72).*

In the Norwegian healthcare context it is even suggested that the nursing plan is not limited to use by nurses, as the:

> *"documentation of this work-process [nursing process] is also called the care plan, it is interdisciplinary and can be used by all professions." (KiTH, 2003).*

However, based on my fieldwork in work settings fully dedicated to interdisciplinary work/integrated care, the different professionals did not share a common apprehension of the patient case and the patient's problem. In fact, this only occurred in brief moments and only if it was regarded as adding value to a given professional perspective (see Paper 7). Accordingly, when using notions such as integrated care,

we should be careful not to refer to it as an absolute entity, but rather take into account what perspective is involved and who is promoting it.

A given implementation of an infrastructural arrangement for integrated care will inevitably privilege one of the professional groups involved, making its perspective more visible and explicit (for example, nursing is made more explicit through the nursing plan). By this I do not imply that IT systems dedicated to a particular profession are isolated from the broader practice. As demonstrated in Papers 6 and 7, physicians and psychologists used the EPR-based nursing record when producing their own reports. Implicitly this also makes it crucial to pay close attention to the non-common – that is, the information that remains local to the various professionals.

Balancing between rational aims and practical applicability

Efficiency and quality have been fundamental in the various setting I have visited. In the Trondheim case for example, this entailed improved written documentation and the formalization of the handover practice. Yet, as demonstrated in Papers 1 to 7, it is by no means given how efficiency and quality are achieved, and how knowledge is shared in specific nursing practices.

In order to come to such an understanding, the first thing to do is to recognize the rather contradictory objectives related to the design and implementation of EPRs in nursing. Current efforts of implementing such systems seem to adhere to a rational perspective, primarily contributing to fulfil organizational accountability at the expense of practical applicability. As Svenningsen (2003) argues, and as verified in this thesis, current 'rational' efforts seem to contribute to amplify the tension between the documentation and the flow of work.

To counter this tendency there is a need to balance the design and implementation of EPRs to facilitate, not only rational processes as in 'what should be done', but also to enable sensemaking processes as in 'what is going on'. It is this latter perspective that produces the buffer between documentation and flow of work, and accordingly, is crucial for delivering efficient, continuous and high quality care. Throughout this thesis I have pointed to various issues that might be worth considering in this respect; for example, making space for narrative practices when implementing new technologies. Not only are narratives an efficient way to share knowledge, it also enables closure and supports processes beyond the mere handing over of information like building trust, foster learning and the like.

7.3 Implications for Method

Following the whole implementation process

Given the relative lack of emphasis being given to their written accounts and the fact that the efforts of introducing the electronic-based nursing record in the healthcare sector is still in an early phase (and thus our knowledge about their effects is rather limited), there is a need to further explore how the nursing record is played out in practice. In this thesis I argue for a practice-oriented approach to this end. Also the interconnected and mutually dependent entities of material arrangements and practices of different professionals underscore the need for doing empirical studies in a work setting by following the whole process of implementing a new system - before, during and after.

As demonstrated in this thesis, such studies have the potential to reveal both explicit and implicit dependencies that must be taken into account when introducing new technologies. They may indicate how, and to what degree, a new system is used, as this may not be entirely clear to the users themselves. For example I have demonstrated how the nursing plan was primarily used as a formal tool, and only for a limited part of the documentation practice (see Papers 6 and 7). Also this study has shed light on how the old informal information sources were in fact heavily used in practice, serving as a foundation for the formal record. The old documentation was in this sense not replaced but rather transformed to comply with the new work practice (see Papers 4 and 5).

Operating on various arenas together with different stakeholders – making the research practically relevant

Implication for design has been, and still is lively debated in the IS-literature (see Hughes et al., 1992; Dourish, 2006). Particularly relevant for this study is the ongoing discussion about the level of granularity that contributions from ethnography and interpretive studies have for design (see Dourish, 2006). On the one hand, field-workers typically have an affinity for unfolding the complexity of work related to highly local and situated practice. On the other hand, designers have an inclination towards explicit specifications as input to their practice (see Hughes et al., 1992).

Dourish (2006) argues that there is a need to make ethnographic research more relevant for design. Yet his concern is primarily related to the requirements themselves (i.e. their content and functions) in which the 'problem of implications for design' has a strong bias towards the local and singular work setting. This however, downplays how the researchers negotiate their results in distinct *arenas* with different stakeholders.

The argument made here is particularly motivated by the relative lack of examples of contributions (i.e. implications for design) that result in information systems that work over time, beyond the project phase itself, and across contexts (see Braa et al., 2004). Inspired by insights from studies in the fields of science and technology I thus argue for a need to move beyond localized, artefact-centric 'implications for design' to network-based interventions (Braa et al., 2004). As researchers we should engage ourselves in shaping arenas that enable learning to take place, experience to be shared across boundaries and where local competence and capacity are cultivated (ibid).

As explicitly illustrated in Paper 6 (Tromsø case), rather than handing over a 'context-free' set of requirements derived from the study, the requirements were considered as just one element that needed to be negotiated with the different stakeholders in different arenas. Given the diversity of expectations related to the design and implementation of nursing plans (managerial, professional, vendor, etc), an effort was made to fine-tune the local needs of the nurses against the backdrop of competing interests. For example when engaging with the vendor, focus was primarily on the product (the EPR nursing module), and when engaging with the users, focus was particularly on their work practice (see Paper 6). Similarly in Trondheim, when presenting preliminary results to the nurses the focus was on the nurses work practice. For example how oral interaction and redundancy might appear as unproductive yet play an important role in maintaining an overview (see Papers 4 and 5). When discussing the same results with the local project managers, whose main concern was how to evaluate the effects of the system on quality and efficiency, I made an effort in

describing how evaluation was not only an external activity, but also an intrinsic part of actually using the system. For example how the nurses themselves established arenas and places to meet and share experiences. Design implications were in this sense not considered fixed once and for all, but rather served as a starting point for discussion, reflection and negotiated changes with various stakeholders.

8 Conclusion and recommendations for further work

This thesis explores the relationship between tools for documenting work and the work practice, and how this relationship is being transformed when new tools are being implemented in nursing practice. The empirical basis for the thesis is based on ethnographically inspired fieldwork at the Department of Rheumatology at St. Olavs University Hospital in Trondheim and the Department of Special Psychiatry at the University Hospital in Tromsø. In both cases an in-depth empirical study of the introduction of the EPR-based nursing record is carried out.

Based on the efforts of the nursing practitioners that I have had the privilege of following, a set of papers have been produced that all try to disentangle nurse's documentation practice and the work that it takes to integrate a new tool as a part of their everyday work. The main contribution of the thesis is thus primarily the detailed, empirically underpinned exploration of efforts of introducing the electronic-based nursing module in practice as they are presented in the various papers. I apply a process-oriented perspective on the nursing record that stresses how it is situated, its temporality, regularly (re)negotiated and achieved in practice. In practice the EPR-based nursing record can be conceptualized as a multitude of relations. Information embedded in the formal infrastructural arrangement that is constantly changed, altered, and negotiated in response to changes in the surrounding nodes that constitute the heterogeneous network.

The thesis has illustrated that implementing the EPR-based nursing record with the aim of improving information sharing is extremely difficult. It is by no means given how efficiency and quality are achieved and how knowledge is shared in concrete healthcare practice. For example, redundancy and informal documentation practices were reintroduced in the Trondheim case and the standardization of nursing plans unintentionally subverted the possibilities for interdisciplinary cooperation in the Tromsø case. In order to succeed, the most important thing to do is to move beyond simplistic strategies of replacing the existing information sources. The strategy to pursue is rather to find mechanisms that strengthen the relations between the different nodes. Implicitly this also involves paying closer attention to the non-common, meaning, information that remains specifically for the various professionals.

It is also illustrated how aims and goals related to the EPR change and expand over time and in relation to multiple stakeholders. An example of this is how the nursing plan started out as tool for nurses and gradually turned into a resource management tool. Such transformations of ambitions are typical in information system projects and should not come as a surprise. Primary work transforms into something different, and where technologies find new areas of application.

In the methods chapter this study was partly evaluated. However there are some additional issues that need to be mentioned. First, and most importantly, as in any interpretative inspired research project, the findings in this thesis could be subject to alternative interpretations. In fact, from a political point of view, it will inevitably be subject to different world-views and thus also potentially interpreted differently. I have however made an effort to frame the thesis and present the contributions as particularly relevant for specific communities. For example, the fact that three of the papers have been accepted in key CSCW-conferences indicates the relevance of my research beyond the concrete research settings where I did my fieldwork.

Second, the types of cases where I have done my fieldwork merely represent one aspect of the overall healthcare context. In this sense the empirical basis upon which this thesis rests is limited. This makes the applicability of my contributions to, say, intensive or acute care practice, more tentative than practice that handles chronically disordered patients.

Third, and following from the second point, even though both research settings can be said to provide treatment and care to patients suffering from a chronic disease. They differed in the sense that in Trondheim the focus was primarily on physically disordered patients, whereas in the unit in Tromsø handled mentally disordered patients. Also, as described earlier, the level of formalization in the two cases differed, the engagement among the staff, and so on. Subsequently the type of problems handled, the professionals involved and the tools used in the process differed significantly. The findings from the two cases are thus not directly transferable. Still, as argued in Chapter 4, the two cases are complementary. In Trondheim I was able to follow the whole process of implementing the system (before during and after), while the Tromsø case was most useful for exploring the new system in use (i.e. implication of actually using a newly implemented system).

Fourth, the thesis is based on ethnographic data from specific nursing work practices in which the systems were used. I have not observed how other professionals were using it. Here I have rather relied on data collected through interviews and diverse written documents. Whether I have been able to go beyond the formative context and uncover hidden agendas, disagreements or other personal or organizational issues properly is thus connected with some uncertainty. Having said that I have presented preliminary results for various professionals in different settings and in that sense made an effort to validate the multiple viewpoints.

Future challenges of designing and implementing information systems within healthcare will in essence be related to managing complex socio-technical relationships. As argued in Chapter 7, in order to better understand how, there is a need for doing empirical studies in concrete work settings by following the whole process of implementing a new system.

Given the current commitment of creating coherent and effective healthcare services across disciplinary and institutional boundaries (see Winthereik and Vikkelsø, 2005), one area that I find particularly relevant for future research is to look closer at practices with a strong presence of interdisciplinary work, and between those practices and otherwise separate practices. For example how new systems, primarily intended for one group of professionals are used in interaction with others, such as patients, other professionals and other healthcare institutions. Another relevant theme too pursue is the temporal and evolving character of medical information and work. How information is made common in heterogeneous work practices and how it unfolds along different temporal dimensions (e.g. medical, patient, nursing, managerial, and so on).

References

Aanestad M. 2002. *Cultivating Networks: Implementing Surgical Telemedicine.* PhD dissertation. Unipub no. 228, Faculty of Mathematics and Natural Sciences, University of Oslo.

Action plan. 2005. *Action plan for psychiatric healthcare 2005-2015*. Accepted by the Helse Nord Regional Health Enterprise 22.06.2005

Allen D. 2004. Re-reading nursing and re-writing practice: towards an empirically-based reformulation of the nursing mandate. *Nursing Inquiry, Special Centenary Issue*, 11(4). pp.271-83.

Alvesson M. 2001. Knowledge work: Ambiguity, image and identity. *Human Relations*, 54(7). pp. 863-886.

Ash J. S., Berg M. and Coiera E. (2004) Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. *The Journal of the American Medical Informatics Association*, 11(2). pp.104-112.

Atkinson P. 1995. *Medical talk and medical work*. Sage Publications Ltd. 1995

Baldwin L. and McGinnis C. 1994. A computer generated shift report. *Nursing Management*. September.

Bannon L. J. and Bødker S. 1997. Constructing Common Information Spaces. *Proceedings of the European Conference on Computer Supported Cooperative Work 1997*. Kluwer. pp.81-96.

Bannon, L. J. 1998. Computer supported collaborative working: challenging perspectives on work and technology. *In information Technology and Organizational Transformation: innovation For the 21st Century Organization*. R. D. Galliers and W. R. Baets, Eds. Wiley Information Systems Series. John Wiley & Sons, New York, NY. pp.37-63.

Becker H. S. 1998. *Tricks of the Trade: How to Think about Your Research While You're Doing It.* Chicago, The University of Chicago Press

Becker H.S. 1999. The Chicago School, So-Called. *Qualitative Sociology*, 22(1). pp.3-12

Benbasat I. and Zmud R.W. 2003. The identity crisis within the IS discipline: defining and communicating the discipline's core properties. *MIS Quarterly*, 27(2). pp.183-94.

Berg M. 1997. *Rationalizing medical work: decision-support techniques and medical practices*. Cambridge Mass. MIT Press.

Berg M. 1999a. Patient care information systems and health care work: a sociotechnical approach. *International Journal of Medical Informatics*, 55(2). pp 87-101

Berg M. 1999b. Accumulating and coordinating: occasions for information technologies in medical work. *Computer Supported Cooperative work*, 8.pp.373-401.

Berg M. and Timmermans S. 2000. Orders and their others: on the constitution of universalities in medical work. *Configurations*, 8. pp.31-61.

Berntsen K., Munkvold G. and Østerlie T. 2005. Community of Practice versus Practice of the Community Knowing in Collaborative Work. In N Janardhana Rao (ed). *Effective Knowledge Management - Emerging Trends*. The Icfai University Press, February.

Bijker W. E., Hughes T. P. and Pinch T. 1987. *The Social Construction of Technological Systems*. MIT Press, Cambridge, Mass.

Björvell C., Wredling R. and Thorell-Ekstrand I. 2002. Long-term increase in quality of nursing documentation: effects of a comprehensive intervention. *Scandinavian Journal of Caring Science*, 16(1). pp.34–42.

Blackler, F. 1995. Knowledge, knowledge work and organizations: An overview and interpretation. *Organization Studies*, 16(6). pp.1021-1046.

Boland, R. J. Jr. and Tenkasi, R. V. 1995. Perspective making and perspective taking in communities of knowing. *Organization Science*, 6(4). pp.350–372.

Bossen, C. 2002. The Parameters of Common Information Spaces: The Heterogeneity of Cooperative Work at a Hospital Ward. *Proceedings of Computer Supported Cooperative Work 2002*, ACM Press. pp.176-185.

Bowers, J. 1994. The work to make a network work: studying CSCW in action, *Proceedings of the Conference on Computer Supported Cooperative Work 1994*, pp.287-298

Bowker G. C. and Star S. L. 1999. *Sorting Things Out: Classification and Its Consequences*. MIT Press.

Bowker G. C., Star S. L. and Spasser M. A. 2001. Classifying Nursing Work. *Online Journal of Issues in Nursing*. Available at http://www.nursingworld.org/ojin/tpc7/tpc7_6.htm (accessed July 17th, 2007)

Braa J., Monteiro E. and Sahay S. 2004. Networks of action: sustainable health information systems across developing countries, *MIS Quarterly*, 28(3). pp.337-362. Special issue on Action research.

Bratteteig T. and Gregory J. 1999. Human Action in Context. A Discussion of Theories for Understanding Use of IT -- Käkölä, T. (ed.): *Proceedings of IRIS'22: Information systems Research In Scandinavia*

Brown J. S. and Duguid P. 2000. *The Social Life of Information*. Harvard Business School Publishing.

Cabitza F., Sarini M., Simone C. and Telaro M. 2005. When once is not enough: the role of redundancy in a hospital ward setting. *Proceedings of the 2005 international ACM SIGGROUP conference on Supporting group work*. pp.158-167

Callon M. 1986. Some elements of a sociology of translation: domestication of the scallops and the fishermen of St. Brieuc Bay. I J. Law (red.) *Power, Action and Belief: a new sociology of knowledge*? London: Routledge & Kegan Paul.

Carlsen A., Klev R. and von Krogh G. 2004. *Living knowledge: The dynamics of professional service work*. Palgrave Macmillan.

Carstensen P. H. and Schmidt K. 1999. Computer Supported Cooperative Work: New Challenges to Systems Design. vol. 43, *CTI Working Paper*, February 1999.

Casper M. J. 1998. Working on and Around Human Fetuses: The Contested Domain of Fetal Surgery. In Mark Berg and Annemarie Mol (eds.) *Differences in Medicine: Unraveling Practices, Techniques and Bodies*. Durham, Duke University Press. pp.28-52

Chaudhry B., Wang J., Wu S., Maglione M., Mojica W., Roth E., Morton S. C. and Shekelle P. G. 2006. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine*, 144(10). pp.742-752

Ciborra, CU. 1999. A Theory of Information Systems Based on Improvisation. In Currie WL. et Galliers B. *Rethinking Management Information Systems*, Oxford university press. pp.136-55.

Coiera. E. 2003. *The Guide to Health Informatics*. Second Edition. Arnold, London.

Cook S. D. N., and Brown J. S. 1999. Bridging epistemologies: The generative dance between organisational knowledge and organisational knowing. *Organization Science*, 10(4). pp.381-400.

Davies C. A. 1999: *Reflexive Ethnography – A guide to researching selves and others*. The ASA Research Methods. Routledge. Taylor & Francis Group

Dehli W. P. and Snøfugl G. 2005. *Nasjonal strategi for elektronisk pasientjournal – Rapport fra forprosjekt*. Sosial- og helsedirektoratet. 09/2005.

Devers K.J., Casalino L. P., Rudell L. S., Stoddard J. J., Brewster L. R. and Lake T. K. 2003. Hospitals' Negotiating Leverage with Health Plans: How and Why Has It Changed? *HSR: Health Services Research* 38(1). pp.419-446.

Dourish P. and Belotti V. 1992. Awareness and Coordination in Shared Workspaces. In *Proceedings of the 1992 ACM conference on Computer-supported cooperative work*. ACM Press, Toronto, Canada. pp.107–114

Dourish P. 2006. Implications for Design. In Proceedings of. *ACM Conference on Human Factors in Computing Systems CHI*, Montreal, Canada. pp.541-550.

Ehnfors M. 1994. Documentation of patient problems and nursing diagnosis in a sample of Swedish nursing records, *Vård i Norden* 14(4). pp.14-18

Ellingsen G. 2003. *Global reach local use: Design and use of electronic patient record systems in large hospitals*. Dr. Scient. Thesis, Norwegian University of Science and Technology,

Ellingsen G. and Monteiro E. 2003a, Big is beautiful. Electronic patient records in Norway 1980 – 2000, *Methods of Information in Medicine*, 42(4). pp.366-370

Ellingsen G. and Monteiro E. 2003b. A patchwork planet: Integration and Cooperation in hospitals. *Computer Supported Cooperative Work*. 12(1). pp71-95.

Ellingsen G. and Monteiro E. 2006. Seamless Integration: Standardisation across Multiple Local Settings. *Computer. Supported Cooperative Work*, 15(5-6). pp.443-466. December

Engeström Y. 2000. From individual action to collective activity and back: developmental work research as an interventionist methodology. In Luff, P., Hindmarsh, J., Heath, C. (Eds), *Workplace Studies*, Cambridge University Press, Cambridge.

Engeström Y. and Middleton, D. (Eds). 1996. *Cognition and communication at work*. New York: Cambridge University Press.

Fetterman D.M. 1998. *Ethnography*, Second edition. SAGE Publications, Thousand Oaks, CA.

Fitzpatrick G. 2000. Understanding the Paper Health Record in Practice: implications for EHRs. *Proceedings of HIC. Integrated information for Health Care*.

Fitzpatrick G. 2003. Emergent expertise sharing in a community. In M. Ackerman, V. Pipek, & V. Wulf (Eds.), *Sharing expertise: Beyond knowledge management* Cambridge, MA: MIT Press. pp.81-110

Forsythe D. 1999. It's Just a Matter of Common Sense: Ethnography as Invisible Work, *Computer. Supported Cooperative Work* 8(1). pp.127-145

Fox S. 2000. Communities of practice, Foucault and actor-network theory. *Journal of Management Studies* 37(6). pp.853-867.

Fricker J. 2003. *Pain in Europe. A Report*. Cambridge, England: Mundipharma International Ltd.; 2003: 1–23. Available from URL: http://www.paineurope.com/files/PainInEuropeSurvey_2.pdf [last accessed July 17th 2007]

Gasser L. 1986. The integration of computing and routine work. *ACM Transactions on Office Information Systems*, 4(3). pp.205-225

Gerson E. and Star S.L. 1986. Analyzing due process in the workplace. *ACM Transactions on Information Systems*. 4(3). pp.257–270.

Getty M., Ryan A. A. and Ekins M. L. 1999. Comparative study of the attitudes of users and non-users towards computerized care planning. *Journal of clinical nursing*. 8(4). pp.431-439.

Gherardi S. 2000. Practice-based theorizing on learning and knowing in organisations. *Organization*, 7(2). pp.211-223.

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

Grimson J., Grimson W. and Hasselbring W. 2000. The SI Challenge in Health Care. *Communications of the ACM.*, 43(6). pp.48-55.

Grudin J. 1988. Why CSCW Applications Fail: Problems in the Design and Evaluation of Organization of Organizational Interfaces. *Proceedings of the 1988 ACM conference on Computer-supported cooperative work*, pp.65-84

Grudin J. 1994a. Computer Supported Cooperative Work: History and Focus. *IEEE Computer*, 27(5). pp.19-26

Grudin J. 1994b. Groupware and social dynamics: Eight challenges for developers. In *Communications of the ACM* 37(1). pp.92-105

Gutwin C. and Greenberg S. 2001. A Descriptive Framework of Workspace Awareness for Real Time Groupware. Computer Supported Cooperative Work, Kluwer Academic Press. 11(3). pp.411-446.

Hagen T. P. and Kaarbøe O. M. 2006. The Norwegian hospital reform of 2002: Central government takes over ownership of public hospitals. *Health Policy* 76(3).

pp.320–333

Hannah K J., Ball M. J. and Edwards, M J. (eds). 2006. Introduction to Nursing Informatics, 3rd Edition, Springer Verlag

Hanseth O. 2004. Knowledge as infrastructure. In C. Avgerou, C. Ciborra and F. Land (eds). *The Social Study of Information and Communication Technology: Innovation, Actors and Contexts*, Oxford University Press, Oxford.

Hanseth O. Aanestad M. and Berg M. 2004. Guest editors' introduction: Actor-network theory and information systems. What's so special? *Information Technology and People*, 17(2). pp.116-123

Hanseth, O. and Monteiro E. 1997. Inscribing behaviour in information infrastructure. *Accounting, Management and Information Technologies*. 7(4).pp.183 - 211.

Hardey M., Payne S. and Coleman P.G. 2000. 'Scraps': hidden nursing information and its influence on the delivery of care. *Journal of Advanced Nursing*, 2000, 32(1). pp.208-214.

Hardstone G., Hartswood M., Procter R., Slack R., Voss A. and Rees G. 2004. Supporting Informality: Team Working and Integrated Care Records. *Proceedings of Computer-supported cooperative work 2004*. pp.142--151

Hartswood M., Procter R., Rouncefield M., and Slack R. 2003. Making a case in medical work: Implications for the Electronic Medical Record. *Computer Supported Cooperative Work* 12(3). pp.241–266. Kluwer Academic Publishers.

Harvey L. and Myers M. D. 2002. Scholarship and practice: the contribution of ethnographic research methods to bridging the gap, *In Qualitative Research in Information Systems: A Reader'*. M.D. Myers and D.E. Avison (eds.), Sage Publications, London, pp.169-180.

Heath C. and Luff P. 1992a. Explicating face to face interaction. In N. Gilbert (ed.), *Researching Social Life*. London: Sage. pp. 306-327.

Heath C. and Luff P. 2000. *Technology in Action*. Cambridge: Cambridge University Press.

Heath C. and Luff P.1992b. Collaboration and Control: Crisis Management and Multimedia Technology in London Underground Line Control Rooms. *Computer Supported Cooperative Work*, 1(1-2). pp.69-94.

Hellesø R. 2000. *Sluttrapport fra prosjektet SykIT Elektronisk sykepleiedokumentasjon i Medakis*. NFR, prosjektnummer 128665/320

Hellesø R. and Ruland C. M. 2001. Developing a module for nursing documentation integrated in the electronic patient record, *Journal of Clinical Nursing*. 10(). pp.799-805.

Hong L.K. and Duff R.W. 2002. Modulated Participant-Observation: Managing the Dilemma of Distance in Field Research. *Field Methods* 14(2). pp.190–196. Sage Publications

Hughes, J., Randall D. and Shapiro D. 1992. Faltering from Ethnography to Design. In *Proceedings of Computer Supported Cooperative Work 1992*. pp.115-122.

Hutchins, E. 1995. *Cognition in the Wild*, Cambridge, MA: MIT Press.

Jørgenvåg R. 2006. *Samdata Somatikk sektorrapport 2005 – Sammenligningsdata for*

den somatiske spesialhelsetjenesten 2005. Sintef Helse. Rapport 1/06.

KITH. 2003. *Veileder for elektronisk dokumentasjon av sykepleie* [Guide for electronic documentation of nursing], KITH Rapport R 14/03

Klein H. and Myers M. 1999. A set of principles for conducting and evaluating interpretive field studies in information systems. MIS Quarterly 23(1). pp.67-94.

Kling R. 1991. Cooperation, Coordination and Control in Computer Supported Work, *Communications of the ACM*, 34(12), pp.83-88.

Lachmund J. 1999. Making Sense of Sound: Auscultation and Lung Sound Codification in Nineteenth-Century French and German Medicine. *Science, Technology & Human Values*, Vol 24(4). pp.419-450

Lægreid P., Opedal S. and Stigen I. M. 2005. The Norwegian Hospital Reform: Balancing Political Control and Enterprise Autonomy. In *Journal of Health Politics, Policy and Law*, 30(6). pp.1027-1064

Lærum H., Ellingsen G. and Faxvaag A. 2001. Doctors' use of electronic medical records systems in hospitals: cross sectional survey *BMJ* 323. pp.1344-1348

Laet M. de. and Mol A. 2000. The Zimbabwe Bush Pump: Mechanics of a fluid technology. *Social Studies of Science*, 30(2). pp.225-263.

Latour B. 1991. Technology Is Society Made Durable, in J. Law (ed.), A Sociology of Monsters? Essays on Power, Technology and Domination, Sociological Review Monograph 38. London: Routledge.

Latour B. 2005. *Reassembling the Social: an Introduction to Actor-Network-Theory*. Oxford: Clarendon

Latour B. and Woolgar S. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.

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

Lave J., and Wenger E. 1991. *Situated learning: Legitimate peripheral participation.* Cambridge, MA: Cambridge University Press.

Law J. 2004. *After Method: Mess in Social Science Research*, Routledge, London

Law J. 1992. Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity. *Systems Practice*, 5(4). pp379-393.

Law J. and Singleton V. 2000. Performing Technology's Stories. *Technology and Culture*, 41. pp.765-775.

Law J. and Singleton V. 2005. Object Lessons, *Organization*, 12(3) pp.331-355.

Lee A. S. and Baskerville R. L. 2003. Generalizing Generalizability in Information Systems Research. *Information Systems Research*, 14 (3). pp.221-243.

Lee T.T and Chang P.C. 2004. Standardized care plans: experiences of nurses. In *Taiwan Journal of Clinical Nursing* 13. pp.33–40.

Lee T.T. 2005. Nurses' concerns about using information systems: analysis of comments on a computerized nursing care plan system. In Taiwan, *Journal of Clinical Nursing*, 14. pp.344–353

Lium J.T. and Faxvaag A. 2006. Removal of paper-based health records from Norwegian hospitals: Effects on clinical workflow. In Arie Hasman, Reinhold Haux, Johan van der Lei, Etienne De Clercq, Francis Roger-France (eds.) *Studies in Health Technology and Informatics*. pp.1031-1036.

Luff P., Hindmarsh J. and Heath C, 2000. *Workplace Studies Recovering Work Practice and Informing System Design*. Cambridge University Press, Cambridge

Manias E. and Street A. 2000. The nursing handover: uncovering the hidden practices of nurses. *Intensive and Critical Care Nursing* 16. pp.373-383

McCloskey J.C. and Bulechek G.M. 1994. Standardizing the language for nursing treatments: an overview of the issues. *Nursing Outlook*, 42(2).pp56-63

Mølstad K, Mauritzen A. M. and Angermo L. M. 2007. *Dokumentasjon av sykepleie i elektronisk pasientjournal. En veileder fra Norsk Sykepleierforbunds forum for IKT og Dokumentasjon*. 3.utgave. Februar 2007

Monteiro E. 2000. Actor-Network Theory and Information Infrastructure. In: Ciborra, C.U. et al. (eds.). *From Control To Drift – The Dynamics of Corporate Information Infrastructures*. Oxford: Oxford University Press, pp.71-83.

Monteiro E. 2003. Integrating health information systems: a critical appraisal. *Methods of Information in Medicine*, 42. pp428-432

Monteiro E. and Hanseth O. 1995. Social Shaping of Information Infrastructure development: on being specific about the technology. In Orlikowski et al (eds) *Information Technology and changes in organisational work*, Chapman & Hall. pp.325-343

Moser I. and Law J. 2006. Fluids or flows? Information and qualculation in medical practice. *Information Technology & People* 19(1).pp.55-73

Myers M.D. 1999. Investigating information systems with ethnographic research. *Communications of the Association for Information Systems*. 2(23).

Myers M.D. and Avison D.E. 2002. *Qualitative Research in Information Systems: A Reader*, Sage Publications, London.

Naur P. 1992. Programming as theory building, in P. *Naur Computing: A human activity*, ACM Press.

Nonaka I., and Takeuchi H. 1995. *The knowledge creating company.* Oxford, UK: Oxford University Press.

Nørgaard, E. 2003. Høy vekst i utgifter til helseinstitusjoner – men fylkesvise variasjoner. *Samfunnsspeilet* nr. 2. Can be accessed at: Available from URL http://www.ssb.no/samfunnsspeilet/utg/200302/05/ [last accessed July 17th 2007]

NOU. 2005. *Fra stykkevis til helt. En sammenhengende helsetjeneste* [From partly to completely. An integrated healthcare]. Helse-og omsorgsdepartementet. 2005:3 (NOU [Royal commission report]).

Nygren E. and Henriksson P. 1992. Reading the Medical Record. Analysis of Physicians' Ways of Reading the Medical Record. *Computer Methods and Programs in Medicine*, 39. pp1-12.

Olson J.S., and Teasley S., Covi L. and Olson G. 2002. The (Currently) Unique

Advantage of Collocated Work. In *Distributed Work*, edited by P.J. Hinds and S. Kiesler, MIT Press. pp.113-135.

Olson, G.M. and Olson J.S. 1996. The Effectiveness of Simple Shared Electronic Workspaces. In *Groupware and Authoring*, edited by R. Rada. Academic press. pp.105-12

Orlikowski W. J. 1992. Learning from Notes: organizational issues in groupware implementation. Proceedings of *Computer Supported Cooperative Work*, 1992. New York: The Association for Computing Machinery. pp.362-369.

Orlikowski W. J. 2006. Material knowing: the scaffolding of human knowledgeability. *European Journal of Information Systems* 15. pp.460–466

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

Orlikowski W. J. and Iacono S. 2001. Research commentary: desperately seeking the 'IT' in IT research – a call for theorizing the IT artifact, *Information Systems Research*, 10(2). pp.121-34.

Orlikowski W. J. and Robey D. 1991 "Information technology and the structuring of organizations", *Information Systems Research*, 2(2). pp.143-69.

Orlikowski W. J. and Yates J. 2002 It's About Time: Temporal Structuring in Organizations, *Organization Science*, 13(6).pp.684-700

Orr J., 1996. *Talking about machines: An ethnography of a modern job*, Cornell, CA: Cornell Univ. Press.

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

Petersen S. Ø. 2005. Post-war baby boom becomes elderly boom - some consequences for the hospital sector in Norway. Paper presented at the *PCS/I Conference*, Ljubljana, Slovenia.

Pinch T. and Bijker W. 1987. The social construction of facts and artifacts: or how the sociology of science and the sociology of technology might benefit from each other", i Bijker, W.; Hughes, T. og Pinch, T (eds.): *The social construction of technological systems*. MIT Press, pp.17-50.

Poissant L, Pereira J, Tamblyn R, Kawasumi Y (2005). The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. J Am Med Inform Assoc 2005; 12: 505-16

Rafferty A.M. 1996. *The Politics of Nursing Knowledge*, London Routledge.

Randall S. 2000. What's Common about Common Information Spaces?, Paper presented at the *Workshop on Cooperative Organisation of Common Information Spaces*, Technical University of Denmark, 2000, Available at http://www.itu.dk/people/schmidt/ciscph2000/Randall.pdf (accessed July 17th 2007).

Randall D and Rouncefield M. 2006. *Fieldwork for Design*. Tutorial at the CSCW2006, Banff, Canada

Reddy M.C., Dourish P, and Pratt, W. 2006. Temporality in Medical Work: Time also

Matters. *Computer Supported Cooperative Work.* 15(1).pp.29-53

Rolland, K H, Hepsø, V and Monteiro E. 2006: Conceptualizing Common Information Spaces Across Heterogeneous Contexts: Mutable Mobiles and Side-effects of Integration, *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, ACM, 2006. pp.493-500.

Saba V., Hovenga E., Coenen A., McCormick K., and Bakken, S. 2003. *Nursing language-Terminology models for nurses*. ISO Bulletin, 16-18. Available at www.iso.ch/iso/en/commcentre/isobulletin/articles/2003/pdf/terminology03-09.pdf [last accessed July 17th 2007]

Schmidt K and Simone C 1996. Coordination Mechanisms: Towards a Conceptual Foundation of CSCW Systems Design. *Computer Supported Cooperative Work* 5(2-3). pp.155-200.

Schmidt K. 2000. The critical role of workplace studies in CSCW, in Christian Heath, Jon Hindmarsh, and Paul Luff (eds.): *Workplace Studies: Recovering Work Practice and Informing Design*, Cambridge University Press, Cambridge 2000.

Schmidt K. and Bannon, L. J. 1992. Taking CSCW seriously: Supporting Articulation Work. *Computer Supported Cooperative Work*, 1(1). pp.7-40.

Sellen A. J. and Harper R. H. 2003 *The Myth of the Paperless Office*. MIT Press.

Sensmeier J., Raiford R., Taylor S. and Weaver C. 2003. Improved operational efficiency through elimination of waste and redundancy. *Nursing Outlook* 51(3).pp30–S32.

Sexton A., Chan C., Elliot M., Stuart J., Jayasuriya R. and Crookes P. 2004. Nursing handovers: do we really need them? *Journal of Nursing Management.* 12. pp37– 42.

SHD. 2001a. *Governmental action programme 2001-2003. Electronic interaction in the Health and social sector* "say @".

SHD. 2001b. *SHD 2000-2001. Legislation of Health Enterprises.* Proposition to the Odelsting No. 66 from the Ministry of Health and Social Affairs. http://www.dep.no/hd/norsk/publ/otprp/030001-050012/index-inn001-b-n-a.html [last accessed July 17th 2007]

SHD. 2004. *Te@mwork 2007*. Electronic Cooperation in the Health and Social Sector. National strategy 2004 – 2007 for Norway. Norwegian Ministry of Health.

SHD. 2005. *Te@mwork 2007.* Electronic Interaction in the Health and Social Sector Implementation plan 2006. The Norwegian Directorate for Health and Social Affairs

Sismondo S. 2004 *An introduction to Science and Technology Studies.* Blackwell Publishing Ltd.

Star S. L. and Strauss A. 1999. Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work. *Computer Supported Cooperative Work* 8(1-2):pp.9-30

Star S. L., Bowker, G. C., and Neumann, L. J. 1997. *Transparency at Different Levels of Scale: Convergence Between Information Artifacts and Social Worlds,* (http://epl.scu.edu:16080/~gbowker/converge.html) [last accessed July 17th

2007).

Strauss A. 1993. *Continual Permutations of Action*, Thousand Oaks, CA: Sage.

Strauss A. and Corbin, J. 1998. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. 2nd ed. Thousand Oaks, CA: Sage Publications

Strauss A., Fagerhaugh S., Suczek B. and Wiener C. 1985. *Social Organization of Medical Work*, Chicago, The University of Chicago Press.

Suchman, L. 1987. *Plans and situated actions. The problem of human-machine communication*. Cambridge: Cambridge University Press.

Svenningsen, S. 2003. *Electronic Patient Records and Medical Practice: Reorganization of Roles, Responsibilities, and Risks.* PhD-Series 10.2003, Samfundslitteratur, Copenhagen.

The Ministry of Health and Social Affairs 2004. *Te@mwork 2007: Electronic Cooperation in the Health and Social Sector, Governmental Strategy 2004-2007*.

Timmermans S. and Berg M. 1997. Standardization in action: Achieving universalism and localisation through medical protocols, *Social Studies of Science* 27. pp.111-34.

Timmermans S. and Berg M. 2003b. *The gold standard: the challenge of evidence-based medicine and standardization in health care*. Philadelphia: Temple University Press.

Timmermans S. and Berg M. 2003a. The practice of medical technology. *Sociology of Health & Illness.* Silver Anniversary Issue, 25. pp.97–114

Timmermans S., Bowker G. C. and Star S. L. 1998. The architecture of difference: Visibility, control and comparability in building a nursing interventions classification. In *Differences in Medicine: Unraveling practices, techniques and bodies*, edited by A. Mol and M. Berg, Durham, Duke University Press. pp202-225.

Tjora A. 2004. Maintaining Redundancy in the Coordination of Medical Emergencies. *Proceedings of the 2004 ACM conference on Computer supported cooperative work*, November 6-10, Chicago, Illinois, USA, pp.132-141.

Turnbull D. 1993, The ad hoc collective work of building Gothic cathedrals with templates, string and geometry. *Science, Technology and Human Values*, 18(3).pp. 315-340.

Urquhart C and Currell R 2005. Reviewing the evidence on nursing record systems. *Health Informatics Journal*. 11(1) pp.33–44

van Maanen, J. 2002. The fact of fiction in organizational ethnography. In A. M. Huberman and M. B. Miles. *The Qualitative Researcher's Companion*. Thousand Oaks, CA: Sage Publications.

Vikkelsø, S. 2005. Subtle Redistribution of Work, Attention and Risks: Electronic Patient Records and Organisational Consequences. *Scandinavian Journal of Information Systems*. 17(1). pp.3-30

Voutilainen P., Isola A. and Muurinen S. 2004. Nursing documentation in nursing

homes – state-of-the-art and implications for quality improvement. *Scand J Caring Sci*; 18. pp.72–81.

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

Walsham G. 1995. Interpretive case studies in IS research: nature and method. *European Journal of Information Systems*, 4(2). pp.74-81.

Walsham G. 1997. Actor-Network Theory and IS Research: Current Status and Future Prospects. In *Proceedings of the IFIP Working Group International Conference on Information Systems and Qualitative Research*, pp.466-480, Chapman and Hall.

Walsham G. 2001. Knowledge Management: The Benefits and Limitations of Computer Systems, *European Management Journal*, 19(6). pp.599-608.

Walsham G. 2004. Knowledge management systems: Action and representation. *Proceedings of Action in Language, Organisations and Information Systems* (ALOIS2004).

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

Waters K. R. 1999. Individualized care: is it possible to plan and carry out? *Journal of Advanced Nursing*, 29(1).pp.79-87.

Wenger E. 1998. *Communities of Practice – Learning, Meaning and Identity*. Cambridge University Press.

WHO. 2003. World Health Organization. Core Health Indicators for Norway. Available from URL: http://www.who.int/whosis/database/core/core_select_process.cfm [last accessed July 17th 2007]

WHO. 2005. Face to face with chronic disease. Available from: Available from URL: http://www.who.int/features/2005/chronic_diseases/en/index.html, [last accessed July 17th 2007]

Wilkinson J.M. 2001. *Nursing process and critical thinking*. New Jersey: Prentice Hall.

Williams R. and Edge D. 1996. The social shaping of technology, *Research Policy*. 25(6). pp.865-899.

Winthereik, B. R and Vikkelsø S. 2005. ICT and Integrated Care: Some Dilemmas of Standardising Inter-Organisational Communication. *Computer Supported Cooperative Work*, 14(1). pp. 43-67.

Yanow D. 2003. *Interpretive Empirical Political Science: What Makes This Not a Subfield of Qualitative Methods*. Qualitative Methods Section (APSA) Newsletter 2nd Issue, Fall 2003. Available from URL: http://class.csueastbay.edu/publicadmin/dyanow/QualMeth.pdf , [last accessed July 17th 2007]

Zuboff S. 1988. *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books.

Appendix A: Acronyms and terms often used in the thesis

EPR	Electronic Patient Record
EPR-based nursing module	Refers to the part of the EPR that constitutes the nursing record. The shorter, yet equivalent, term 'nursing module' is also used in the thesis.
Nursing record	General reference to all documents used by the nurses and that is officially a part of nurses written accounts (EPR-based and/or paper based record). For example various types of reports, nursing plans, shift reports, admission note, nursing discharge summaries, various letters, etc
Nursing plan	The part of the nursing record that enables a canonical overview of probable nurse-related problems for a particular patient group combined with relevant interventions and outcomes. Typically nursing plans includes the possibility to incorporate international standardized classification systems such as NANDA, NIC and NOC
Nursing record in practice	A reference to both the official (i.e. nursing record) and unofficial documents and ways of coordinating work (e.g. personal notebooks/scraps, oral communication, etc).
NANDA	North American Nursing Diagnosis Association Commonly used to refer to the taxonomy itself
NIC	Nursing Interventions Classification
NOC	Nursing Outcomes Classification

Appendix B: The Papers

Paper one:
Community of Practice versus Practice of the Community - Knowing in collaborative work

Community of Practice versus Practice of the Community: Knowing in collaborative work

Kirsti E. Berntsen *Glenn Munkvold* *Thomas Østerlie*

Norwegian University of Science and Technology
Faculty of Information Technology, Mathematics and Electrical Engineering
Department of Computer and Information Science

keb@idi.ntnu.no *glm@idi.ntnu.no* *thomasos@idi.ntnu.no*

***Abstract**: How do software developers, field service technicians, and medieval cathedral builders accomplish collaborative work? This paper looks at how they learn from each other by building and sharing knowledge across time and space.*

To illustrate this, we first present Community of Practice (CoP) as a way of understanding collaborative work which puts focus on the community and its social interaction. CoP, introduced by Lave and Wenger (1991), is based on the fundamental belief that dividing theory from practice is unsound. Hence CoP contradicted traditional theories of learning, where learning and working often are conceived as separate processes. Using Orr's (1996) rendition of service technician's work, it is shown that stories act as repositories of accumulated wisdom in keeping track of facts, sequences and their context. Representations made by a CoP to aid their work, are termed Reifications which can be stories, tools, artefacts etc. Practice is seen as a duality of Participation and Reification which both require and enable each other. We find however, that CoP based analyses tend to focus on the human actors in that you start out by looking for the communities and what defines them. We also present examples of alternative approaches that illuminate the technology and artefacts that are present in collaboration. Berg(1997) uses Actor-Network Theory (ANT) to illustrate the responsibility awarded to artefacts in the process of documenting a hospital-patient's fluid balance. Hutchins(1995) describes navigation as a joint accomplishment of artefacts and people. Turnbull(1993) sees a wooden template as a chief enabler of building gothic cathedrals without use of structural mathematics. Facets of knowledge/knowing is discussed, their accumulation and transfer by stressing the value of both the social and the technical approach.

***Keywords**: collaborative work, communities of practice, actor-network theory, role of technology, knowledge sharing*

1. Introduction

What is it that software developers do when building software systems? And what is it that field service technicians do when fixing broken copying machines? For that matter, what did medieval cathedral builders do when raising tall stone cathedrals across Europe? What do software developers, field service technicians, and medieval cathedral builders have in common? In the context of this paper, the answer is they achieve their goals through *collaborative work*: they build and share knowledge and learn across time and space.

Researchers in different academic fields have made attempts to describe and explain collaborative work. The IS researcher wants to understand the collaborative efforts involved in developing software (Naur, 1992). The ethnographer (Orr, 1996) wants to describe and understand how field service technicians collaborate on fixing broken copying machines, and the historian (Turnbull, 1993) wants to know how cathedral builders managed to raise a multitude of tall stone cathedrals all across Europe in a relatively short period of time.

Let's turn the coin and rephrase the questions posed above. How are software systems built? How are broken copying machines fixed? How is the building of gothic cathedrals achievable? There is of course no single answer to these questions, but they raise the issue concerning the constituents of collaboration.

This paper discusses how different research traditions have opened the black box of collaborative work, trying to explain collaborative work with different approaches. This is not an exhaustive literature review on the topic, but rather the beginnings of one.

The paper is structured as follows. First, we present Community of Practice (CoP) as a way of describing and understanding collaborative work. After discussing the contribution to understanding collaborative work provided by the thinking around CoP, we discuss the approach's shortcomings in addressing the role of technology in collaborative work. We then present alternative approaches to describing and discussing collaborative work which are specific on the role of technology. After discussing these approaches' contribution to understanding collaborative work, we conclude by drawing the implications that such an approach has on the way we think about collaborative work and the sharing of knowledge and knowing.

2. Programming as theory building

Naur (1992) argues that software development is more than just production of a program and certain texts. Successful software development is a question of having the appropriate theory, as in a mental model, of the software system. With certain kinds of large programs, the continued adoption, modification, and correction of errors depends on knowledge possessed by a group of developers who are closely and continuously in connection with the software system. The developers' knowledge transcends that which is recorded in the documentation: they possess a theory of the software. "[A] person who has or possesses a theory … knows how to do certain things and in addition can support the actual doing with explanations, justifications, and answers to queries, about the activity of concern" (ibid., p. 229). The notion of theory was proposed by Ryle

(1949) in an effort to describe the difference between intellectual and intelligent behaviour. Ryle claims that intelligent behaviour is the ability to do certain things without having any concrete knowledge to build this behaviour on.

Naur's perspective on software systems development is that of the individual developer. While his contribution is significant in that it provides argumentation for viewing software systems development as a knowledge intensive activity, it fails to address the dynamics of collaborative work. Even though he argues that the theory of the software system must be shared by a group of developers, the theory is still embedded in the individual. By not being specific on the description of *how the theory is shared*, Naur only manages to point out that software development is in fact collaborative work. The context surrounding the development of software is not included in Naur's discussion.

The question, then, becomes: how is knowledge shared, across time and space, and how does context play a role? The related topic of how knowledge is built or acquired across time and space will be touched upon in our discussion.

3. Communities of practice

The way people work differs from the abstract ways organizations describe that work in manuals, training programs, organizational charts, and job descriptions (Brown and Duguid, 1991). Communities of practice (Wenger, 1998) is a concept used to better understand the activities and processes going on in work, and what kinds of social engagements provide a better context for learning and innovation to take place.

CoP was first introduced by Lave and Wenger (1991). It is based on the fundamental belief that dividing theory from practice is unsound. Hence CoP contradicted traditional theories of learning, where learning and working often are conceived as separate processes. Instead, CoP argues that learning should be contextualized by acknowledging its presence and allowing it to continue to be an integrated part of work. Based on the fieldwork of Orr (later published as Orr, 1996) Brown and Duguid (1991) illustrate how formal descriptions of work and learning often are abstracted from actual practice, and how knowledge is socially constructed through informal interaction. Orr did his fieldwork by observing a group of Xerox repair technicians who met regularly in informal, common areas trading stories and insights around their work (repairing different types of copying machines). The workers actually made a point out of spending more time in each other's company. This slack initially seemed like an excellent opportunity for productivity improvements. However, Orr's fieldwork shows that these activities were actually a very important part of becoming, being and remaining a good technician. It was central to how the technicians learned, how they improved their skills, how they formed bonds as a community of practice, and how they transferred and honed their knowledge and expertise amongst themselves.

The creation and transformation of knowledge in the Xerox case is related to social interaction among technicians. Taking form as storytelling, the knowledge transfer made the technicians capable of sharing not only the type of knowledge that could be read out of books, but also the type of knowledge not explicitly stated in the company's instruction manuals. The practice included sharing both the explicit and the

tacit/implicit. What was said and left unsaid thus served as an intrinsic part of solving the problem. According to Brown and Duguid (1991) stories act as repositories of accumulated wisdom and it allows people to keep track of the sequence of behaviour and of their wisdom, in keeping track of the facts and their context. In a highly situated and improvisational approach, the technicians were able to construct a shared understanding out of bountiful conflicting and confusing data.

Communities of practice rely on the informal depiction that each member generates of it: who is part of the community, which are the different modes of participation that are accepted, who knows what, what cultural tools are used to mediate communication and interaction, and so forth. The depictions of the community are iterative and evolve continuously as community members share experiences, take action and interact with each other, as well as the outside world which is reasoned about. A shared understanding is negotiated and emerges from scattered pieces of knowledge and knowing. The differentiation between knowledge and knowing is described by Cook and Brown (1999, p.381) in that "[k]nowledge and knowing is seen as mutually enabling (not competing). We hold that knowledge is a tool of knowing, that knowing is an aspect of our interaction with the social and physical world."

In general, Wenger (1998) defines a CoP along three dimensions:

1. a joint enterprise that is continually renegotiated by the members of the community
2. mutual engagement, that bind the members together into a social entity
3. a shared repertoire of common resources that the members have developed over time (routines, vocabulary, artefacts, experiences, stories, etc.).

The resources developed by the community can somehow be considered the accumulated knowledge and knowing of the community.

This informal, narrative and contemplative nature or aspect of a CoP, does not preclude that a community may also make formal representations, checklists, tools etc. as well as to define concepts and ideas, to aid them in their endeavours of work (ibid., pp. 62-71). These representations are termed *Reifications.* Practice can be seen as a duality of *Participation* and *Reification* in which both require and enable each other. "Participation is not merely that which is not reified (ibid., p.66). On the contrary, they take place together. … There is no reification without participation … [and vice versa]". The reifications/artefacts play a key role since they are often used as explicit representations of the informal model that is shared among the members. Reifications may also function as *boundary objects* through which different communities can relate to each other. A boundary object has a common denominator that each community can identify and relate to, but may play different roles and have extra meanings within the CoP, in line with the context and joint enterprise of that particular CoP.

Discussion of shortcomings

In CoPs the relation between the subject and the "world" assume that the subject adapts to the surroundings by means of participating in communities of practice. The artefacts and technology which aid their existence remain self-evident and in the background.

Practice - implicitly understood as knowing, which means doing and learning how to do, is explained, understood and interpreted by means of the human subject.

In order to see the artefact in the theory of CoP, the artefact must either be the central joint enterprise, or a boundary object. Brown and Duguid's example of the Xerox technician's CoP has the artefact, its representations and interactions within the customers organizations as "The central joint enterprise" around which the CoP evolves. The machine/artefact is also a boundary object that connects their CoP to their customers' communities of practice.

CoPs allow the artefact a place on the agenda in a more or less informal fashion as reifications of human action. They play a critical role in cultivating and coordinating knowledge but are only considered to be frozen reifications that must be interpreted by the human actors. A similar point has been made by Prout (1996 in Timmermanns and Berg 2003, p.9) saying that "Work is constructed as done on and through machines, but not by them".

4. Illuminating the elusive technology

A relevant question is then: Does the theory of CoP adequately cover the relevant aspects of collaborative work? The poignant catch here is the word *relevant*. The relevance of various theories depend on the direction of interest in the application of theory. Wenger states in his introduction (1998) that his purpose is "… to propose … what I call a social theory of learning … which comes close to developing a learning-based theory of the social order. In other words, learning is so fundamental to the social order we live by that theorizing about one is tantamount to theorizing about the other." No wonder, then, that CoP has become widely used, outside its original scope of learning.

CoP has been widely adopted within both communities studying organizational knowledge as well as within management theory. Contu and Willmott (2003) contend that many of these renditions have disregarded or failed to see, some aspects of Lave and Wenger's (1991) original work such as: "… embryonic appreciation of power relations as media of learning" (Contu & Willmott 2003, p. 283) in that the topic of power relations in a situated learning context often is not addressed by those who embrace the concept of CoP into their own discourses. There may be many reasons for this end result, Contu and Willmott (ibid.) reason about both the present oversight of power relations and for the subsequently necessary re-inclusion of power relations into the situated learning discourse.

We intend to show that in a similar fashion, other embryonic appreciations also tend to disappear when using CoP for theorizing on communities that include artefacts as reifications. Wenger's concept of the boundary object that mediates understanding between communities, albeit sometimes very selective understandings, is both illuminating and useful. Various artefacts and technologies may constitute such boundary objects, along with other reifications such as narratives, rules and norms, etc. The concept is a powerful one for grasping constituents of communication and collaboration between different communities in illustrating that it allows them to

cooperate without a unilateral (universal) consensus on activities, purposes and priorities. However, the deeper aspects of the reifications as resources within the community and across communities is little expanded in CoP. CoP divulges some aspects of artefacts in communities, but remains ignorant or uninterested in others.

It is our observation that common concepts concerning the humane inhibit the inclusion of non-human aspects into our discourses of societies, organizations and activities. And so we mostly turn a blind eye to the technologies we interact with. When we do address technology, acknowledging its presence, it tends to be in an instrumental dichotomous fashion where the humans are either in total control or at its mercy. We wish to expand our concepts of both the artefacts and the humane, to stretch the dichotomy into a duality ascribing more than structure or mediation to the artefacts. Wenger does describe such a duality, but the focus of Cop is still mainly on the social aspects.

5. Making technologies explicit

Marc Berg uses actor-network theory (ANT) to take a closer look at artefacts within work practices, both the IT system and other artefacts. Berg's studies show that some qualities of technology as artefact may be seen as universal in holding both knowledge and a transformational power of informal practical world aspects into formal representations.

Marc Berg (1997) takes a detailed look at practice in a hospital intensive care unit. His case describes each minute part of a work process which aims at documenting a hospital-patient's fluid balance, which is a sum of what fluid goes in and what comes out. In observing and recording each minute detail of the particular process, separate elements are identified. This hybrid consisting of several people, various artefacts, routines and experiences comprises everything that is needed for the activity of measuring a patient's fluid balance to proceed. The formal tools, the artefacts, come to life only as part of real life activity.

The shape of the bag of diffusion liquid with its quantity scale gives input to the nurse for the number to be entered into the fluid balance spreadsheet. The granularity of the scale defines the level of accuracy. The size and shape of the drinking cup and the urine container also re-represents (as in representing again) the separate liquid in- and outputs of the patient's body into formal representations. These formal representations can again be entered into the spreadsheet. The person entering the number needs no knowledge of medical theory, diagnosis, treatment, or purpose for performing this specific task. The only interpretation necessary by the human is reading the quantity scale in order to enter it into the spreadsheet. "The task of producing formal representations is delegated to the mundane artefacts which perform, in Latour's terms, 'the practical task of abstraction'" (Berg 1997, p.144)

Berg focuses on the interrelationships between the artefacts and the human workers in saying that through these interlockings, new competencies can be achieved and higher levels of complexity in work tasks can be achieved. People can be seen as communicating/interlocking via the tools without intimate knowledge of the other parts of the process chain. The distributed nature of the activity, shared between the artefacts

and human actors effect a distribution of control and responsibility across the heterogeneous ensemble of humans and artefacts. The individual actors have no overview of the complete process, and cannot affect global workarounds based on an overall picture. The humans are not in control of the overall task. On the other hand, neither are any of the artefacts. The human actors introduce workarounds in performing their own particular tasks pertaining to the unexpected contingencies of either their colleagues or the artefacts. Another shape or functionality, in effect a different inscription in the involved artefacts, would however shape the human actors tasks differently.

Another point of Berg is that the ensemble of humans and artefacts–the actor network–cannot bee seen as stable once the artefacts are in place. In line with the view of artefacts and humans as equal actors in producing the end result of an activity or process, then all actors within the network are affected when changes occur in the forces influencing the network. Most work processes have aspects of drift in which work is continually redesigned to adapt to the particular circumstances. This drift also introduces the need to continually adapt the use and/or functionality of the artefacts. A quaint analogy of this need for adapting artefacts can be related to perhaps our most archaic artefact of all–the hammer. A modern-day hammer comes in various shapes and sizes–adapted to each craft's particular need. The cleft in today's carpenter hammer arose from the need to pull out misplaced iron nails. This functionality was inconceivable in the times of wooden pegs.

While Berg places technology as embedded locally, Hutchins (1995) is concerned with the "circulation" of cognition in collaborative work. Traditionally human cognition has been placed within the mind of the individual, as previously exemplified by Naur's notion of programming as theory building. A basic idea in distributed cognition is that human activity does not take place solely in the heads of people, but that the environment–social, physical, and artefactual–provides a cognitive context from where cognition actually should be delineated. Looking at the practice of navigating ships, Hutchins (1995) develops a methodological and analytical framework for understanding how cognitive achievements can be conceptualised as a joint accomplishment of artefacts and people. According to Hollan et al. (2000) in distributed cognition, one expects to find a system that can dynamically configure itself to bring subsystems into coordination to accomplish various functions. At the core of Hutchins' argumentation lies an assumption of equality between people and artefacts in structuring practice. In this way the centre of attention in collaborative activities are the interdependencies between people, and between people and artefacts.

Similarly Turnbull's (1993) study of medieval cathedral building can be understood in terms of collaborative work. Medieval cathedrals were built in a discontinuous process by different groups of masons. Turnbull's challenge is to explain how masons could build these tall buildings without knowledge of structural mechanics. During the 13th century 50 cathedrals were raised throughout Europe. Turnbull envisions the cathedral building site as an "experimental laboratory" in which the key elements were the template, geometry, and skill" (p.322). The argument is that the collective work of cathedral builders was not one of human ingenuity alone, but also manifest in artefacts. Turnbull shows how wooden templates for building arches circulated between building sites, acting as accumulations of every design decision that had to be passed on.

Because a template is easy to replicate, it could circulate among builders at a site, and among building sites across Europe. In this way, knowledge of gothic cathedral building, as manifested in the template, could circulate and spread. Also, argues Turnbull, the template has an organizing effect, having the power to organize large number of workers. Turnbull's approach is specific on the role technology plays in transferring knowledge and indirectly coordinating collective work.

6. Discussion

We have so far discussed different approaches to describing and understanding collaborative work. The approaches were presented in two parts. We first presented CoP as an approach to describe and understand collaborative work, arguing that this approach conceals or fails to address many of the inscribed qualities of the technology. We then presented different examples making technology more visible. We focused on describing these approaches as dissimilar in terms of the role technology play in their way of describing and understanding collaborative work. In this section, we attempt to extract similarities in the topics these approaches handle. We see two topics running through all the works presented above:

- knowledge accumulation and knowledge transfer
- different facets of knowledge

6.1 Knowledge accumulation and transfer

Knowledge accumulation is a question of where knowledge is stored. While stored gives mechanistic associations, it is not intended in this way. Rather, it is used to describe that different knowledge is embedded in different actors. It is a question of who/what has knowledge. The who/what dimension follows from the differences between the different approaches presented above. The communities of practice approach, exemplified by Julian Orr's (1996) ethnographic study of field service technicians and copying machines, views knowledge as embedded in the practices of human actors. It is the field service technicians and the human users of the copying machine that has knowledge of the machines. The user knows the specifics of a given machine, while the field service technicians know the general problems associated with series and models of machines as well as possibly having knowledge of the history of the specific machine.

The distinction between knowing and doing is not made explicit. The epistemological assumption in CoP is that doing or knowing is socially situated. Knowledge is an intrinsic property of people's engagement in communities of practice. Accumulation of knowledge is attributed to the human actors in a "collective mind of the community". Application of the knowledge is solely explained by means of human agency.

Conversely, in Marc Berg's (1997) study of cooperative work in hospitals, knowledge is explicitly accumulated along a process chain. This process chain consists of humans as well as technology in a chain of distributed links. The separate artefact links in the process chain also have knowledge inscribed in them. The various liquid vessels have

the appropriate size, shape and measurement scales appropriate for their appointed task of collecting liquids and turning them into a numeral representation. The vessels know, as Mol (2003) would put it. This is similar to Turnbull (1993) who argues that knowledge of building cathedrals is based on the key elements of the template, geometry, and skill (p.322). The template, however, plays an important role in accumulating knowledge outside humans. It "encapsulated every design decision that had to be passed down to the man doing the carving in shop and quarry" (ibid.). The way the artefact accumulates knowledge, is a primary explanatory factor in Turnbull's work, as the building of gothic cathedrals was a discontinuous process. It is this discontinuity that is missed by solely looking towards humans as knowledge accumulators.

Narration is an important aspect in the communities of practice approach to collaborative work. The narrative is a way of transferring knowledge. Knowledge is transferred through social interaction, through narratives, through talking about machines. Turnbull, Hutchins, and Berg on the other hand, see knowledge transfer as the circulation of artefacts among people and among communities. In this line of thinking knowledge is shared through circulating artefacts among people. Which is it? Which of these approaches are correct? Is knowledge accumulated in people and shared through social processes, or is knowledge accumulated in artefacts are shared through the circulation of artefacts? Our argument is that both are valid, important and dependant of each other.

6.2 Facets of knowledge

In line with Nonaka and Takeuchi's (1995, p. 235-240) assault on what they term "false" dichotomies we argue that the dichotomy of human versus artefact is such a false dichotomy. "The dynamic and simultaneous interaction between two opposing ends of 'false' dichotomies creates a solution that is new and different. In other words, A and B create C, which synthesizes the best of A and B. C is separate and independent of A and B, not something 'in between' or in 'the middle' of A and B" (ibid., p. 236). Rather the concepts of knowledge accumulation and knowledge transfer must be seen in the light of the dynamic integration of three of the synthesized "false" dichotomies that Nonaka and Takeuchi put forward (p.237) namely explicit versus tacit knowledge, body versus mind, and individual versus organization. Nonaka and Takeuchi, however, do not include the artefacts in their theorizing. This is in line with Cook and Brown (2003, p.381) who state that: "Organizations are better understood if explicit, tacit, individual and group knowledge is treated as four distinct and coequal forms of knowledge (each doing the work the others cannot), and if knowledge and knowing are seen as mutually enabling (not competing).

In accepting Berg's argument that knowledge and knowing is distributed among actors, and that no single actor has the complete picture of the collaborative work process, we argue that knowledge can be accumulated in both humans and artefacts. In this way, knowledge and knowing can be shared through the circulation of artefacts and accessed, interpreted and applied by people. CoP stresses that the interpretation and application is activated through social interaction. This, for us, is the consequence of applying Berg's argument to the topic of knowledge and knowing accumulation and sharing in

collaborative work. What we are saying is that a medieval mason, although skilled at building brick walls and columns, is unable to raise a gothic cathedral without the template. Conversely, a person not skilled in masonry is unable to build a cathedral no matter how many templates he is in possession of. Using CoP alone to analyze this example fails to appreciate the qualities of the artefacts. Focusing on the technology renders the social barely visible.

Based on the above discussion, it may be argued that the CoP approach is mainly concerned with the social aspects regarding establishing and sharing of knowledge/knowing. As Wenger (1998, p.141) puts it "knowing is defined only in the context of specific practices, where it arises out of the combination of a regime of competence and an experience of meaning", while Turnbull and Berg are more concerned with how knowledge is made durable and transferable across social contexts.

The body versus mind dichotomy can be seen as an illustration of the skills that the human has acquired as opposed to the abstract depictions or representations we have of those skills. Knowledge/knowing as read from text books can be seen as knowledge transfer in an abstract manner. Know-how may be analyzed and put into words and numbers in order to externalize its content and make it explicit. In the process of abstraction and transfer, something is lost. Nonaka and Takeuchi give the name tacit knowledge to the part of know-how that cannot be externalized. Wenger (1998) states that "[c]lassifying knowledge as explicit or tacit runs into difficulties, however because both aspects are always present to some degree … what counts as explicit depends on the enterprise we are involved in" (p. 69) . In other words, that which may be inexpressible and tacit in one CoP may be "easily" expressible in another CoP whose joint enterprise is different. In order not to confuse Polanyi's (1983) use of the term tacit knowledge with that described by Nonaka and Takeuchi, which we discuss in the following, we use the term implicit knowledge of that which may be difficult to express.

Only some part of knowledge/knowing is transferable in an abstract and explicit way. CoPs alleviate the problem by strategies that achieve Learning by doing, socializing and telling stories, which will indirectly include extra dimensions in knowledge transfer without needing the same level or type of abstraction. The narratives include the context of each situation that indirectly may infer these implicit aspects. The scope of interpretations increases when we abstract. In doing, socializing and telling stories we can direct, align, combine, and recreate our understandings to get a clearer picture, in order to narrow or redirect the scope. Through stories people build up a repertoire for improvisation. Narratives are reactivated by adding new elements. They naturally integrate the implicit elements as well as the explicit and are tuned to balance between content and context. In seeing texts, mathematics and books as examples of the embodiment of formal abstractions, we can infer that these abstractions in the form of artefacts like books, represent knowledge made durable in a way that allows explicit knowledge accumulation and transfer. The transfer of implicit knowledge is seen to be more cumbersome. However we believe that the "simple" artefact as exemplified by the mason's wooden template is the embodiment of part of the gothic architects acquired implicit knowledge/knowing. The use of the technology of a template is an embodiment of parts of the explicit knowledge that does without the formal mathematical kind of abstraction. In lack of a CoP with a narrative way of transferring some of the implicit aspects, the template will perform a similar job. The template accumulates and transfers

knowledge/knowing in a less formal and less abstract fashion which is durable, scales and transfers differently and perhaps better, than structural mechanics and mathematics.

We find that Wenger's theory of CoP with its *reifications* misses out on this formative aspect, that technology may hold in that it fails to recognize that different characteristics of different technologies as exemplified by the book, the template, and the liquid container.

In leaving the dichotomies of the explicit versus tacit (implicit), body versus mind, and individual versus organization behind in regards to knowledge transfer and accumulation, we argue that the dichotomy of humans versus artefact can be left behind, too.

7. Conclusion

In the introduction the same question were asked in two different ways. By rephrasing the questions our intention was twofold. First, to illustrate how different types of questions focus our attentions differently, and thus lead us towards different approaches in our understanding of collaboration. Second, to "implicitly" prepare the reader on the content of the rest of the paper, and hopefully provoke the reader to reflect a bit on the issue. In short the first type of questions emphasised the community aspect of collaboration–the "what" questions–while the second type of questions were directed towards the practice part of collaboration–the "how" questions. Our intention was not to favour any of the approaches, but to stress the importance of both and illustrate how they accent different aspects to our understanding of collaboration.

To sum up we demonstrate how a focus on the technology might provide different insights to the CoP example of Orr's service technicians and how the social position of CoP gives additional insights to the examples of Turnbull's templates and Berg's liquid vessels.

Turnbull illustrates that technologies as abstractions, in this case as a wooden template, can hold and transfer knowledge as design information between communities with similar community skills/knowing in effect communities that have the skill to build with brick and mortar. The template works as a boundary object that traverses the community boundaries through both time and space, and comes across with a similar meaning, close enough to enable another master builder to decide to build a gothic rather than a Romanesque church. If this story looses sight of the technology, the artefact, then the transferral of knowledge becomes a mystery. The powerful qualities of this simple artefact are vital to the whole "plot". It scales better than the numerical mathematics, on which we rely today, in that it transcends language barriers and non-existent structural mathematics and it is durable in withstanding wear and tear. It travels well. So, just any technology will not do. Technologies have different characteristics which relate differently to different societal factors. Which technology is best at any point in time and setting will depend of the whole dizzying network of factors that make up and influence our social world, including the artefacts and what reifications we may establish in our communities. In analyzing possible relationships between the social and

the non-human, and focusing at least equally on both, we may identify aspects of technology that grant us to be better equipped in reaching our goals.

Berg describes a use of technology where the artefacts are links in a production chain. Loose the liquid-container's specific qualities and the process is seriously hampered. The containers design is a product of knowing how best to collect and transfer the liquid in question into abstractions suitable for their entry into the liquid chart. Now this particular example is not so advanced as to render it impossible to establish a workaround if the vessel should disappear, but it clearly illustrates the distribution of responsibility and control, power and action into the separate links. The end link of the chain need have no suitable knowledge of what the whole process is about, let alone the differing links within the chain. There is no social interaction involved in the production of the end result in relation to a specific patient. The activities of the communities that designed the different artefacts may be long gone and the resulting process chain can scarcely be described as a community. However, if one look at the human actor as constituent of a particular link in the chain, CoP would see this actor as a part of a community where probably several people carry out that same activity for different patients. The liquid vessels would be the boundary object mediating the interaction with the next human actor in the chain. In effect the CoP based analyses focuses on the human actors because you start out by looking for the communities and what defines them.

Orr's service technicians discuss the technology in their community through sharing stories. Through these narratives of humans and artefacts, the technicians iterate, rephrase, and recombine various bits of knowledge and experience to build new knowledge, knowing and tactics in coping with the machines. Their stories are their common stored knowledge, which sit in their collective memory and make sense in light of different contexts and experiences. Wenger uses this example to stress the importance of the community's collective work of producing the knowledge that enables them to carry out their work. However, through these stories, the machines gain a life of their own. The fact that contexts vary, different machines of the same make behave both similarly and differently, is constantly contributing to and feeding the activity of the community. In this case the artefact need not be seen as a boundary object mediating meaning between communities, but also an actor with its own agenda, albeit based on their initial design. The qualities of the machines are highly relevant not only as the focal point of the CoP of service-technicians but also as part of the community, or as actors in the CoP as ANT would allow.

References

Berg, M. (1997). On Distribution, Drift and the Electronic Medical Record: Some Tools for a Sociology of the Formal, Proceedings of the Fifth European Conference on Computer-Supported Cooperative Work, ECSCW'97, Kluwer, pp. 141-156.

Brown, J.S. and Duguid, P (1991), Organizational Learning and Communities of Practice: A unified View of Working, Learning and Innovation, Organization Science, Vol. 2, No. 1, pp. 40-56.

Cook, S.D.N and Brown, J.S. (1999), Bridging Epistemologies: The Generative Dance between Organizational Knowledge and Organizational Knowing, Organization Science, Vol. 10, No. 4, pp. 381-400.

Contu, A. and Willmott, H (2003), Reembedding situatedness: The importance of power relations in learning theory, Organization Science Vol. 14, No. 3, pp. 283 – 296.

Hollan, J., Hutchins, E., and Kirsh, D. (2000), Distributed cognition: Toward a new foundation of human-computer interaction research, ACM Transactions on Computer-Human Interaction, Vol. 7, No. 2, pp. 174-196.

Hutchins, E. (1995). Cognition in the Wild, Cambridge, MA: MIT Press.

Lave, J, and Wenger, E. (1991), Situated learning: legitimate peripheral participation. Cambridge: Cambridge University Press.

Mol, A. (2003), The body multiple: Ontology in Medical Practice, Durham, UK: Duke University Press.

Naur, P. (1992), Programming as theory building, in P. Naur Computing: A human activity", ACM Press.

Nonaka, I. and Takeuchi, H. (1995), The Knowledge-Creating Company, Oxford, UK: Oxford University Press.

Orr, J. (1996), Talking about machines: An ethnography of a modern job, Cornell, CA: Cornell Univ. Press.

Polanyi, M, (1966) *The tacit Dimension*, Routledge and Kegan Paul, London.

Ryle, G. (1949), *The Concept of Mind*, London, UK: Penguin.

Timmermans, S. and Berg, M (2003), The practice of medical technology, Sociology of Illness & Health, Vol. 25, No. 3, pp.97-114.

Turnbull, D. (1993), The ad hoc collective work of building Gothic cathedrals with templates, string and geometry, Science, Technology and Human Values, Vol. 18, No. 3, pp. 315-340.

Paper two:
Practice-Based Knowledge Integration

Practice-Based Knowledge Integration

Glenn Munkvold

Norwegian University of Science and Technology
Faculty of Information Technology, Mathematics and Electrical Engineering
Department of Computer and Information Science

NTNU-IDI, Sem Sælands vei 7-9, NO-7491 Trondheim, NORWAY

glm@idi.ntnu.no

Introduction

For organisations the tension between integration and specialisation has become a key issue, as knowledge of work is becoming increasingly fragmented through specialization (Kogut & Zander, 1992; Grant, 1996; Becker, 2002). Specialization, as knowing more about less, distributes the overall accomplishment of work on several (Becker, 2002; Hutchins, 1995; Berg, 1997; Aanestad, Mørk, Grisot, Hanseth & Syvertsen, 2003), with the consequent need for integration of different competencies and types of expertise. Becker (2002, p3) provides the following definition of knowledge integration:

> *"By knowledge integration we mean solving problems raised by specialisation: Specialisation leads to a dispersion of specialised bodies of knowledge that are held by different specialists.... Knowledge integration refers to how this drawing on different bodies of specialised knowledge is organised"*

The capability of relying upon specialisation and the ability to integrate specialised knowledge has been identified as a critical factor in the competitiveness of organisation. (Kogut & Zander, 1992; Grant, 1996). Because of this, integration has become a theme for numerous research efforts.

A first line of research looks at knowledge integration as the *transferring* of knowledge to where it is supposed to be used (Berends, Debackere, Garud & Weggeman, 2004). By transferring knowledge to someone who is able to use it and combine it with his or her own work practice, knowledge is integrated. If we are able to capture and model the content of knowledge, we can disseminate it and make it usable across contexts. As an integration mechanism, transfer is problematic because "*it is costly and counters the necessary specialisation of organisation members"* (Berends et.al, 2004, p.4). Moreover, the notion of knowledge as something that can be externalised and combined is problematic in itself (Blackler, 1995; Walsham 2001, 2004).

Current discourse on knowledge is filled with ambiguities and varying conceptualisations (see e.g. Cook & Brown, 1999; Davenport & Prusak, 1998; Walsham, 2001; Carlsen, Klev & von Krogh, 2004; Fitzpatrick, 2003; Boland & Tenkasi 1995; Blackler, 1995; Alvesson, 2001; Gherardi, 2000) and a detailed discussion of this issue is beyond the scope of this article. For this article, we will recall that the underlying tenet grounding most of the existing views is a distinction between explicit and tacit knowledge. Explicit knowledge refers to knowledge that is movable and easy to convey, while tacit knowledge is intimately connected to our

identity and thus hard to formalize (Polyani, 1966). Nonaka & Takeuchi (1995) claim that conversion between tacit and explicit knowledge is "*... a 'social' process between individuals and not confined within an individual*" (Nonaka & Takeuchi, 1995, p61). While popular, the their view on tacit knowledge as something to be externalised and combined has been critised (see e.g. Blackler, 1995; Walsham 2001, 2004). As human interaction is always mediated by representations, our experiences and the way we perceive the world can never be replicated perfectly. Hence, Walsham (2001) argues that the knowledge management discourse in general, and knowledge management systems in particular, should pay closer attention to the contextual sides of knowledge.

This different understanding of knowledge leads to a second line of research on knowledge integration, one that is first and foremost paying attention to the relational and situated nature of knowledge (Suchman, 1987; Brown & Duguid, 1991; Lave & Wenger, 1991). Rather than trying to single out the knowledge entities and how they could merge, the focus is on understanding how knowledge is deeply embedded in situated practices and closely connected to people's ability to act (see e.g. Carlsen et.al, 2004; Cook & Brown, 1999). In this article we discuss research in this direction. In particular, we elaborate on the practice-based perspective on knowledge integration to understand better the role of artefacts. In our opinion it is not enough to look at the practice in terms of human interaction, we also need to look at the overall system where integration takes place. Our perspective is illustrated with an example from the health care domain. We will look in particular at the patient-list, an A4 format template created by nurses to support their everyday activities and used in different settings in the hospital ward. We illustrate how the patient-list serves various functions within the ward and how it, along with other actors, helps the integration of different aspects of work. For the ongoing efforts of introducing information technology in health care, understanding the implicit roles of existing material arrangements is essential as it helps us identify how technology might be better designed.

The article is organised as follows; in the next section we discuss research on knowledge integration and the relevance of adopting a practice-based perspective, paying attention to the artefacts used within practices. The third section introduces health care as a relevant domain to study integration and presents a concrete example on how the patients-list integrates different aspects of work. The last section sums up the contribution of this article.

Knowledge integration

While the literature abounds on diverse classifications on how to coordinate the efforts of specialists (see e.g. Ditillo, 2002; Berends et.al, 2004; Willem & Scarbrough, 2002; Becker, 2002), we remain at their common reference point; the work of Grant (1996). Grant identifies four different organising mechanisms for integrating knowledge: (1) rules and directives, (2) sequencing, (3) routines and (4) group problem solving. Rules and directives are standards that regulate interaction between workers (e.g. policies and rules). These standards or artefacts can be said to accumulate knowledge. In health care for example, the transition from paper based to electronic health records (EPR), have imposed new rules and directives in how to handle EPR's (e.g. security and privacy). Sequencing is a mechanism for coordinating efforts across time and space. For instance, a procedure is a sequence of actions that should be undertaken to do a certain task. In terms of work, sequencing can be said to be a mechanism for minimising communication and maximising specialisation. In health care there are diverse types of procedures ranging from clinical (e.g. how to perform an operation) to administrative (e.g. how to refer a patient to a specialist). Routines are habitually procedures embedded in work-practices. They are beneficial in that they enable complex interaction in the absence of other coordinating mechanisms. For example, experienced surgeons do not search for a procedure before performing a standard operation, as it has become an embodied routine. Group problem solving is different from the previous three mechanisms in that it requires personal and communication intensive forms of integration. In this sense, group work in itself is a mechanism for integrating knowledge.

Of the four mechanisms, the latter (group) has been recognised as fundamental for knowledge creation (see e.g. Becker, 2002; Ditillo, 2002). Ditillo (2002, p.11) claiming that "*knowledge integration is best achieved through direct involvement*", suggest a group-based approach to knowledge integration. In a similar vein, Fitzpatrick (2003, p.106) contend that "*strategies to supporting knowledge sharing, even in large scale communities cannot discount for the interactional human-to-human processes through which it is nurtured in local settings or across settings*". The fundamental view grounding these perspectives is that no individual can possess all knowledge and thus a group or community, where knowledge is naturally distributed, becomes an effective mechanism for integration. In this sense knowledge is not treated as a transferable entity, but rather knowledge integration is considered to be a collective and interactive process. Understanding integration thus implies unfolding human interaction.

A practice-based perspective on knowledge integration

Based on the assumption that we know more than we can express, Polyani (1966) points out that we sometimes act according to our "feelings" without being able to give rational explanations for our conducts. In this sense the notion of tacit knowledge has become an important aspect of the way we understand work (Levin & Klev 2002). Empirically assessing knowledge thus implies attending to the everyday practices constituting organisational performances. Practice implies doing and is the situatedness of all human action (Suchman, 1987).

In a practice-based perspective, emphasis is on the active and productive processes of knowledge (see e.g. Carlsen et.al, 2004; Cook & Brown, 1999). Practices are driven by, but not limited to tacit knowledge; they are improvised, spontaneous and hallmarked by responses to changing and unpredictable environments (Brown & Duguid 2000). Emphasis is on Communities of Practice (CoP) in which knowledge sharing and integration takes place, rather than on individuals, methods or particular systems. In this sense, the traditional view on knowledge integration needs an elaboration. Boland and Tenkasi (1995, p.359) provides an interesting perspective:

> *"... the problem of integration of knowledge ..... is not a problem of simply combining, sharing or making data commonly available. It is a problem of perspective taking in which the unique thought worlds of different communities of knowing are made visible and accessible to others"*

Our experiences and the way we perceive the world can never be replicated perfectly, but to be able to make visible different world-views we need common denominators. That is entities that are interpreted differently in different social worlds, but still remain common enough to be recognisable (Star & Griesemer, 1989, p.393). These entities are what Star and Griesemer (1989) call *boundary objects*. In a practice perspective these boundary objects are means of representing, learning about and transforming knowledge (Carlile 2002). They enable collaborative work across social worlds (i.e. different CoP's).

We would like to emphasise that these "social worlds" consist of both people and artefacts. Knowledge is distributed among actors, and no actor has the complete picture of the collaborative work process (Hutchins, 1995; Berg, 1997).

Activating the artefacts

Practice then, as knowing in action, implies unfolding the joint activity performed by interrelated elements. In this perspective activity does not take place solely in peoples heads. Hutchins (1995) would contend that it is the system that knows.

Looking at the practice of navigating ships, Hutchins (1995) develops a methodological and analytical framework for understanding how cognitive achievements can be conceptualised as a joint accomplishment. Hutchins (1995) maintains equality between people and artefacts in structuring practice. One expects to find a system that can dynamically configure itself to bring subsystems into coordination to accomplish various functions (Hollan, Hutchins & Kirsh, 2000). Thus, the centre of attention in work activities is the interdependencies of people, and people and artefacts.

In the same way, Berg (1996, 1997) illustrates each minute part of a work process aiming at documenting a hospital-patient's fluid balance, which is a sum of what fluid goes in and what comes out. In observing and recording each minute detail of a particular process the separate elements are identified. This hybrid comprises everything that is needed for the activity to proceed including several people, various artefacts, routines and experiences. The formal tools come to life only as part of the real life activity. In Berg and Hutchins terminology integration implies looking at how work is distributed, delegated, coordinated and communicated across time and space (Berg, 1996; Hutchins, 1995; Ellingsen & Monteiro, 2003).

In this article artefacts are provided an active role in integrating knowledge. Artefacts are not only mediating human action, rather they play an active role in shaping that same action. Furthermore there is a relational interaction between artefacts and humans. Knowledge then is not entities that can be merged, but rather a distributed system of cognitive elements whose integrative potential lies in the collective ability to perform.

Integration in practice – an example from health care

Below we provide a small example on how an artefact, the patient list, is produced and used in a hospital ward. By going beyond the concrete representational aspects of the list, other aspects of work become visible. For instance the informal and implicit coordination and interaction among the people that populate the ward. The description and analysis of the patient-list described below is based on observations from a four-week stay at a hospital ward working as a nursing assistant.

The Patient-List

Medical records take many forms. Information from the electronic patient record, clinical specific systems and other systems are often printed out on paper and copied to become usable in the everyday work. Representations of patients are found on walls, in circulation, in copies, as annotated copies, in computers, in peoples' heads, in letters, in post-it notes, in pockets, et cetera. In this article we analyse one of

these artefacts - the patient-list. The patient-list is a sheet of A4 paper; listing all admitted patients arranged after which room they are lying. Every nurse on watch carries a copy of the list. The patient-list summarizes information about patient's diagnosis, type of treatment and report, i.e. recent information that might be relevant for nurses (as shown in Figure 1). It is a tool for planning, coordinating, distributing, delegating, and communicating.

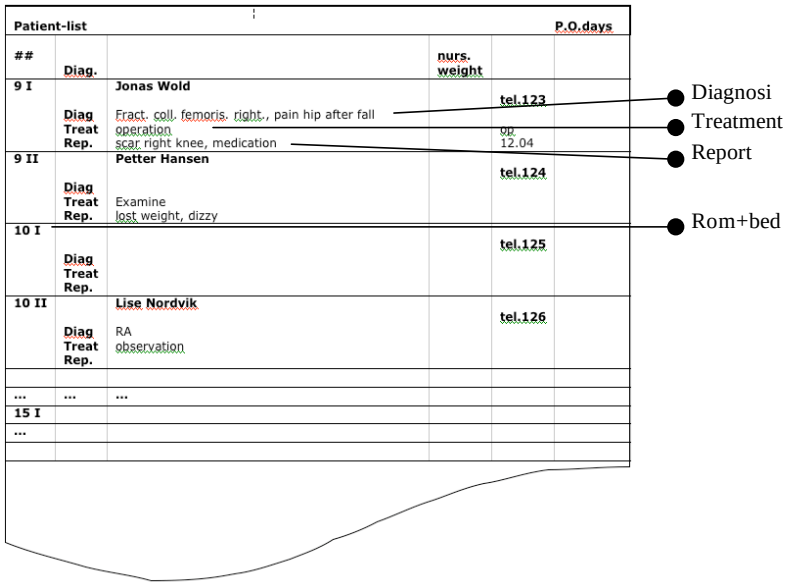


Figure 1: A section of the patient-list (fabricated for visualisation purposes only)

A new list is assembled during each night watch. A fresh copy of the patient-list is given to all nurses starting a new watch. During their watch, the nurses use the patient-list to record information regarding things that happen during their watch. Upon change of watch, in order to hand over tasks and information, a briefing meeting is held with the nurses ending their watch and those starting a new watch. Nurses actively use the patient-list during these meetings (sometimes supported by other documents). Nurses finishing the watch use their personal patient-list as a reference. Nurses starting their watch take notes on their own "blank" copy while listening to the brief. All the patients at the ward are reported on, and at the end of the brief all nurses have information about the patients. Moreover they all have written down the distribution of responsibility in the patient-list. Afterwards they go about doing their duties in the ward, with the patient list nicely folded into their pockets. Frequently during the watch they pick up the list to make sure that they are on schedule. Furthermore, the list is used as a reference point during discussions,

meetings, and so on.

Constructing knowledge by interplaying, tinkering and enacting

The patient-list itself seems like a rather poor representation of patients. It is assembled from a myriad of different, richer, representations. What, then, makes its way from these richer representations into the patient-list? During the night watch, a software program assembles the list. This program delegates the task of providing information to the nurses. It determines what information the nurses are expected to provide. Still, it presents a limited number of fields to fill. Once the nurses have provided the software with the required information, the patient-list is assembled. Knowledge is in this sense distributed between the nurses, the software and the patient list. What is it then that decides what information is extracted from the different representations? Is it the fields provided by the software? Is it the nurses who determine what goes into these fields? There is *interplay* between the nurses and the software, in effect an integration process. In deciding what should go into the different fields, the nurses fluctuate between glimpsing into the patient record, asking colleagues or by memorising. In this sense, filling out the form is a process of *tinkering* (searching, combining, reducing and writing down). Furthermore, what eventually becomes engraved into the patient list is based on a process of *enactment* based on different knowledge representations. According to Ellingsen & Monteiro (2003), in rendering knowledge credible, relevant and trustworthy, knowledge representations have to be *enacted*.

Reconstructing meaning by telling stories and circulating

In the briefing meeting the reporting nurses (accompanied by the patient list) are themselves highlighting certain parts of what has happened during their watch. The report takes form as a story, structured by the list and told by the nurse. Stories, the patient-lists re-made by the nurse, act as repositories of accumulated wisdom and it allows people to keep track of the sequence of behaviour and of their wisdom (Brown & Duguid, 1991; Orr, 1996). *Storytelling* thus serve as a mechanism for integrating knowledge. Furthermore, the stories are not only shared in the briefing meeting, they circulates, partly by means of the patient-list, partly by means of nurses encounters, et cetera.

Circulation can also be seen as the way the patient-list travel as a template among the nurses. The list is easy to replicate, and thus easy to circulate. In this way knowledge about nursing, as manifested in the patient-list can circulate and spread. Furthermore the list has an organizing effect, having the power to organize large number of workers (see Turnbull, 1993).

Knowing as a sociotechnical interaction

In the latter part of this analysis we look closer into the details of the list (see Figure 1). What does the patient-list know? By taking a brief look at it, the list can tell nurses which rooms and bed are available. In the figure, the list tells us that bed 1 in room number 10 is available. Furthermore the list does not give Petter any diagnosis, but tells us that the he is waiting for an examination. For Lise Nordvik the situation is more clear-cut, the list tells us of a diagnosis, and that the patient is admitted to the hospital for observation.

In the way that the nurse interacts with the patient-list, it regulates and coordinates the action that can be taken. E.g. a new patient should be admitted to bed 1 in room 10. The list tells nothing about Petter's diagnosis. The nurse might want to consult a physician before giving him any medication. The patient-list tells nurses that Lise has been here before, that this patient knows her way around, but that the nurses must keep an eye on her regularly. All the three cases illustrates that interaction does not solely take place between people mediated by artefacts. Rather interaction can as often be identified as something happening between humans and artefacts. Artefacts and humans have knowledge about different aspects of the ward and its patients, and it is in the interaction that this knowledge becomes usable. Action is the result between the social and the material and the integration is not observable in itself, only the resulting practice.

Conclusion

This article has addressed the concept of knowledge integration. We have described how a practice-based perspective provides an extension of the seminal work on knowledge integration by Grant (1996). In our practice-based approach, we have emphasised the role of artefacts, not only as a mediators of human action, but as active participants in shaping that same action. By providing an example from health care, the patient-list, an A4 format template created by nurses and used in different settings at a hospital ward, we have highlighted the relational interplay between artefacts and humans in work-performance. Tinkering, enacting, storytelling, circulation and sociotechnical interaction have been identified as mechanisms for integrating knowledge.

The main contribution of this article is the proposal for a practice-based perspective on knowledge integration where specialisation, as traditionally being located only within humans, is challenged. We have emphasized the need to look beyond the pure representational aspects and also attend the interactive roles of tangible arrangements (e.g. paper). This makes it imperative to be explicit on the role of artefacts in work-

performance because it plays such an important role in our understanding of collaboration and work. As we have demonstrated, the patient-list plays an active role in structuring and coordinating work (see also Fitzpatrick, 2000). Furthermore, paper in itself provides rich support for collaborative work; it can help us gain knowledge of how technology might be better designed (Sellen & Harper, 2002). In health care for instance, any move to introduce IT impacts the very nature of that care, so if we do not have a profound understanding of the richness and complexity in the accomplishment of that work, we will not be able to design effective systems that will fit with the work (Fitzpatrick, 2000).

Traditionally when specifying requirements for knowledge management systems, conventional interview-techniques are employed to portray existing work arrangements. In other words, work is specified as presented by the human workers. The problem then is that they (the human workers) are not consciously aware of the interactive role artefacts play in performing work. As artefacts "don't talk back" conventional interview-techniques needs to be supplemented with additional ethnographic techniques to enable technology designers to look beyond the pure representational aspects of tangible arrangements. However, technology designers do not have the professional competence of ethnographers, so there is a need to provide them with guidelines to simplify the effort needed.

Another issue that naturally comes out of this article is the understanding of how users themselves actually design their own work-practices in the usage of artefacts. For instance, in health care organisations decisions on what kind of 'general' types of information systems to implement have already been made (e.g. Electronic Patient Record, Picture Archive and Communication System, etc). Thus future research needs to attend to the domestication of technology, that is how to effectively integrate it into different work environments. This implies not only understanding how technology needs to be designed, but also how existing work-arrangements need to be adjusted.

References

Aanestad, M., Mørk,, B. E., Grisot, M., Hanseth, O. Syvertsen, C. M., (2003). Knowledge as a barrier to learning: a case study from medical R&D. 4th European Conference on Organisational Knowledge, Learning and Capabilities, IESE Business School, Barcelona, Spain

Alvesson, M. (2001). Knowledge work: ambiguity, image and identity. Human Relations, 54(7), 863–886.

Becker, M. C., (2002), Towards a consistent analytical framework for studying knowledge integration – Communities of practice, interaction, and recurrent interaction patterns'. Paper presented at the 3rd European conference on organizational learning, knowledge and capabilities, Athens, April

Berends, J. J., Debackere, K., Garud, R., Weggeman, M. C. D. P. (2004). Knowledge integration by thinking along. Eindhoven Centre for Innovation Studies, The Netherlands. Working Paper 04.05.

Berg, M. (1996). Practices of Reading and Writing: The Constitutive Role of the Patient Record in Medical Work. Sociology of Health and Illness, Vol. 18, pp. 499-524.

Berg, M. (1997). On Distribution, Drift and the Electronic Medical Record: Some Tools for a Sociology of the Formal, Proceedings of the Fifth European Conference on Computer-Supported Cooperative Work, ECSCW'97, Kluwer, pp.141-156.

Blackler, F. (1995). Knowledge, Knowledge Work and Organizations: An Overview and Interpretation, Organization Studies. Vol. 16, No. 6, pp. 1021-1046.

Boland, R. J. Jr, & Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. Organization Science, 6(4), 350–372.

Brown, J.S. & Duguid, P. (1991). Organizational Learning and Communities-of-practice: Toward a Unified View of Working, Learning, and Innovation. Organization Science, Vol. 2, No. 1, pp. 40-57.

Brown, J.S., Duguid, P., (2000), "The Social Life of Information". Harvard Business School Publishing.

Carlsen, A., Klev, R., von Krogh, G. (2004). Living knowledge. The dynamics of

professional Service work. Palgrave Macmillan.

Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. Organization Science 13 (4) pp. 442-455.

Cook, S. D. N., & Brown, J. S (1999). Bridging Epistemologies: The Generative Dance between Organisational Knowledge and Organisational Knowing. Organization Science, 10(4), 381-400.

Davenport, T.H. & L. Prusak (1998). Working knowledge . Boston: Harvard Business School Press.

Ditillo, A. (2002). The relevance of information flows in knowledge-intensive firms. SDA Bocconi. Working paper 74

Ellingsen, G., Monteiro, E. (2003). Mechanisms for producing a working knowledge: Enacting, orchestrating and organizing. Information and Organization 13. 203–229

Fitzpatrick, G. (2000). Understanding the Paper Health Record in Practice: implications for EHRs. Proceedings of HIC. Integrated information for Health Care.

Fitzpatrick, G. (2003). Emergent expertise sharing in a community. In M. Ackerman, V. Pipek, V. Wulf (Eds) Sharing Expertise: Beyond Knowledge Management, 81-110, January, Cambridge, MA, MIT Press.

Gherardi, S. (2000). Practice-based Theorizing on Learning and Knowing in Organisations. Organization. Volo 7(2): 211-223

Grant, R.M. (1996). 'Toward a knowledge-based theory of the firm', Strategic Management Journal 17 (Winter Special Issue): 109-122.

Hollan, J., Hutchins, E., & Kirsh, D. (2000), Distributed cognition: Toward a new foundation of human-computer interaction research, ACM Transactions on Computer-Human Interaction, Vol. 7, No. 2, pp. 174-196.

Hutchins, E. (1995). Cognition in the Wild, Cambridge, MA: MIT Press.

Kogut, Bruce and Zander, Udo (1992): Knowledge of the firm, combinative capabilities, and the replication of technology. Organization Science, Vol. 3, No. 3, 383-397

Lave, J, & Wenger, E. (1991), Situated learning: legitimate peripheral participation.

Cambridge: Cambridge University Press.

Levin, M., & Klev, R (2002). Forandring som praksis. Læring og utvikling i organisasjoner. Fagbokforlaget

Nonaka, I. & Takeuchi, H. (1995), The Knowledge-Creating Company, Oxford, UK: Oxford University Press.

Orr, J. (1996), Talking about machines: An ethnography of a modern job, Cornell, CA: Cornell Univ. Press.

Polanyi, M, (1966) The tacit Dimension, Routledge and Kegan Paul, London.

Sellen, A. J., & Harper R. H. R, (2002). The Myth of the Paperless Office. MIT Press

Star, S.L., and J.R. Griesemer (1989), Institutional Ecology, Translations, and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology 1907-39, Social Studies of Science, Vol. 19.

Suchman, L. A. (1987). Plans and Situated Actions: The Problem of Human-Computer Communication. New York: Cambridge University Press.

Turnbull, D. (1993), The ad hoc collective work of building Gothic cathedrals with templates, string and geometry, Science, Technology and Human Values, Vol. 18, No. 3, pp. 315-340.

Walsham, G., (2001), "Knowledge Management: The Benefits and Limitations of Computer Systems", European Management Journal, Vol. 19, No. 6 pp. 599-608.

Walsham, G., (2004). Knowledge Management Systems: Action and Representation. Action in Language, Organisations and Information Systems. Proceedings ALOIS2004

Willem, A., & Scarbrough, H. (2002). Structural effects on inter-unit knowledge sharing: The role of coordination under different knowledge sharing needs. Third European Conference on Organisational Knowledge, Learning and Capabilities. 5-6 April, Athens

Key terms

Artefact: Any human-made object. It can be both physical (e.g. paper, application) or conceptual (e.g. norm, convention, habit)

Distributed cognition: Cognition is understood as derived from the environment. It is based on an assumption of equality between people and artefacts in structuring practice

Integration: Integration refers to how work is performed. Knowledge-entities cannot be merged, but should be looked upon as a distributed system of cognitive elements whose integrative potential lies in the collective ability to perform.

Knowledge integration:By knowledge integration we mean solving problems raised by specialisation: Specialisation leads to a dispersion of specialised bodies of knowledge that are held by different specialists. Knowledge integration refers to how this drawing on different bodies of specialised knowledge is organised.

Knowledge integration mechanism: The mechanism from where knowledge integration is performed (becomes visible). Examples here are tinkering, enacting, storytelling, circulation and interplaying.

Practice: The relational interplay between humans and artefacts that enable work performance.

Sociotechnical: The interactive interplay between humans and artefacts in work-performances

Paper three:
From plans to planning – the case of nursing plans

The definitive version was published in Proceedings of the 2007 international ACM conference on Supporting group work

http://doi.acm.org/10.1145/1316624.1316628

From plans to planning: the case of nursing plans

Glenn Munkvold
Norwegian Univ. of Science and Tech.
Dept. of Computer and Info. Systems
7491 Trondheim
Norway
(+47) 7359 3980
glenn.munkvold@idi.ntnu.no

Gunnar Ellingsen
University of Tromsø
Department of Telemedicine
9037 Tromsø
Norway
(+47) 7762 6121
gunnar.ellingsen@unn.no

Eric Monteiro
Norwegian Univ. of Science and Tech.
Dept. of Computer and Info. Systems
7491 Trondheim
Norway
(+47) 735 96 751
eric.monteiro@idi.ntnu.no

ABSTRACT
Drawing on a critical perspective stemming from socially informed studies of medicine, we analyze an ongoing effort to establish electronic nursing plans at the university hospital of central Norway (St. Olav's hospital). We argue for an alternative interpretation of the relative lack of success to date of making the nurses use the nursing plans. Rather than a preoccupation with the singular artifact – *the* plan – we emphasize the *process of planning* as a collective, ongoing and heterogeneous achievement. Our perspective on plans implies that they should be recognized as more of a network and less a singular artifact.

Categories and Subject Descriptors
J.3 [**Computer Applications**]: Life and Medical Sciences – Medical Information Systems

K.4.3 [**Computers and Society**]: Organizational Impacts - Computer-supported collaborative work

General Terms
Documentation, Human Factors, Standardization

Keywords
Planning, Cooperation, Coordination, Redundancy, Formal, Informal, Nursing, HealthCare Work.

1. INTRODUCTION
The history of modern Western medicine is characterized by a gradual process of rationalization through increased professionalisation, institutionalization, codification and standardization of terminology and practice [2]. As a result, medicine has been transformed from 'art' to 'science' [4]. A forceful expression of this is the increased emphasis on *plans* such as clinical guidelines, protocols and care plans [31][37]. Plans thus embody the purposeful intention of increased uniformity of practice, higher quality and better cost containment. They are placed at the very core of patient care delivery [23][30][31], directly connected to commonly used expressions like shared care, seamless integration and continuity of care. This pivotal role of plans together with the empirical documentation of low actual compliance to clinical and nursing plans [5][31], forms the background for efforts to impose more planned practices.

Drawing on a critical perspective stemming from socially informed studies of medicine [2], we analyze an ongoing effort to establish nursing plans at the department of Rheumatology in the University Hospital of the Mid-Norway health region. The very modest current use of such plans is the source of considerable concern [5][31].

Nursing plans are paper-based or electronic artifacts. Planning is assumed to take place through the use, i.e. filling in and subsequent reading off, of these plans. The use (or lack thereof) of these artifacts is what is traditionally focused. We argue for an alternative interpretation of the relative lack of success to date of making the nurses use the nursing plans. Rather than a preoccupation with the singular artifact – *the* plan – we emphasize the *process of planning* as a collective, ongoing and heterogeneous achievement.

Two examples from our case are used to illustrate how planning unfolds in practice. The first portrays a nurse in the process of producing the written report. The second example looks at the collective effort of handing over information and the way responsibility is distributed among nurses on a shift. In both examples it is illustrated how, in the process of planning, information is being distributed across a variety of nodes, and how planning is achieved by a network of artifacts, structures and people. There is planning but no singular plans. Plans, in the sense of the practice of planning, are rather a trajectory that is constantly changed, altered, negotiated in response to changes in the surrounding nodes that constitute the heterogeneous network of planning.

Our perspective on plans implies that they should be recognized as more of a network (distributed, heterogeneous, and negotiated) and less a singular artifact. Robust, working plans are achieved, not by the absence of, but by the presence of distributed and redundant information sources. The design and implementation of electronic based nursing plans needs to acknowledge them as such.

The remainder of this paper is organized as follows. First we conceptualize the mixture of perspectives underpinning the role and function of plans. We then go on to describe the method used

followed by two concrete episodes from the case were planning takes place. Finally we analyze and discuss our findings and conclude the paper.

2. CONCEPTUALISING THE ROLE AND FUNCTION OF PLANS

The implementation of Electronic Patient Records (EPR) in Norwegian hospitals has revitalized the awareness towards electronic based nursing plans [8][17][20][21], in line with broader international trends [14][23][24][25][34].

A nursing plan is an overview of probable nurse-related diagnoses (problems) for a particular patient group combined with relevant measures. The actual classification of a patient group may be based on medical diagnoses, a particular surgery or medical procedure or the like.

The motivation for using nursing plans, both paper-based and electronic ones, is compound. From a managerial perspective, the international nursing research literature reports that:

> "Over the past three decades, public and private purchasers turned to managed care plans to stimulate greater hospital competition and reduce hospital expenditures and costs" [7](pp. 419-420).

From a clinical perspective, nursing plans are expected to improve the quality of the documentation [5][31][37], which again is considered crucial for a safe and high quality deliverance of care. To be more specific:

> "It is a severe threat for the individuality and safety of patient care if important aspects of nursing care remain undocumented. One cannot rely on information that is not documented. (…) Ultimately, the documentation practices reflect the values of the nursing personnel." [37](pp. 79-80)

> "It is expected that nurses obtaining appropriate and accurate information when they need it will improve the chance of making better decisions about patient care." [23] (p. 38).

These prospects are furthermore connected with current efforts of introducing EPRs in western hospitals. As Hellesø and Ruland [17] put it:

> "Information technology has gained a larger and more fundamental role in the management, distribution and storage of information in healthcare. The patient record and electronic nursing documentation is expected to reduce redundancy and increase access to up-to-date information as an integrated part of the EPR" (p. 799)

Nursing plans are also assumed to ensure a well-functioning communication between caregivers, for instance between hospitals and care homes [30] as well as improve the efficiency of the nurse handover:

> "If the care plans were updated, the incoming nurses could read them and identify the patients' problems and the nursing strategies to manage them, thus eliminating this information from the handover" [31](p. 38).

Similar arguments are also echoed in Norwegian policy documents [11][20]. For instance the Nurses Forum of ICT argues that:

> "An EPR may easily make available normative information (…) by showing current guidelines or procedures and then it is possible to document just the deviation (…) this may simplify the documentation and increase the quality of nursing" [11](p. 17).

Fulfilling the "promises" of electronic based nursing plans is closely connected to the expectation of replacing a lot of existing dispersed and redundant information sources in the hospital:

> "the information presented may be irrelevant, repetitive, speculative or contained in other information sources" [31](pp. 37-38).

> "The documentation of the nursing process is carried out within different areas such as palliative aid, treatment, and rehabilitation and preventive health aid. Therefore, it shall exist a 'collected thing which documents all health assistant that is given to, or planned for a patient. This collected thing is (…) denoted the nurse documentation. The purpose with this collected thing is to have everything concerning the nursing process collected in a common place" [20](p. 26).

> "A nursing information systems should contain all components that are part of the nurses' systematic care plan process, that is, the nurse assessment, the establishment of problems, goals, planned and accomplished measures, and evaluation" [21](p. 8).

> "Grouping of patients in the EPR for a team (…) may replace many of the notes which the individual nurse make today in connection with the changing watches" [11](p. 27).

> "Written handover may lead to an increased focus on ensuring accurate and thorough nursing documentation and improved utilization of nursing care plans, as these become the primary focus for patient care delivery" [31](p. 42)

However, given the high expectations outlined above, the actual use of nursing plans has so far been disappointing. Studies have pointed to how "nurses have problems integrating the nursing process and care planning into their daily record-keeping" [5](p. 35). In a survey referred to by Sexton et al. [31](p. 38), "nursing care plans were referred to in handover only 1% of the time and this was probably because care plans were not being updated". One explanation may be that the "nursing process is thought to be time-consuming to document" [38](p. 80) and its value were questioned (ibid). For instance, some have argued that nursing plans are more significant for the professionalism of nursing than for patient care [23].

We employ a perspective on the challenge of establishing working nursing plans that draw heavily on insights from the social organization of health care [1][4][13]. More specifically, we build on a critique of prevailing assumptions about the use of formal tools (like electronically based nursing plans) as worked out most clearly by Berg [4]. His critique is highly relevant to a firmer understanding of the underlying reasons for the relative lack of success of nursing plans for nurses. There are two aspects of Berg's analysis particularly relevant in relation to nursing plans.

Firstly, Berg emphasizes the essentially *distributed* nature of plans. Rather than thinking of plans as captured by any singular plan, he points out how the plan is distributed across both a number of human actors and different artifacts. To make a working plan, it has to be distributed and delegated across a whole

network of social and material/ technical nodes: "It is a *whole, hybrid practice* – including nurses, physicians, data items, and organizational routines – that must be made sufficiently docile" (ibid, p. 91).

Secondly, instead of the traditional focus on a plan as an artifact, we should focus on the *practice of planning*, i.e. the process through which actual planning unfolds. This, as Berg (ibid.) explains, gives rise to an understanding of plans as a kind of trajectory:

> "The resulting trajectory is not a product of consciously developed plans, nor is it the result of a sequence of 'decisions'. There is no overall 'plan': the actual itinerary of the trajectory is the emergent effect of the interlocking of entities performing subtasks. The complexity and diversity of the managed array of heterogeneous elements, moreover, necessitates continual adaptation and reaction to upcoming contingencies. … The trajectory is continually reset on the spot, as the outcome of the continual articulation work" [4] (p. 138)

3. METHOD

3.1 Research setting

Rheumatism is a general term covering over 200 different types of diseases with different causes and types of treatment. It characterizes a fluctuating, but progressive developing disorder with potentially severe disabling outcome and reduced life expectancy. Its incurable nature and negative influence on health and quality of life makes it a disease of considerable concern throughout the world. Only in Norway, with a population of approximately 4,5 million people, more than 300.000 people are diagnosed with a rheumatic disease.

The problems facing patients are complex, and health care professionals with different areas of expertise are involved in the treatment. This interdisciplinary approach to treatment and care together with a rather complex case history make the paper-based medical records of rheumatic patients thick (i.e. holding a substantial amount of information).

The case study was carried out in the inpatient ward at the department of Rheumatology in the University Hospital of the Mid-Norway health region. The main clinical undertaking of the ward is chronic inflammatory rheumatic diseases such as inflammatory joint diseases and connective tissue diseases. The ward is organized as a primary care unit, and patients are admitted both for medical treatment and surgery. Three physicians and about 20 nurses work there together with a physiotherapist, an occupational therapist and a social worker. The ward has 16 beds and treats approximately 650 patients per year with an average hospitalization-length of 8 days.

The nurses play a crucial role in ensuring quality patient care. They are the only group of professionals that stay with the patient 24 hours a day and thus need to master a whole range of skills, such as helping with activities of daily living, post surgery observation, pain management, patient education, counseling, and so on. The variety in proficiency makes the nurses highly dependent on tools to aid planning and coordination of work.

3.2 Research method

Methodologically, the study adheres to an interpretive research tradition [22] and relies on participant observations as a primary method [12]. It comes close to what is commonly labeled ethnographic studies of technology [35], which again places our approach in the broader landscape of similar studies [3][19][32][40].

The first author has followed the introduction of electronic nursing plans at the ward. He was told about the project and invited to take part in its evaluation while working as a nursing assistant at the ward (approx. six months prior to the actual launch of the project). In November 2004, when the project formally started, he thus knew most of the people working there and did not have to spend too much time explaining his presence and involvement in the project. He had already gained legitimacy and had become a trusted member of the community, without going native [18].

Collected data includes 450 hours of observation, tape recordings of handovers and meetings where nursing plans where discussed, 31 interviews, examination of official as well as unofficial documents and informal discussions with employees. To capture the "non-movable" aspects of nursing like for instance the paper-based medical record, the chart, nurse's personal notes, etc, a digital camera was used. In addition, emails and other types of documentation relevant for the case have been forwarded to him from various actors involved in the project.

Observations have been carried out at all hours to cover all nursing shifts. However, the majority has taken place during the day and the evening shift. Handwritten fieldnotes were taken during the observations and transcribed immediately afterwards. To supplement the observations documentary material like the Kardex, nursing plans, running notes, nurses' personal notes, procedures and so on have been collected as supplements.

Interviews were carried out with nurses at the ward as well as project managers and representatives from the EPR-vendor. In all cases questions related to the introduction of the electronic nursing plans were discussed, for example their expectations to electronically based nursing plans, their usage of the paper based patient record and what they regarded as essential information for the delivery of proper care.

The analysis of the data is based on a hermeneutic approach where a complex whole is understood "from preconceptions about the meanings of its parts and their interrelationships" [22](p. 71). This implies that the different sources of field data are all taken into consideration in the interpretation process. The method included relatively detailed case write-ups (see for instance [9]) followed by an examination of the data for potential analytical themes. Main analytical categories have emerged gradually and served as a basis for the selection of the two empirical examples presented in the paper (among a collection of similar candidates).

Regularly during the fieldwork, data have been validated through discussion with key informants as well as transcripts being read by informants for approval and verification of their content.

4. CASE

Electronic based nursing plans were first introduced in the ward in November 2004. The new tool was expected to support decision-making and make it easier to document the process of nursing. The introduction of nursing plans did however take some time.

For various reasons the nurses struggled to integrate the nursing plans as a part of their documentation practice, for example, differences among the staff in computer skills, lack of resources allocated to the project, in-house training that was delayed several times due to problems of combining it with the rotation scheme, lack of specifications on how to actually use the system and so on. In fact, at the time when the empirical investigation was ended (one year later), the nurses still struggled to integrate the new tool as a part of their documentation practice.

As have been described elsewhere, the new tool was used, yet not as anticipated prior to its implementation (see [27][28]). A main reason thereof was the nurses somewhat idealistic expectations regarding the tools capacity (and effects). That is, planning was assumed to take place through the use, i.e. filling in and subsequent reading off, of the electronic based nursing plans. However, this did not resemble well the way planning actually unfolded in practice. Rather, the process of planning seemed to be more of a collective, ongoing and heterogeneous achievement. As we will demonstrate below, *the* plan was hardly visible in practice, but the process of planning was.

In the following we present two examples as illustrations of how planning unfolds in practice. The first portrays a nurse in the process of producing the written report while the second looks at the collective effort of handing over information and distributing responsibility among nurses on the oncoming shift. We try to illustrate how, in the process of planning, information is being distributed across a variety of nodes in order to comply with both formal requirements and as a way to delegate and coordinate work according to a local division of labor. Various, partly overlapping, information sources continuously emerge and disappear in the process. Both examples are based on empirical data from the old documentation practice (i.e. prior to the actual integration of the electronic-based nursing plans). Even though it was available and promoted by several of the nurses as an important tool, the paper-based nursing plan was hardly used (and updated) in practice. Rather the nurses would draw more extensively on the written report and other artifacts.

4.1 Writing the report

It's almost three o'clock Thursday afternoon. The nurses' office is filled with nurses preparing for the handover. Two of them, Anne and John, have picked up a patient from recovery. The patient has just undergone a surgical operation for an upper femur rupture.

We enter the nursing office, as Anne, the nurse responsible nurse, is about to write the report. She is sitting in front of one of the many computers in the room. On the desk in front of her lies a binder. It typically holds official nursing documents like the main card, nursing reports, information from and to relatives, and so on. Today however, some additional documents have been put there,, including a surgery chart that holds information about the status of the patient prior to and during the surgery, and a couple of observation forms. Next to the binder lies the patient list. It is an A4 sheet of paper annotated with information from Anne's activities during the shift. Finally, on the computer-screen in front of Anne the EPR-application is open. IT is however not used by during the writing of the report.

The nursing report is written on a preformatted paper-form. Individual reports are sorted out successively by the date and a signature, which both are placed in a column on the left hand side of the form, Anne picks up the latest report. The form is only half full. She enters the current date and starts to write:

> *The patient came back from intensive care at 14:30 today*

She stops, takes a quick look at the surgery chart and picks up the main card. The following text is written on the main card:

> *Physio ... X-ray post-operative + 7 days.*

A bit hesitant, but eager to find out, I interrupt and ask why this is written in the main card. Anne replies:

> "These are follow-up instructions that the surgeon has written it in the surgery chart (…) It is crucial that all nurses in charge of a patient know, and that's why I write it here rather than in the report. If I write it in the report it will only get lost in the text" (Nurse Anne)

With me occupied writing down her answer, Anne turns her attention back to the report:

> *Blood pressure was a bit high during the operation*

Anne remembers something being said about the medication when the patient was picked up from intensive care, but cannot remember what. Unable to find the answer in the surgery chart, she turns to John, her colleague, sitting next to her. John doesn't remember either. They both look through the surgery chart again. Together they are able to locate it, whereupon Anne writes the information in the report:

> *Got seloken during the operation without any effect.*

Having done that, Anne picks up the patient list and the observation form. Strictly speaking she should have had access to the medical chart, but at this time of the day it is unavailable because the physicians use it. Anne rather relies on observations and medication that has been temporarily recorded in the patient list. Some of the information in the list and the observation form are extracted and merged into one account in the written report:

> *173/80, P[uls] 83, saturation 88. Bedridden with 2 litres of oxygen. Analgesic: Paracet 1gram x 4, perhaps morfin 1mg iv [intravenous]. Has been to control X-ray after the operation*

The report is now complete. Anne reads through it once more while at the same time putting the documents, which now are spread out on the desk in front of her, back into the binder. Afterwards she leaves the room. The binder is left behind on the desk. She returns a few minutes later with a yellow post-it note in her right hand. She opens the binder again and places the post-it on top of the main card (which usually is the form first appearing in the binder). The yellow post-it holds the following information:

> *8/7… called the public administrative office…. agreed to call back when the patient is being discharged from the hospital… nurse Anne.*

Post-it notes like these are usually sticked to specific places on specific forms in the binder. This is because they typically hold information that is primarily of temporal relevance (and interest) and thus do not fit any of the preformatted fields found in any of the standard forms. In this case, the message (i.e. post-it) is placed below a field called "Others involved". It is placed exactly there to denote where in the record the information belongs and thus also where the nurses normally would look when they need to contact the public administrative office again.

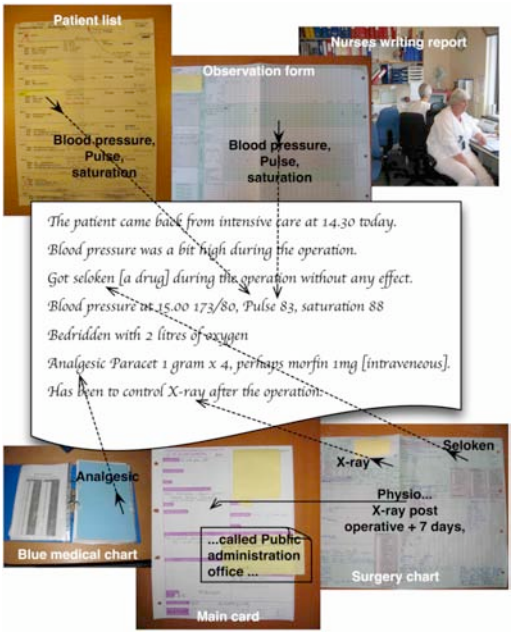


Figure 1: The report (in the middle) and the various documents (and people) used in the process of writing it.

As demonstrated in Figure 1, various entities enter the scene in the process of writing the report. Their integration is in effect allowed by the narrative nature of the report. What to include and exclude is however not obvious. Things are left out for various reasons. For example, although it is actually not prescribed, Anne wants to give the patient fluid intravenously. She explains why:

> "No fluid is actually prescribed, but I believe we're better off just giving it to her [the patient] anyway…It has been said that she has gotten 1500ml already and that she should continue to eat and drink, But the "old" lady will probably not eat much anyway, so I believe she's better off if we give her fluid intravenously … also because of the heat… I will discuss this with the oncoming nurse" (Nurse Anne)

In discussing the issue with the oncoming nurse later on, the argument was the same:

> "Talking to Anne was important to be able to understand the reason why the patient needed fluid intravenously" (oncoming nurse)

Both the written report and the oral brief were necessary for the oncoming nurse to decide what needed to be done. Hence in the context of the handover conference and from the perspective of the nurse, the report and the plan were not separated entities but rather intrinsically intertwined in one and the same process.

4.2 The morning meeting - handing over information and distributing responsibility

Our second example takes place in the department's meeting room. The room is placed at the heart of the ward, denoting its importance in planning and coordinating work. Encircled by chairs, a large table holding diverse magazines, books, papers and documents is placed on the middle of the floor. The walls are almost covered by bookshelves, whiteboards, billboards, posters, pictures and various reminders. At one end is a computer attached to the local network and connected to a projector. The projector is placed in the middle of the table, pointing towards a screen on the wall at the far end side of the room. In one corner is a kitchenette with a small fridge, a sink and coffee-machine, emphasizing that the room is also used for more informal activities.

The performance of the morning meeting is basically the same every day. It follows a certain sequence of events and is carried out within certain time limits. The meeting formally starts at 07.30. However, most nurses show up a couple of minutes earlier. While waiting for the meeting to start they read through the overview of enlisted patients. The overview is recorded on the large whiteboard on the wall as well as in the newly updated patient-list, which is lying on the table.

The entrance of the head nurse formally signifies the start of the meeting. A brief is provided both by nurses on the night shift as well as by the nurses from the afternoon shift the day before. This "double reporting" ensures that the oncoming shift get a story as coherent and complete as possible from all activities the last 24 hours.

Nurse Per from the night shift is ready to hand over information. He is looking at a patient list. The list is annotated with information from activities during his shift. The patient list is actually not approved as an official document. Yet all nurses find it extremely useful. As one nurse did put it:

> "I write keywords down on the list and afterwards I transfer my observations into the documentation (…) For example when you need to take a patients temperature at certain intervals during a shift (…) I also use it as a reminder. For instance if a new patient has been admitted during a evening or night shift it is important to notify the patient and the responsible nurse on next shift about [standard procedure like] the urine specimen the next morning, the temperature in the evening, blood samples and so on..." (Nurse)

Structured by the list and told by Per, an account is provided for all admitted patients. From time to time, while giving the report, he checks the official documents to make sure that information has also been entered there. Oncoming nurses listen and take notes on their own "blank" patient list. Their presence clearly contributes to the accomplishment of the brief. Typically they would ask questions or make supplementary comments to the brief. This clearing up of ambiguities and adding of details improves both the quality and relevance of the brief. Halfway through the report a discussion starts:

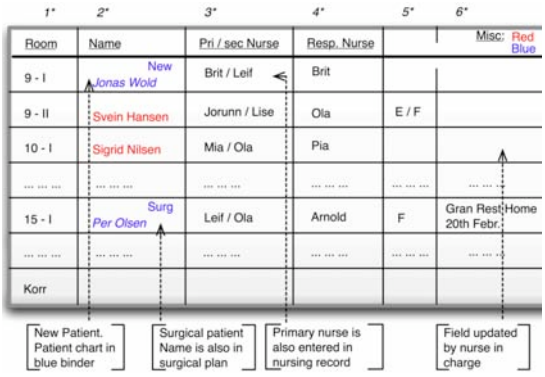
Per:	I just didn't know that the patient was put on a new regime [new medicine] – somadrill, … The medication was already prepared by the day-watch.
Oncoming Nurse A:	The physicians must make sure to tell us when changing the medical chart after we have prepared the medicine.
Per:	Yes, at least tell the nurse in charge so that she can tell me… nobody told me anything yesterday, and as long as the patient manages his own medicine it is difficult to control…
Head nurse:	I'll discuss this with the physicians.

Normally changes to medication is decided and documented in the medical chart during the previsit, at which point the nurses set it up for the next twenty-four hours. A signature by the nurse preparing the medication serves as a guarantee that the right medication and correct dosages have been prepared. In the example above, the physicians have made changes in the medical chart without informing the responsible nurse. During the nightshift, medical charts are normally updated and signed and medication prepared in the middle of the night, typically after the patients have fallen asleep. In this case the change was discovered too late, leaving the patient mistakenly on the old regime.

Around 07.40, the two nurses from the nightshift have completed their brief. As they leave the room, they put their personal patient-list in a box labeled 'destruction'. The box is placed on one of the shelves on the wall nearby the kitchenette.

The attention is now shifted to the whiteboard (see Figure 2), which is about to be updated by the head nurse. The whiteboard holds an overview of enlisted patients and their status. The nurses always keep it up to date. Yet, sometimes information is entered there by others. For example, if a patient needs to be examined by a physiotherapist, he or she might write an F behind the patients' name on the whiteboard (see an example in Figure 2). This makes the information on the whiteboard relevant for several people and activities. Nearly all professionals, including the ones that hardly ever visit the unit, know that the most recent and updated overview of the state of affairs in the ward is to be found on the whiteboard. As one nurse said during an interview:

> "It's important for us as well as for outsiders. For instance, when someone from the laboratory is here to take blood-samples, they always check the whiteboard before they go find the patient (…) We also frequently move patients, for instance if a man is lying in a double room and two women are admitted to the ward" (Nurse)



1* Room and bed-number
2* Patient name and category (new, surgical or emergency patients). Patients are distributed between two physicians. Patient-names are written in red or blue accordingly.
3* The slash distinguishes between the primary nurse and secondary nurse. The same information is recorded in the nurse documentation.
4* This column denotes the responsible nurse at a particular shift. It is always kept up to date
5* Specific codes and information – for instance, direct referral to the physiotherapist (F)
6* Diverse information. E.g. future plans for a patient like date and place to where he or she is transferred when being discharged from the ward.

Figure 2: The whiteboard that holds an overview of all admitted patients

While updating the whiteboard, the head nurse makes sure that the patients are distributed evenly among the nurses on the oncoming shift. Because this is a primary care unit, people more or less know in advance which patients they will be responsible for. In addition, she writes the names of the primary and secondary nurse on the whiteboard. In cases of doubt, if, for example a patient is re-admitted to the ward, the information is also recorded in the main card in the nursing documentation.

A nurse makes a remark while looking at the whiteboard:

Nurse A:	For how long are we actually going to have Sigrid in 9.2. at our ward? She disturbs the other patients and she denies taking her medicine.
Nurse B:	I thought she had been referred to the local nursing care centre?
Head nurse:	We have sent an application, but haven't got any answer yet [she writes '*application to home nursing care*' behind the nurses' name on the whiteboard – see figure]
Nurse A:	We need to get rid of her, she doesn't actually belong here. Even her daughters want her out of here.
Head nurse:	I'll see what I can do. I'll try to speak to our head physician, maybe he can help us.

Many of the patients suffering from a rheumatic disorder are old and in some cases mentally disturbed (which is the case in the example above). These types of patients might behave quite unpredictably and thus nursing them might involve a lot of work. The patient discussed in the extract above is waiting to be transferred to a local nursing home. However, this process might take some time. In this case it obviously has taken too long. In order to speed up the process, the head nurse promises to talk to the head physician. Notice how the head nurse also enters the information on the whiteboard. This is done to communicate to all nurses, including those not working in this shift, that an effort is being made to handle the problem.

Also, in updating the whiteboard, the head nurse makes sure that newly admitted patients are divided evenly between the two assistant physicians working on the ward. The distinction is easily visible as names are written in red or blue, matching the color of the two binders holding the medical charts (see example of the bleu medical chart in Figure 1). In fact, the act of writing new patient names on the whiteboard is only a small element in a long chain of performances made by several, people and artifacts. A professional evaluation made by the chief physician decides who is going to be admitted and who is not. The decision is documented in the admission plan. Prior to the arrival of the patients, their names are copied from the admission plan into the program-book, which again is kept in the meeting room easily available for nurses and others to write messages in. Because she has participated in this longer chain of events, the head nurse does not merely copy new names from the program book to the whiteboard. In the process she also talks about the patients, and in that sense shares her personal knowledge about them with the rest of the nurses.

Finally, the head nurse reads out loud the program of the day. This concludes the formal meeting. The program of the day is written in a book, which is normally kept in the meeting room, and typically includes practical things and messages as well as X-ray schedules and the surgery plan. That is, the surgery plans are not entered directly into the program book, but rather a copy of it has been downloaded from the EPR the day before and put into the program-book. It is important to know about 'surgery patients' and when they have been scheduled for surgery as, among other things, they have to go through preoperative and postoperative procedures. This is also underscored on the whiteboard, a remark saying 'surgery' is written behind the names of surgery patients.

5. DISCUSSION

A main objective with electronic based nursing plans is to replace and integrate information found in an assembly of heterogeneous, redundant and informal information sources. The implementation of such a tool is however a complex undertaking and more often than not it fails to produce the anticipated effects. In this chapter we elaborate further on how plans are heterogeneously distributed and how redundant information and informal documentation practices contribute to, and are a part of, robust plans.

5.1 The heterogeneity in planning

From time to time, in our case at regular intervals, various entities are drawn together in order to make a coherent account of the state of affairs and plan future events. This is evidently the case with Anne. The report is an outcome of a rather intricate, contingent and heterogeneous process. It is, in effect, a product of the various entities that enter the scene in the process of producing the report. For instance information about the medication is not remembered by Anne, but by the surgery form. In locating it, another actor, John, is introduced. Hence the final sentence "*Got seloken during the operation without any effect*" is the product of the effort of a network that includes Anne, John, the surgery form, the written report and the fact that it was Anne and John that picked up the patient from intensive care.

In Anne's case, notice also how the output is in fact not reducible to one artifact alone (e.g. the written report). Information sources serve different purposes and are used differently in different situations. Hence in many cases they are purposely put in various places, for example information about the next X-ray is entered into the main card because it is where Anne expects other nurses to search for it; the insertion of the post-it note in a certain spot on the main card; the phone call to the public administration office and so on. Information about the state of affairs and future events is in fact deliberately distributed across several material artifacts as well as people. This makes the process of handing over information to the next shift irreducible to the written report alone. Equally important are the oral handover conference taking place just afterwards, the oncoming nurses' familiarity with the patient, the place where the handover is carried out, the availability of the different documents, and so on.

The same line of reasoning is applicable to the second example. The distribution of patients is made collectively available through the act of updating the whiteboard. However, it is not a performance of the head nurse alone;, rather it is an accomplishment of a network including all the nurses, the whiteboard, the patient list, the program book, and so on. In the process, information is not merely transferred between entities. Rather it is being distributed on several entities. Yet, what appears to be a duplicate is not necessarily so as information entities are changed in the process of making and using them. As [39] put it:

> "Information simply cannot be transmitted between settings without also being changed, as information is tied to its materiality" (p. 47)

By commenting on each patient while entering the names of the patients onto the whiteboard, the head nurse is simultaneously sharing her personal knowledge with the rest of the nurses. The information appearing on the whiteboard is in this sense not only a copy of the names found in the program, because, in the process, the knowledge attached to them is changed.

Planning entails more than filling in and reading off forms, whiteboard or the like. Neither the report, as illustrated by Anne or the handing over of information by Per, nor the distribution of responsibility by the head nurse can be depicted only as processes of moving (or transmitting) information. Rather, they are all processes of transforming information entities with the purpose of making them fit with a specific sociotechnical practice. The plan is in this sense in effect heterogeneously distributed in time and space and needs to be acknowledged as such in the design and implementation of electronically based nursing plans.

5.2 The redundancy in heterogeneity

In the theory section it was described how the design and implementation of nursing plans are embedded in an arena of competing interests (managerial, professional, vendor, practice, and so on). Making them work in practice thus entails finding a

realistic balance between the documentation of tasks and the natural flow of carrying out these tasks ([33]).

On one hand, embedding the plan into one artifact seems appealing as it may simplify both organizational information and work and contribute to fulfilling objectives related to e.g. organizational accountability. On the other hand, several studies have pointed that overlapping information sources and redundancies indeed have a role to play, as they are potential sources for reliability in collaborative work (see e.g. [6][10][19][36]). The redundant character of artifacts and information contributes in making components robust since if "one component fails for lack of knowledge, the whole system does not grind to halt" [19] (p. 86). In addition, information from different information sources may be compared in order to ensure proper information quality. This important role of artifacts and redundancy imply that people must pay attention to work context well beyond their primary work tasks.

One recent conceptualization of redundancy is put forward by [6] (pp. 159-161). A distinction is made between redundancy of functions, efforts and data. Redundancy of functions is referred to as the overlap in skills among people that enables a seamless flow of work and/or substitution of labor. Redundancy of effort is referred to as the repetition of tasks by one or more persons, while redundancy of data denote the existence of the same data entities in several places (for this latter category, see also [10]). As will be illustrated below, all these various forms of redundancy can be discerned also in our case. Given the heterogeneous nature of planning, we furthermore claim that redundancy is always in the making. It is an ongoing process of questioning, negotiating and validating. Finally redundancy might serve secondary purposes like alleviating frustration, enabling different focus of attention, building trust, etc.

Heterogeneity absorbs redundancy, and as illustrated in both our examples, redundancy is crucial for the ongoing accomplishment of work. Perhaps the most obvious example is the patient list. Information found on the list is copied there from various entities. The list thus exemplifies what Cabitza et al. [6] would call redundancy of data, as does the whiteboard, the program-book and even the oral account provided by the reporting nurse. Assuming that information is tied to its materiality (see also [16]), these artifacts are however not identical.

To clarify our argument let us return to Anne and the production of the report. In Anne's case a coherent account is not produced despite of, but rather because of the existence several, distributed and redundant entities (including redundant functions, efforts and data). For instance, she is asking John (cf. redundancy of functions), she is drawing on the list (cf. redundancy of data), she is checking the surgery form twice (cf. redundancy of effort), and so on. Redundant information is also produced in the process. As illustrated in figure 1, the written report is more or less containing elements of information also documented elsewhere. Despite the fact that all forms and documents are available for, and used by, the oncoming nurse, it is exactly the redundant feature of the written report that enables an efficient and high-quality handover. Anne explains why:

> "I know that a lot of the information in the report is also written elsewhere. Still I write it in the report to make sure she [nurse starting the next shift] is aware of my main observations and medication. It's important for her and helps her find out what to focus on, where to look for more detailed information [different forms], and so on" (Nurse)

Anne's explanation is valid also for the second example. In the collective process of distributing patients, elements of information are intentionally made redundant in order to facilitate various functions. For instance, when the head nurse writes '*application to home nursing care'* on the whiteboard behind the name of the patient that is frequently stirring up the ward, it is not a planned act, but rather carried out because of an escalating discussion among the nurses. The content of the whiteboard is in this sense negotiated in response to changes in its surrounding network. Information is made redundant because it serves a specific purpose. When recorded, the remark serves the purpose of continuously reminding the group of nurses that an effort is being done to solve the problem.

Health care relies on a mixture of formal and informal concerns [26] and here we have merely touched the surface of the issue. Still it is our observation that that reducing redundancy and circumventing informal practices are largely framing current efforts of introducing EPR's in modern hospitals [17][31] So far, though, the results have been disappointing. Fully integrated EPRs' are rare [15]. Hence the growing body of literature addressing the relevance, and indeed the importance of redundancy in health care work [6][10][36], is highly welcome as it evidently plays a crucial role in the production of coherent and effective health care services.

6. CONCLUSION AND IMPLICATIONS

There is planning but no plans. The prevailing perception of an almost total lack of use of nursing plans is ill founded and ultimately misconstrued. The practice of planning does not take place through the filling out and subsequent 'use' of a (paper-based or electronic) nursing plan. Rather planning unfolds (i) distributed across a network of material/technological and human resources and (ii) continuously through ongoing and negotiated additions, deletions and changes. The official nursing plan, which is hardly visible in our case, is in this sense merely a node in a network of interconnected, mutually dependent nodes of material arrangements, practices and different professionals.

Planning is a process where information entities are continuously contextualised and de-contextualised to make them relevant for particular events or to adapt them to certain material arrangements (such as the whiteboard). Redundant information entities are created on the spot in order to preserve an efficient, continuous and high quality delivery of care services (i.e. preserve the flow of work). It is this heterogeneity of information sources that finally makes up for, and serves as a premise for, a high-quality nursing plan. Thus, in practice, the plan should be conceptualized as a multitude of relations that are constantly changed, altered, and negotiated in response to changes in the surrounding nodes that constitute its heterogeneous network.

We outline two aspects that follow from our analysis. Firstly, the implicit, at times explicit attempts to cram planning into one, singular artifact is misconstrued. Rather than designing *the* nursing plan, planning should be supported in a distributed manner and embedded in the many, existing information systems. Secondly, the dangers or, indeed, 'the problem' of duplicated and redundant information are readily understandable – but exaggerated. Robust, and effective planning presupposes a certain level of redundancy (see e.g. [10][29]). By this we do not claim

that our focus should be only on the consequences of reducing redundancy based in the old work practice as the expression of redundancy (and artifacts used) may change and new forms of redundancy may be shaped when as technologies are being implemented.

Future research needs to further explore the role of informal and redundant information sources in healthcare work. This involves in particular situations where new technologies (such as electronic based nursing plans) are being introduced into existing work-practices. Also, the interconnected, and mutually dependent entities of material arrangements, practices and different professionals underscore the need for doing empirical studies that follow the whole process of implementing a new system (before, during and after). Such studies may reveal both explicit and implicit dependencies that must be taken into account. They may also indicate how, and to what degree, a new system is used, as this may not be entirely clear to the users themselves.

7. ACKNOWLEDGMENTS

We would like to thank the staff at the Department of Rheumatology at the St Olav hospital who participated in this study. Also thanks to Birgit Krogstie, who edited the last draft of the paper.

8. REFERENCES

[1] Atkinson, P. *Medical talk and medical work*. Sage Publications Ltd. 1995

[2] Berg, M. and Timmermans, S. Orders and their others: on the constitution of universalities in medical work. *Configurations* 8, 31-61. 2000.

[3] Berg, M. Accumulating and coordinating: occasions for information technologies in medical work. *Computer supported cooperative work*, 8: 373-401. 1999.

[4] Berg, M. *Rationalizing medical work: decision-support techniques and medical practices*. Cambridge, Mass. : MIT Press. 1997

[5] Björvell, C., Wredling, R. and Thorell-Ekstrand, I. Long-term increase in quality of nursing documentation: effects of a comprehensive intervention, *Scand J Caring Sci*; 16; 34–42. 2002.

[6] Cabitza, F., Sarini, M., Simone, C., Telaro, M. When once is not enough: the role of redundancy in a hospital ward setting. *GROUP 2005*: 158-167. 2005

[7] Devers, K.J., Casalino, L.P., Rudell, L.S, Stoddard, J.J., Brewster, L.R. and Lake, T. K. Hospitals' Negotiating Leverage with Health Plans: How and Why Has It Changed? *HSR: Health Services Research* 38:1, 419-446. 2003.

[8] Dips. *Sykepleiedokumentasjon i Dips*. http://www.dips.no/dipsnew.nsf/d8008ff72aa2b44dc1256b3e004c5b12/0b430e9f46b06b32c1256b4c003501ea?OpenDocument. 2005 (accessed May 24th 2007).

[9] Eisenhardt, K. M. Building Theories from Case Study Research. *Academy of Management Review*, Vol. 14, No. 4, pp. 532-550. 1989

[10] Ellingsen, G. and Monteiro, E. A patchwork planet: Integration and Cooperation in hospitals. *Computer Supported Cooperative Work*. 12(1), 71-95. 2003

[11] Forum for ICT. *Dokumentasjon av sykepleie i pasientjournalen. En veileder fra Sykepleiernes forum for IKT og Dokumentasjon*. Versjon 1.1 – August 2002.

[12] Fetterman, D.M. *Ethnography*, Second edition. SAGE Publications, Thousand Oaks, CA. 1998

[13] Freidson, E. *Profession of Medicine: A Study of the Sociology of Applied Knowledge*. The MIT Press. 1970

[14] Getty, M. A comparative study of the attitudes of users and non-users towards computerized care planning, *Journal of Clinical Nursing*, vol 8, 431-439. 1999

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

[16] Hayles, K. How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics. Chicago: The University of Chicago Press. 1999

[17] Hellesø, R. and Ruland, C.M. Developing a module for nursing documentation integrated in the electronic patient record, *Journal of Clinical Nursing*, 10: 799-805. 2001

[18] Hong, L.K., Duff, R.W. Modulated Participant-Observation: Managing the Dilemma of Distance in Field Research. *Field Methods* 14(2,):190–196. Sage Publications. 2002

[19] Hutchins, E. Cognition in the Wild, Cambridge, MA: MIT Press. 1995.

[20] KITH. *Kravspesifikasjon for elektronisk dokumentasjon av sykepleie, Nasjonal standard*, http://www.kith.no/upload/1101/R12-03DokumentasjonSykepleie-rev1_1-NasjonalStandard.pdf 2003a. (accessed May 24th 2007).

[21] KITH. *Veileder for elektronisk dokumentasjon av sykepleie*, KITH Rapport R 14/03. 2003b

[22] Klein, H.K. and Myers, M.D. A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly* 23(1): 67-94. 1999.

[23] Lee, T.T. and Chang, P.C. Standardized care plans: experiences of nurses in Taiwan, *Journal of Clinical Nursing* 13, 33–40. 2004

[24] Lee, T.T. Nurses' concerns about using information systems: analysis of comments on a computerized nursing care plan system in Taiwan, *Journal of Clinical Nursing* 14, 344–353. 2005

[25] Lee, T.T., Yeh, C.H. and Ho, L.H. Application of a computerized nursing care plan system in one hospital, *Journal of Advanced Nursing* 39(1), 61–67. 2002

[26] Moser, I., Law, J. Fluids or flows? Information and qualculation in medical practice. *Information Technology & People.* 19(1) 55-73. 2006

[27] Munkvold G. and Divitini M. From storytelling to reporting - converted narratives, *in Proceedings of MCIS'06, the Mediterranean Conference on Information Systems*, October 2006 Venice, Italy 2006.

[28] Munkvold G., Ellingsen G. and Koksvik H. Formalizing work – reallocating redundancy, *in Proceedings of the 2006 20th anniversary conference on Computer Supported Cooperative Work (CSCW)*, November 2006, Banff, Canada

[29] Perrow, C. *Normal accidents: Living with high-risk technologies*. New York: Basic Books. 1984

[30] Reed, J. and Stanley, D. Improving communication between hospitals and care homes: the development of a daily living plan for older people, *Health and Social Care in the Community* 11(4), 356–363. 2003

[31] Sexton, A., Chan, C., Elliot, M., Stuart, J., Jayasuriya, R. and Crookes, P. Nursing handovers: do we really need them? *Journal of Nursing Management*. 12, 37–42. 2004

[32] Suchman, L. *Plans and Situated Action: The Problem of Human-Machine Communications*. Cambridge: Cambridge University Press. 1987

[33] Svenningsen, S. *Electronic Patient Records and Medical Practice: Reorganization of Roles, Responsibilities, and Risks*. Copenhagen Business School. 2003.

[34] Timmons, S. Nurses resisting information technology, *Nursing Inquiry*, 10 (4): 257-269. 2003

[35] Tjora, A. *Aksjonskollektivet: Samarbeid og bruk av teknologi i akuttmedisinsk koordinering*. Trondheim: G-Academy, 137 s. 2002.

[36] Tjora, A. Maintaining Redundancy in the Coordination of Medical Emergencies. *Proceedings of the Conference on Computer Supported Cooperative Work CSCW'04*, Chicago, Illinois, USA, pp. 132-141. 2004

[37] Voutilainen, P., Isola, A. and Muurinen, S. Nursing documentation in nursing homes – state-of-the-art and implications for quality improvement, *Scand J Caring Sci*; 18; 72–81. 2004

[38] Waters, K.R. Individualized care: is it possible to plan and carry out? *Journal of Advanced Nursing*, 29(1), 79-87. 1999

[39] Winthereik, B. R. and Vikkelsø, S. ICT and Integrated Care: Some Dilemmas of Standardising Inter-Organisational Communication. *Computer Supported Cooperative Work*, vol. 14, pp. 43-67. 2005

[40] Zuboff, S. *In the Age of the Smart Machine: The Future of Work and Power*. New York, NY: Basic Books. 1988

Paper four:
Formalizing work – reallocating redundancy

Formalizing Work – Reallocating Redundancy

Glenn Munkvold
Nord-Trøndelag University College
Department of Information Technology
7729 Steinkjer
Norway
(+47) 7359 3980
glenn.munkvold@idi.ntnu.no

Gunnar Ellingsen
University of Tromsø
Department of Telemedicine
9037 Tromsø
Norway
(+47) 7762 6121
gunnar.ellingsen@unn.no

Hege Koksvik
Trondheim University Hospital
Department of Rheumatology
7006 Trondheim
Norway
(+47) 7386 7990
hege.koksvik@stolav.no

ABSTRACT
This paper reports from an introduction of the electronic patient record for nurses in a Norwegian hospital. In addition to establish electronic written accounts of nurses' reports, a major aim was to formalize nurses' work, related to handover conferences. Despite the projects proclaimed success, like reduced overtime, improved quality of the written documentation and eliminated redundancy, our analysis demonstrates an opposite effect. Formalizing the nursing handover and thus reduce redundancy, in fact resulted in a reintroduction of redundancy, although at another time and place. We found that work (and redundancy) in fact had moved, to another time (i), into different artifacts (ii), or old artifacts that now were used/annotated differently (iii).

Categories and Subject Descriptors
J.3 [**Computer Applications**]: Life and Medical Sciences – Medical Information Systems

K.4.3 [**Computers and Society**]: Organizational Impacts - Computer-supported collaborative work

General Terms
Documentation, Human Factors, Theory

Keywords
Collaboration, Coordination, Transformation, Redundancy, Formal, Informal, Nursing, Health Care Work.

1. INTRODUCTION
Maintaining continuity of treatment and care within, and across institutional boundaries is a major concern in modern health care institutions. With the nature of health care work increasingly becoming fragmented, specialized and distributed, ensuring a coherent and effective delivery of care is considered to be a major challenge [14]. Important means to deal with this situation have been the formalization of health care work in general, and the electronic patient record (EPR) in particular [6], [42]. The EPR, as well as other similar technologies that aid collaboration and coordination among health care providers, have thus become a significant setting for enquiries in the field of Computer Supported Cooperative Work (CSCW) [4], [8], [10], [12], [18], [20], [39].

In this paper we look at collaboration in the context of the nursing handover conferences, which is an important arena for ensuring continuity of care within hospitals. With nurses being the ones "who weave together the many facets of the [health care] service and create order in a fast flowing and turbulent work environment" [1] (p 279), they are a particularly interesting group to study.

Historically, the ways nurses organize their work and carry out their responsibilities have relied on an oral practice to communicate patients' conditions across shifts. Informal practices (for instance oral practice and personalized recordings) have been used extensively at the expense of formal, written documentation and specific facts [17], [31]. The lack of formal practice has also implied that nurses have used a large amount of heterogeneous, redundant information sources, that often is referred to as causes of reduced quality and low efficiency [3].

Concretely, we have followed the implementation of an EPR for nurses in the Department of Rheumatology at Trondheim University Hospital in Norway. In addition to establish electronic written accounts of nurses' reports, a major aim was to formalize nurses' work, related to handover conferences. A part of this process was to eliminate superfluous information sources and routines.

Despite the proclaimed project success, e.g. reduced overtime, improved quality of the written documentation and eliminated redundancy, our analysis demonstrates an opposite effect. Formalizing the nursing handover and thus reduce redundancy, in fact resulted in a reintroduction of redundancy, although at another time and place. We found that work (and redundancy) in fact had moved, to another time (i), into different artifacts (ii), or old artifacts that now were used/annotated differently (iii). Hence, attempts to formalize by removing unstructured aspects of nurses work, introduced new types of informal elements. More concretely, we proceed along the following dimensions:

Firstly, we explore the role of redundancy in the oral practice in the traditional nursing handover conferences. These conferences involve a lot of redundant information, typically when the nurses share information about the patients, and discuss various care strategies. A major motivation with the EPR was to formalize documentation and thus reduce redundant information in the handover process. We aim at having a deeper understanding of the implications of this, thus aligning ourselves with previous research in the CSCW field [10], [12], [32], [39].

Secondly, we focus on how redundancy was hard to eliminate in the implementation process. Indeed, redundancy was not eliminated; it was rather transformed into new artifacts and practices. We explore how. By this, we also extend the debate in the CSCW field that traditionally has focused on how tools *support* work rather than how a network of people and artifacts may change as a co-construction [4], [12], [18], [40], [42].

Thirdly, and perhaps more disturbingly, lending ourselves to recent achievements in Science and Technology Studies [5], [29] we focus on how initial formalizing efforts in reality reintroduces even more informal work and redundancy, but now largely hidden and disguised. We demonstrate how an informal practice (the initial problem) became part of the solution in order to make the new formal practice work.

The remainder of this paper is organized as follows. First we elaborate further on the theoretical basis for our analysis. We then describe the setting for our empirical investigation and describe the method used followed by a description of the case. Finally we analyze and discuss our findings and draw some implications.

2. THEORY

The nursing handover has received considerable attention in traditional nursing literature and have been identified as crucial to ensure coherence and continuity over the patient trajectory [24], [25]. With the handover predominantly being carried out orally, inefficient completion and its negative effect on the written documentation have been some of its major quandaries [7], [37].

With such a point of departure, we don't intend to engage in a debate arguing for either oral or written accounts. We just note that traditionally there has been a close relationship between written and oral accounts in the organization of medical work [2]. Therefore, there is no straightforward solution on how much this practice can be formalized and how much should remain oral.

Still we cannot ignore that nursing documentation has gained a lot of international attention lately, especially as hospitals have implemented EPR's [13], [30]. The same trend can also be observed in Norway [21]. Formalizing nurses' work is a major aim:

> "Written handover may lead to an increased focus on ensuring accurate and thorough nursing documentation and improved utilization of nursing care plans, as these become the primary focus for patient care delivery" [37] (p 42)

As the quote underscores, written documentation and care plans are at the centre of patient care delivery, (apparently) making other information sources and oral practices candidates for removal.

In one way, this idea seems appealing as it may simplify organization, information and work. However, studies in the CSCW field have pointed out that overlapping information sources and redundancies indeed have a role to play. Redundancies are a potential source for reliability in collaborative work [12], [23], [39]. The redundant character of artifacts and information contributes in making components robust since if "one component fails for lack of knowledge, the whole system does not grind to halt" [12] (p 86). In addition, information from different information sources may be compared in order to ensure proper information quality. This important role of artifacts and redundancy imply that people must pay attention to work context well beyond their primary work tasks. An instance of this is typically the handover conferences between nursing shifts.

Research on redundancy has by and large centered on existing work practices and the consequences of eliminating them (see for instance, [10], [12], [23], [32], [39]**)**. This strand of research is conforming to the traditional CSCW literature, emphasizing how people actually conduct their work:

> "One of the striking features of the CSCW literature is the way many designers try to respect the ways people actually organize and use information" [27] (p 84)

Another strand of research in the field of Computer Supported Cooperative Work (CSCW) has been on the focus on tools and artifacts to support distributed work. Usually these tools are recognized as being singular or standalone. For example paper-artifacts, shared information displays and monitors [19], shared electronic workspaces [33], non-digital editable large displays [34] or regular off-the-shelf products [15].

While much of the CSCW literature has focused on 'tools' and 'support', it has to a minor degree focused on how this relationship might induce change, both in the work practice and in the tool itself. [4] (p 385) denotes this as the tool's transformative potential.

> "The mutual activities of tools and staff members are made possible through their interrelation, and, at the very same time, this interrelation affords the emergence of an overall activity that surpasses the individual contributions that both could be discerned to have"

When the tool perspective considers IT more or less independently of the social context [35], it fails to explain the fluid relationship between the social and the technological. Accordingly, we move beyond the traditional support perspective and rather take a co-construction approach, underscoring that the tool and the work-practice shape each other. By this, we emphasize the process rather than the product. The technologies are rather shaped as processes, where the technology (EPR) continuously interacts with work practice as a co-construction. With that we argue that new tools are not merely technical or neutral devices ready to be put into use. Rather they are constructed or achieved as results of negotiation processes [9], [16], [28]. Acknowledging this perspective, we aim at understanding exactly why and how this co-construction emerges.

Taking into account a co-constructive perspective on the implementation of new technology, we also argue that the traditional view on redundancy must be reconsidered. Traditionally, researchers in the CSCW field have pointed out the consequences of reducing redundancy based in the old work practice. In a co-construction perspective the expressions of redundancy and the artifacts used may also change along similar lines, thus new forms of redundancy may be shaped in the process.

Moving our point a bit further, recent progress in science and technology studies [5], [29] has underscored how formality and informality are two sides of the same coin. That is, the formal and informal are opposites, but still defines each other

> "[T]he formal has its Other, the informal, which it simultaneously creates, rejects, and incorporates" [5] (p. 57)

This also implies that:

> "The informal (…) does not precede the formal; it only comes into being *with* the formal" [5] (p. 45).

A formal work practice defines borders for its hegemony. What is beyond its borders is therefore informality. So, to instantiate our practical point, pressing too hard on a more formal work practice will inevitably induce changes to the related informal practice, perhaps requiring even more informality (and redundancy). Ultimately, the new formal practice may produce the very informal practice it attempts to replace. As John Law [29](p. 14) has observed in his work with complex systems:

> "[T]he search for system perfection [a complete formal work practice] is not only impossible but, more strongly, it may be self defeating"

3. METHOD

Our study is carried out in the Department of Rheumatology at Trondheim University Hospital, which is one of the 5 university hospitals in Norway. The department's in-patient ward has 18 beds and treats 650 patients a year with an average length of stay of 8 days. The medical focus is on chronic inflammatory rheumatic diseases such as inflammatory joint diseases, spondylarthropathies and connective tissue diseases. Patients are admitted to the inpatient ward both for medical treatment and surgery.

The complex need of the patients requires that the nurses need to master a whole range of skills. Nurses working at the in-patient ward have many tasks. Rheumatic diseases are chronic conditions and the nature of the diseases are that patients require different types of nursing input at different times. Therefore the nursing input to care can vary from very essentials of nursing such as help with the activities of daily living to post-surgery observations, pain management, maintaining tissue viability, patient education, reviewing symptoms, management of drug regimens, management of intravenous drug therapy, providing access to other healthcare givers, and counseling patients who are anxious, depressed or have psychosocial problems.

The problems faced by the patients can be multiple and complex, and various health care professionals with different areas of expertise are often involved in the treatment. Importance is therefore attached to communication, quality and continuity of care. Continuity depends on the existence of effective mechanisms of communication between all health care members, and in particular the nurses from one shift to the other. Clear and accurate communication is pivotal to delivering high quality care. One can assume that inconsistent methods of determining and communicating patient care could impact negatively on nursing care. Handover is a commonly used communication medium and is essential to the continuous provision of quality care. The purpose of the handover is to communicate patient information, to provide staff with avenues to informally debrief, clarify and exchange patient information.

Methodologically this work remains within an interpretive research tradition [26], [41] focusing on specific technologies in specific activities. As Chaiklin puts it we "take concrete, meaningful societal practices as a direct object of study" [11] (p .384). We follow a growing body of research that have become to be known as workplace studies [19], [36], [38], [39]. This approach is also being applied in numerous information systems research studies in the health care context [4], [8], [12], [18], [20], [40].

The first author has been following the introduction of electronic based nurse documentation at the department, looking at the process of integrating them into the nursing practice. Although he doesn't have any formal nursing qualifications, he worked four weeks as a nursing assistant at the same ward, six months prior to the launch of the project. The second author has studied the introduction of electronic patient records at another university hospital in Norway for several years. The third author is working as a research nurse at the department. She has been deeply involved in the introduction of electronic based nursing records and the formation of the new handover-conference.

Having spent four weeks working as a nursing assistant, six months prior to the project, the first author already knew most of the people working in the department. Consequently he didn't have to use too much time explaining his presence and involvement in the project. He had already gained legitimacy and become a trusted member of the community, without going native [22].

The empirical material was collected from November 2004 to December 2005, primarily by the first, but also by the third author. Main methods of data collection were an alternation between participant observation and semi-structured interviews, techniques well known within the interpretative information systems research tradition [41]. Collected data include approximately 450 hours of observation, tape recording of handovers and meetings, 31 interviews, examination of various formal and informal documents and informal discussions with employees. To capture the 'non-movable' aspects of nursing (e.g. paper-based medical record, the chart, smaller notes, nurses personal notes, etc) a digital camera was used. The first author also had access to project documentation, emails, etc within the project.

Observations have been carried out at all hours to cover all nursing shifts. However, the majority of them have taken place during the day and the evening shift. In this sense main handovers, which included both departing and arriving shifts, have been attended. Handwritten fieldnotes were taken during the observations and transcribed immediately afterwards. During observation sessions documentary material like the Kardex, care plans, running notes, nurses' personal notes, procedures and task guidelines, and so on were collected to supplement the observations.

Interviews were primarily accomplished with nurses working at the ward, but also with project managers as well as representatives from the EPR-vendor.

Regularly during the fieldwork, data has been validated through discussion with key informants as well as transcripts being read by informants for approval and verification of their content.

4. CASE

In the Department of Rheumatology oral communication was extensively used as a way to pass on information between shifts and informal and personalized recordings of work were used at the expense of formal, written documentation. From January 2005 to June 2005 this practice was changed. Written documentation replaced oral interaction and formal records were emphasized at the expense of informal, ad-hoc documents. Below the overall process is described. First we elaborate on the rationale for restructuring the handover, then we describe how it was transformed and finally we present some early results.

4.1 Relevance and Low Quality

Initially, the nurses had identified two problems with the handover conferences. Firstly, the conferences were considered to be lengthy and inefficient. Irrelevant, at times speculative information as well as data formally documented in the official record was communicated. Meaning sometimes the nurses just spent too much time talking about patients. Other times they just weren't synchronized, in the sense that they didn't have any prearranged agreement on 'who should report next'. Hence the oncoming shift was at times left alone waiting for the next nurse to show up. This lack of structure often brought about overtime and frustration among the nurses.

Secondly, it was a quality issue. Information was not properly documented in the right places. Some of the EPR-documents, like the nursing care plan, were hardly used while others where used beyond their application area. It was common practice to duplicate information. For instance, information that was mainly to be recorded in the patient chart was also recorded in the written report, the patient list, various observation forms, etc. This was considered a major source of error, and failing to comply with their commitment to creating a coherent and effective health care service. More specifically, the written reports was said to contain too much redundant and irrelevant information. For patients being admitted for longer periods, the reports became rather extensive, making it difficult to get an overview of the patient case.

To illustrate the problems encountered by the nurses, now we provide an example of the handover conference as it was carried out prior to the project.

The old handover conference took place in a small room called the interviewing room. Two couches encircling a small table and a TV placed in one corner made the room usable for various purposes. For instance, both patients and staff used it for social purposes. Three o'clock in the afternoon, the oncoming shift had seated themselves in the adjacent couches. By now the leaving shift was finished writing the report and ready to hand over tasks and responsibilities. One after another nurses from the leaving shift turned up, each carrying a binder for their admitted patient and a patient list. The binder contained formal documents to be kept aside for the paper-based patient record. The list on the other hand was an overview of all admitted patients arranged after which room they were lying in. It contained extracted information about diagnosis, treatment and other things relevant for the care provided by the nurses. Its usage, however, was limited to a certain work-shift as it was marked for destruction at the end of every shift.

The brief itself took form as a story. Structured by the patient list, told by the reporting nurse and commonly commented on by one or more nurses from the oncoming shift. All patients on the ward were reported on while oncoming nurses listened and took personal notes on their own blank patient list. We enter the scene as Anne, an experienced nurse, is about to hand over information on a patient. The patient is well known among the nurses as he has been committed to the ward several times earlier. While talking, Anne lends herself to the patient list.

> Anne: room 610-4: doctor Petersen from the Dept. of Orthopedics have looked at the foot (…) He has to discuss with other physicians at the ward what to do with the patient
> Evening shift nurse Jon: Was it the toe?
> Anne: Yes
> Evening shift nurse Jon: But Doctor Larsen has looked at that toe earlier
> Anne: Yes, but doctor Petersen wanted to discuss it with his 'mates' in our ward [physicians working at the rheumatology ward]… so they are discussing and discussing, and I think that's the only remaining issue on this patient.
> Evening shift nurse Lise: Does that mean that the patient does not have the old diagnosis?
> Evening shift nurse Olav: No, it only means that she has an abscess on/in the toe
> Anne: Yes, that's right.

This type of interaction was very common and often there were long discussions around difficult patient cases. Even though Anne didn't use the written report while briefing, it had been updated prior to the brief.

This day, as often happened, the overall brief exceeded the standard half hour. A couple of times the oncoming shift was even left alone waiting for next reporting nurse to show up, hence the clock was almost 15.50 before the last reporting nurse had completed her brief.

Afterwards the oncoming shift gathered in the meeting room. By means of a large whiteboard admitted patients were divided between the nurses. More often than not, the allocation of patients among the nurses was negotiated. Sometimes due to the rotation scheme, as neither the primary nor the secondary nurses were on duty. Other times because some patients were more demanding than others, making it important to distribute them evenly among the nurses. Afterwards, collective tasks were assigned to individual nurses; for instance tasks like printing out the X-ray program, delivering blood-samples, preparing coffee for the patents, and so on.

Throughout the process different artifacts and people came into play. The report which was written prior to the handover conference; the patient list which had been used throughout the watch, but became crucial at moments of coordination; the nurses; the whiteboard; the discussions around patients, etc. Hence, the accomplishment of the handover was not reducible to the reporting nurse alone. It was rather an accomplishment of a network of people and bits and pieces of information heterogeneously distributed in time and place. Elements of information were found in the binder, the patient list and information provided by the oncoming nurses as well as the reporting nurse.

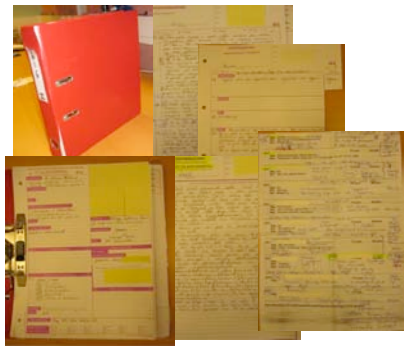


Figure 1: Formal and informal documents used by nurses during the oral handover conference

For the purpose of the handover, among the most important documents were the written report (updated at the end of each shift) and the patient list.

A common feature in all documents, formal as well as informal, was their embedded redundancy. Take for instance the written report found in the binder:

> The patient is disoriented. She is weak, and most of the day she has been sleeping in a chair in the living room. Her daughter has been here today with new clothes. She thought that her mothers' condition has deteriorated. (p5) Patient is referred to a CT scanning of the pelvic tomorrow at 14.00. Fast from 10.00 and drink gastrografin [contrast fluid] from 12.00. Blood samples have been ordered on Monday. Analgesic has been increased to 1gx4. Observe effect during this weekend. Nurse P. Olsen

A lot of this information was also documented elsewhere. Information about the CT scanning could be found in the X-ray program and analgesics in the patient chart. Some parts of the content were also mentioned in previous reports while other parts were indications of future activities. For instance, remarks about the patients' disorientation were mentioned several places in previous written reports and the comment about gastrografin was also mentioned a report the next day.

The redundancy involved in both the oral practice of the handover and in the written documentation was considered a considerable problem:

> "… In my opinion, what's dangerous about the oral report is that too much emphasis is put on what people believe and think. E.g. 'I think… my patient seems depressed and miserable…his wife did not turn up yesterday' and all that. Too much talk not relevant for the situation. Maybe more important are things like ' the wound was red yesterday' and 'that pain healing medication does not seem to help the patient' and ' the patient has to be turned to avoid blisters on the heel'… things that are a bit more concrete. This is something we feel has been overshadowed earlier. That is the content hasn't been good enough when communicated orally. To a large degree the report has been too dependent on the person giving the report" (Head Nurse).

4.2 The decision and the solution

Changing the handover conference was closely connected to the expectations related to the concurrent implementation of the electronic based nursing documentation module in the EPR. From the outset, nursing managers in particular, underlined the close connection between the two projects. As expressed by the Tutoring nurse during an interview:

> "My hope for the EPR is that we become better in stating problems, interventions and evaluation [main elements in the theoretical nursing process]. This will help us systematize and improve our thoughts, and is also necessary due to the increased requirements put on written documentation." (Tutoring nurse)

As the EPR should become the standard documentation tool at the hospital, new requirements related to documentation was something the nurses had to comply to. Emphasizing the written accounts in the handover conference was thus a strategy to prepare for the future usage of the EPR.

Gradually oral accounts were going to be replaced by written accounts and paper-based technologies by electronic based technologies. The overall change is illustrated more explicitly in figure 2 below.

A pilot study was carried out to look into how the oral handover could be improved. The recommendation from the pilot study was to restructure the handover conference by establishing a combination of a written and an oral brief. Oncoming nurses were now supposed to start by reading the written documentation and afterwards confer orally with the reporting nurse issues that needed to be clarified.

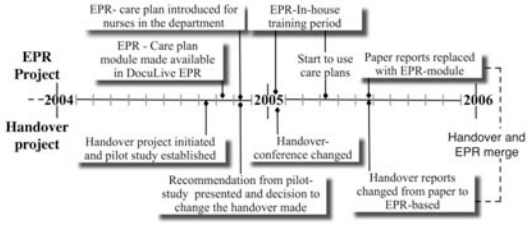


Figure 2: Important milestones in the project.

The change was carried out on two phases. First the handover was changed from oral to written in January 2005. Second, in June 2005, electronic based reports replaced the paper-based report. The report itself was supposed to be written into and read from the EPR. This new practice is described in more detail in the next chapter.

4.3 The new written handover practice

The new handover conference was partly carried out in the nurse's office and partly in departments meeting room. It started at 3 o'clock in the afternoon. By then the leaving shift had already finished writing the report in the EPR and put the binder back into the shelves in the meeting room. The binders had become rather thin, as most of the paper based nursing documentation had been replaced by forms found in the EPR. The oncoming nurses arrived in the meeting room. Here they checked the distribution of

patients that already had been allocated by nurses on the day shift and recorded on a whiteboard in the meeting room, picked up the correct binders and went into the nurses' office to read the documentation.

With most of the nursing documents integrated in the EPR, making it inaccessible while working in the ward, the patient list was typically used to record things to remember and tasks to carry out during the watch. In addition ambiguous issues and questions were written down in order to remember them when conferring with the leaving nurse later on.

Let's take a closer look at this process. We follow Tom, one of the older nurses in the ward. We enter the scene as he is about to start reading on patients that he has been assigned. Tom has seated himself behind one of the computers in the nurses' office. The room is strikingly silent, even though several other nurses are present. With their back turned against the middle of the room, all nurses are deeply concentrated on reading the report. Tom picks up the patient list before opening the EPR. The list helps him remember which patients he has been allocated and thus which patients to search for in the EPR. The first patient has recently undergone a surgery. Tom opens the last report which is dated 13/8 (yesterday). Although a lot of older reports are also available on the screen, Tom only read the last report. I ask why, and he answers:

> "Well it all depends you know. How complex the patient case is. This patient [patient recently undergone a surgery] for instance is rather easy as it more or less is defined in the post-operative procedure what to do. However in other cases things might be more difficult, and then I often go backwards. For instance if the last note indicate that there have been frequent changes in patients condition I usually read backwards to get a better understanding." (Nurse Tom)

Tom continues his reading. From time to time he makes a note on the patient list, which is lying on the table in front of him. Having read on all patients, he returns to the departments meeting room where the nurses from the leaving shift are waiting to give additional information and clear up ambiguities. Tom only talks to nurses that have had the same patients during the day shift. With several simultaneous discussions going on in the room the overall setting appear rather noisy and hectic. While discussing with the first nurse, Tom picks up the patient chart to check the medication. As opposed to the old oral handover, which took place in the smaller meeting room, the patient chart is now available during the brief. It is lying on the conference table in the middle of the room. In fact several nurses use it during the discussions. Also used by several are the patient lists. Not having direct access to the electronic based nurse documentation, the list is commonly used as a reference point during discussions. As is the whiteboard holding information about the allocation of patients.

Officially, around 15.30, all nurses from the day shift should have left the room. However, today three of them are still present. They have all waited patiently for the last oncoming nurse to be available so that that they can have the official discussion. In fact the last reporting nurse doesn't leave before 15.40 after having waited almost ten minutes on another nurse to finish talking with the same oncoming nurse.

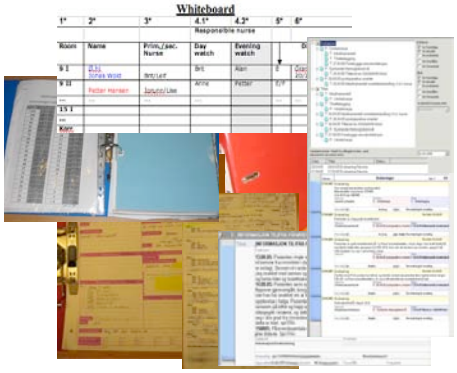


Figure 3: Formal and informal documents used by nurses during the written handover

When the day-shift has left the room, Tom asks every nurse from the oncoming shift to stay put for a couple of minutes. They all gather around the table and provide an oral brief on all admitted patients. This is in fact not a formal part of the handover conference, but initiated by the nurses themselves as they all prefer to have a certain overview of all admitted patients. Structured by the patient list, an account is given for all admitted patients by the various responsible nurses'. E.g. Tom gives a short brief the patients that he has been assigned. Again the list is used for taking notes. Yet during this session some nurses have to leave the room to attend patients that have called them up. Around 16.00 all patients on the list have been reported on. It doesn't take long before the room is emptied and the nurses have started to carry out tasks and responsibilities.

As for the oral handover, in the new written handover various artifacts came into play during the overall process, making the heterogeneity in producing an account even more visible than before. For instance the patient chart and the whiteboard, which were both used extensively during the oral discussion that took place afterwards.

A last interesting observation was the establishment of the weekly summary. Having to handle information that increasingly became more distributed, the nurses felt a need to summarize the information at regular intervals. First of all to make the record easily accessible for nurses that hadn't been on duty for a while. Second, as a marker where important decisions and observations were highlighted.

> "The weekly summary has actually become a necessity because we loose the general view when having to work with so many different documents… for instance the patient chart, various observation forms, care plans, etc." (nurse)

Today, about one year after its introduction, the nurses have agreed to continue handing over information by means of the new written method. As described in the next chapter, according to an internal evaluation, the project was a success.

4.4 Early results

As a part of an internal evaluation, organized by the nurses themselves, time spent on the overall handover was measured over a one-week period prior to and after the change. In addition the nurses completed a questionnaire where one of the questions was to self-report time spent on the nursing documentation throughout the shift. Results from these assessments are illustrated in the tables below.

Table 1: Average time spent using the nurse documentation throughout the watch (in minutes)

	Sept. '04	**May '05**
Day-shift	20	35
Evening-shift	17	16

Table 2: Average time spent on the entire handover (in minutes)

	Sept. '04	**May '05**
Handover - afternoon	41	25

Time spent on the handover was noticeably reduced. Also overtime was reduced:

> "Overtime has decreased significantly" (head nurse)

Figures derived from the questionnaire suggest that the emphasis on the written documentation had increased for the day-shift, but more or less stayed the same for the night shift (see table above). With most of the work being carried out during day-time these figures were not unexpected. In addition, the number of nursing staff was highest during the day. Hence each nurse had fewer patients to handle and more colleagues available to assist if needed. Another interpretation of the figures is that the overall process, both the handover project and the ongoing introduction of the EPR, had made the nurses more attentive to the written documentation in general. They had become more structured in documenting their work. For instance they had become better in updating and using the paper based patient chart, care plans are used more then before and the written reports have become better structured. Since the day-shift knew that the next shift wouldn't get an oral brief, they made sure to put an extra effort in making their written accounts as readable as possible. In particular this was observable for the patient chart, observation forms, and the like. As stated by one of the nurses working night shift:

> "I am impressed how people have improved in updating the patient chart. That simplifies our tidying job a lot" (nurse)

All in all, the figures confirmed that initial objectives were reached (as also partially declared by the nurses themselves). Still the everyday, practical implications of having to follow a new handover and documentation regime could not be derived solely from the numbers in the tables above. This will be further discussed in the next section.

5. DISCUSSION

The discussion is organized as follows. Firstly, we elaborate on redundancy in the oral practice, how it contributes to overview, sensemaking and agreements. In that way, redundancy enabled robust and effective work. Secondly, we present how the reallocation of the use of artifacts actually became a stabilizing mechanism. Thirdly, we illustrate how the initial objective of reducing the informal practices, quite surprisingly, reintroduced those very same practices.

5.1 Redundancy and oral practices

Written documentation has a clear and often more narrow purpose compared to oral accounts. For the nursing profession striving for quality and efficiency through written accounts, this is a dilemma. A lot of important information provided orally in the meetings, is typically ignored in the written accounts, and nurses continuously rely on this information. They often need to understand the whole person to be able to make reasonable judgments on proper care. An example may be related to psychosocial conditions: to understand why a patient behaves the way he does:

> "A patient on the ward has a problem with drugs. In such cases the medicine room is locked at all times and medicine to the patients is locked in there as well and we have one-to-one follow-up on patients that uses medication." (nurse)

The majority of the nurses mentioned the importance of sharing similar (redundant) information about all patients. It was considered a safety issue, as it was crucial that all nurses involved had an accurate understanding of the patient in case of emergency situations

> "Not having an overview implies that we are not as prepared as we should be in cases of emergency… that's not acceptable." (nurse)

Moreover, providing an encouraging atmosphere for patients was also considered to be important. Although environmental therapy is not explicitly visible as a treatment effort, nurses working in this ward inherently strived to obtain sufficient knowledge about all patients as it was considered a fate of good manners.

> "It's nothing more than polite to be able to recognize patients. Look here for instance, I have written crutches behind this patients' name [in the patient list]. In that way I can recognize her when I meet her" (nurse)

> "A patient has digestive trouble, and I have noted this down so that I know when I meet him that I don't provoke by offering food." (nurse)

An interesting aspect of the oral accounts was that it enabled the possibility of including redundant information on the spot. This flexibility enabled the nurse handing over information to decide what should be communicated during the report. He or she could tailor the oral report according the personal preferences, knowledge and experience of the receiving nurse:

> "You know, having the experience from a shift, the reporting nurse should be autonomous in deciding how and what should be conveyed during a brief, as she is the one that has revised plans, recorded observations and has the best knowledge about recent changes in the patient status" (nurse)

What's more, some nurses valued the oral handover because it facilitated a kind of 'debrief' about their activities during the shift.

> "I think the oral report is important because it is a way to reflect on what has happened during this shift and to prepare the next nurse on what to expect during the next one. In this sense the report is useful both for the reporting nurse as well as for the nurse oncoming her shift." (Nurse)

Seemingly similar and redundant information was compared, made sense of and negotiated. Due to the contingent nature of nursing, measures and observations were regularly discussed. With patients suffering from a chronic disorder, nurses usually got to know the patients quite well. Hence, when the reporting nurse was carrying out her report, nurses starting their shift usually knew about the patient being reported on and actively took part in the story presented by the reporting nurse. As one nurse puts it:

> "Maybe the best thing with the oral report is that it enables a feedback and discussions around observations and measures where I am uncertain. For instance, if I am uncertain about how to interpret my observations I can discuss it with the nurses who start their shift. Actually… because of the rotation scheme many of them have been working the day before and therefore know the status of different patients quite well… Sometimes I even avoid putting things into the written report because I am not sure if my observations are correct… better to just make sure that nurses in the next shift observe the same thing" (nurse)

5.2 Reallocation of work – from one CSCW tool to a network of artifacts

The transformation changed the 'handover'-network dramatically from a coherent story presented by the reporting nurse towards a story made by nurses reading information fragmented and distributed among different people and artifacts constituting the patient record. Although many nurses to some extent felt lost during the implementation process, one year after its introduction, the new handover practice was maintained. However, new mechanisms have gradually been introduced to cope with the new practice.

The implementation and improvement of the written documentation was partly motivated by a need to avoid duplication by making sure that information was recorded in proper places. As described above, in the old paper based-practice, duplicates were often found in various documents. For instance information supposed to be recorded in the patient chart was written in the patient list. Similarly, information supposed to be recorded in care plans was instead embedded in the written report, and so on. On the one hand, changing the handover and introducing the EPR actually enhanced nurses written accounts. On the other hand the process of recording and reading became even more heterogeneous than before as the nurses now had to deal with a multitude of additional information sources. Examples of this includes; the nursing care plan as mentioned above; a more extensive usage of the patient chart; and the establishment of the weekly summary (as will be described more closely below). This change was further enforced by the fact that now the nurses 'moved around' during the handover conference (e.g. from the nurses office to the meeting room) and thus had easier access to a variety of supplementary artifacts (like the patient chart).

Another interesting observation was the establishment of the weekly summary, written every Thursday on patients that had been admitted to the ward for longer periods. With information increasingly becoming more distributed, the nurses felt a need to summarize the information at regular intervals. First of all to make the record easily accessible to nurses that hadn't been on duty for a while. Secondly as a marker to highlight important decisions and observations that otherwise could get lost.

> "The weekly summary has actually become a necessity because we loose the general view by having to work with so many different documents… for instance the patient chart, various observation forms, care plans, etc." (nurse)

The weekly summary was in essence a way to maintain an overview on how the individual patient level progressed. Thus the main reason for the weekly summary was that it was needed as a compensation for the old oral accounts in the meetings.

5.3 Reintroducing the informal in order to cope with the formal

The established formal practice, initially considered to be the solution to the informal practice problem, now appeared to nurture the original problem. It is our observation that the efforts to establish a formal practice through nursing documentation have been self-defeating. Below we provide three examples to support our argument: (i) informal pre-allocation of patients, (ii) re-introducing of the oral report, (iii) increased dependence on the informal patient list.

The procedure of allocating patients to the nurses illustrates how an informal practice was used to support a formal practice. The formal principle was that primary and/or secondary nurses should be assigned their own patients and resource-demanding care patients should be distributed evenly. This was far from a straightforward task as they sometimes were off duty. This made the distribution of patients an open question and some patients were more preferable than others:

> "Sometimes we would like to be responsible for specific patients. Either because we know them well or because a substitute or an enrolled nurse, not listed in the official record [nurse binder], previously have had the responsibility for the patient." (nurse)

The new practice of allocating patients was dramatically different compared to the old one. The upcoming shift of evening nurses had been 'deprived' the opportunity to informally negotiate on the distribution of patients. Therefore, another informal practice was established. The nurses showed up earlier than required in order to make sure to get the patients they wanted:

> "Some nurses show up earlier than required and redistributed patients according to their own needs. Immediately afterwards they started to read on their own patients. Thus, nurses showing up later had no influence on the redistribution of patients and had to cope with the leftover." (Nurse in retrospect)

Another mechanism reintroduced due to a lack of overview was the oral report. Immediately after the day-watch had left the ward, the evening watch sat down in the meeting room and gave a short brief on all patients:

> "Now, the day shift nurses leave even earlier than before, however the evening shift often aren't finished by then. Sometimes we [the evening shift] sit as long as until four o'clock and discuss patients before we actually start working in the ward" (Nurse)

An important dimension lacking in the new handover process was the questions and comments from the other nurses on the oncoming shift, which both supplemented and improved the overall report. In addition the 'reintroduced' oral report was crucial for the cooperation and coordination of work taking place

around specific patient groups, as it made available important information to the rest of the nurses (e.g. in cases of emergency)

Our last example illustrates how an easy access to the various formal documents made the nurses rely even more on the 'informal' parts of the documentation. The patient list, primarily used as a temporary record, had now become even more important than before. It was, among other things, typically used to keep an overview over all admitted patients:

> "The patient list has actually become even more important in the report because we no longer have direct access to the nursing record during the handover [last part of the new handover]" (nurse).

Having copied important information from the electronic based nursing documentation to the list, it was actually the only reference point to be used during the discussions that took place in the meeting room. In this sense, some of the work previously performed based on information found in the binder was now carried out based on information in the list. More generally the adaptability and flexibility of the list facilitated a smooth working process, as it was neither too strictly limited to certain aspects of work, nor did it limit the way work was carried out. It seemed to be very important for preserving a collective 'working' memory. At the same time it was valued as a practical working tool, as it allowed the nurses to make provisional notes and comments while working (*in situ).*

The informal practice, as illustrated by the informal pre-allocation of patients, the reintroduced oral report as well as the increased dependence on the informal patient list, had become a part of the solution in order to make the new formal practice work.

6. CONCLUSION

In this paper we have looked the transformation of the handover conference in the context of the introduction of electronic based nurse documentation. In particular we have looked at the notion of redundancy during the overall change. Our analysis has revealed that attempts to reduce redundancy in fact resulted in its reintroduction, however now at another time and place. We found that work (and redundancy) in fact had moved, to another time (i), into different artifacts (ii), or old artifacts that now were used/annotated differently (iii). Moreover we have demonstrated how informal routines in the handover conference, which initially were considered a problem, became part of the solution in order to make the new formalized handover conference work.

7. ACKNOWLEDGMENTS

We would like to thank the staff at the Department of Rheumatology at the St Olav hospital who participated in this study. We are also grateful for comments on earlier version of this paper from Eric Monteiro, Knut Ekker as well as our anonymous reviewers.

8. REFERENCES

[1] Allen, D. Re-reading nursing and re-writing practice: towards an empirically-based reformulation of the nursing mandate, *Nursing Inquiry, Special Centenary Issue*.11(4):271-83. 2004

[2] Atkinson, P. *Medical talk and medical work.* Sage Publications Ltd. 1995

[3] Baldwin, L., McGinnis, C. A computer generated shift report. *Nursing Management*. September 1994

[4] Berg, M. Accumulating and coordinating: occasions for information technologies in medical work. *Computer Supported Cooperative work* 8: 373-401. 1999

[5] Berg, M. and Timmermans, S. Orders and their others: on the constitution of universalities in medical work. *Configurations* 8, 31-61. 2000

[6] Berg, M., and Winthereik, B. Waiting for Godot: Episodes from the History of Patient Records. *In Health Information Management: Integrating Information and Communication Technology in Health Care Work*, edited by M. Berg. London: Routledge, 2004

[7] Bomba, D.T and Prakash, R. A description of handover processes in an Australian public hospital. *Australian Health Review*. February 2005. Vol 29. No1

[8] Bossen, C. The Parameters of Common Information Spaces: the Heterogeneity of Cooperative Work at a Hospital Ward. *In Proceedings of the Conference on Computer-Supported Cooperative Work*, pp. 176-185. 2002

[9] Bowker, G. C. and Star, S. L. Sorting Things Out: *Classification and Its Consequences.* MIT Press. 1999

[10] Cabitza, F., Sarini, M., Simone, C., Telaro, M. When once is not enough: the role of redundancy in a hospital ward setting. *GROUP* 2005: 158-167

[11] Chaiklin, S. Understanding the social scientific practice of Understanding practice. In Chaiklin, S., Lave, J. (Eds.) Understanding practice: Perspectives on activity and context. New York: *Cambridge University Press.* 1996

[12] Ellingsen, G. and Monteiro, E. A patchwork planet: Integration and Cooperation in hospitals. *Computer Supported Cooperative Work* 12(1), 71-95. 2003

[13] Getty, M., Ryan, A.A. and Ekins, M.L.C. A comparative study of the attitudes of users and non-users towards computerized care planning, *Journal of Clinical Nursing*, vol. 8, 431-439. 1999

[14] Grimson, J., Grimson, W., Hasselbring, W. The SI Challenge in Health Care. *Communications of the ACM*. June 2000;Vol. 43, No.6.

[15] Grudin, J. Groupware and Social Dynamics: Eight Challenges for Developers. *Communications of the ACM* 37(1): 93-105. 1994

[16] Hanseth, O.and Monteiro, E. Inscribing behaviour in information infrastructure. *Accounting, Management and Information Technologies*. 7(4):183 - 211, 1997.

[17] Hardey, M., Payne, S. and Coleman P.G. `Scraps': hidden nursing information and its influence on the delivery of care. *Journal of Advanced Nursing*, 2000, 32, 208-214.

[18] Hartswood, M., Procter, R., Rouncefield, M., Slack, R., 2003. Making a Case in Medical Work: Implications for the Electronic Medical Record. *Computer Supported Cooperative Work* 12(3), 241-266. 2003

[19] Heath, C., and P. Luff. Collaboration and Control: Crisis Management and Multimedia Technology in London Underground Line Control Rooms. *Computer Supported Cooperative Work* 1: 69-94. 1992

[20] Heath, C. and Luff, P. Documents and Professional Practice: 'Bad' Organizational Reasons for 'Good' Clinical Records. In: Olson, Gary M., Olson, Judith S., Ackerman, Mark (ed.): Proceedings of the 1996 *ACM conference on Computer supported cooperative wo*rk. November 16 - 20, 1996, Boston, Massachusetts, United States. p.354-363.

[21] Hellesø, R. and Ruland, C.M. Developing a module for nursing documentation integrated in the electronic patient record, *Journal of Clinical Nursing* 2001; 10: 799-805

[22] Hong, L.K., Duff, R.W. Modulated Participant-Observation: Managing the Dilemma of Distance in Field Research. *Field Methods* 14(2,):190–196. Sage Publications 2002

[23] Hutchins, E. *Cognition in the wild*. MIT Press. 1994

[24] Kassean, H. K., Jagoo, Z. B. Managing change in the nursing handover from traditional to bedside handover - a case study from Mauritius. *BMC Nursing*, Volume 4 (2005-02-11)

[25] Kerr, M.P. A qualitative study of shift handover practice and function from a socio-technical perspective, *Journal of Advanced Nursing*, 37(2), 125-135. 2002

[26] Klein, H.K. and Myers, M.D.: A set of principles for conducting and evaluating interpretive field studies in information systems, 1999. MIS Quarterly, 23(1), 67-94.

[27] Kling, R. Cooperation, Coordination and Control in Computer Supported Work, *Communications of the ACM*, Vol. 34, No. 12, pp. 83-88. 1991

[28] Lachmund, J. Making Sense of Sound: Auscultation and Lung Sound Codification in Nineteenth-Century French and German Medicine. *Science, Technology & Human Values*, Vol 24, No 4, pp. 419-450. 1999

[29] Law, J. Ladbroke Grove, or How to Think About Failing Systems. Centre for Science Studies, Lancaster University, December, 2003 (Accessed online August 2006 at http://www.comp.lancs.ac.uk/sociology/papers/law-ladbroke-grove-failing-systems.pdf)

[30] Lee, T.T. Nurses' concerns about using information systems: analysis of comments on a computerized nursing care plan system in Taiwan, *Journal of Clinical Nursing*, 14, 344–353. 2005

[31] Manias, E. and Street, A. The nursing handover: uncovering the hidden practices of nurses. *Intensive and Critical Care Nursing* 16, 373-383. 2000

[32] Munkvold, G., Ellingsen, G. and Monteiro, E. From plans to planning: the case of nurse care plans. *Proc. Continuity of care, HelsIT 2005*, Trondheim Sept. 2005,

[33] Olson, G.M., and J.S. Olson. The Effectiveness of Simple Shared Electronic Workspaces. *In Groupware and Authoring*, edited by R. Rada, 105-126. Academic press. 1996

[34] Olson, J.S., and S. Teasley, L. Covi, and G. Olson. The (Currently) Unique Advantage of Collocated Work. In *Distributed Work*, edited by P.J. Hinds and S. Kiesler, 113-135, The MIT 2002

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

[36] Orr, J. *Talking about machines: An ethnography of a modern job*, Cornell, CA: Cornell Univ. Press. 1996

[37] Sexton, A., Chan, C., Elliot, M., Stuart, J., Jayasuriya, R. and Crookes, P. Nursing handovers: do we really need them? *Journal of Nursing Management*, 2004, 12, 37–42. 2004

[38] Suchman, L. *Plans and Situated Action: The Problem of Human-Machine Communications*. Cambridge: Cambridge University Press. 1987

[39] Tjora, A. Maintaining Redundancy in the Coordination of Medical Emergencies. *CSCW'04*, November 6-10, 2004, Chicago, Illinois, USA, pp. 132-141. 2004

[40] Vikkelsø, S. Subtle Redistribution of Work, Attention and Risks: Electronic Patient Records and Organisational Consequences. *Scandinavian Journal of Information Systems*, 2005, 17(1):3–30

[41] Walsham, G. Interpretive case studies in IS research: nature and method, 1995. *European Journal of Information Systems*, 4(2), 74-81.

[42] Winthereik, B. R. and Vikkelsø, S. ICT and Integrated Care: Some Dilemmas of Standardising Inter-Organisational Communication. *Computer Supported Cooperative Work*, 2005 vol. 14, pp. 43-67

Paper five:
From Storytelling to Reporting - Converted Narratives

FROM STORYTELLING TO REPORTING
-
CONVERTED NARRATIVES

Munkvold, Glenn, Nord-Trøndelag University College, 7729 Steinkjer, Norway, glenn.munkvold@idi.ntnu.no

Divitini, Monica, Norwegian University of Science and Technology, 7491 Trondheim, Norway, divitini@idi.ntnu.no

Abstract

This paper delineates a perspective on knowing in practice that highlights the tension between narrative and codified forms of knowledge. Based on an in-depth study of the implementation of an electronic based record system for nurses, we demonstrate how both forms of knowledge are required to enable a coherent integration of work across different working shifts. We analyse the handover conference from being a collaborative and coherent story created by nurses present during the handover conference to become a story made by oncoming nurses reading of information found in the patient record. The notion of overview is identified as a common theme and precondition for nurses' ability to share knowledge. Our findings indicate that the handover conference, through the transformation, has drifted from being a highly collaborative effort to become an effort primarily emphasising the distributed nature of work. Yet, in our case mechanisms were established locally in order to build an overview as a part of the new handover conference. In the concluding parts of the paper, implications for the design and implementation of collaboration technologies are highlighted. In particular we emphasise the need to further explore the narrative (and collaborative) nature of nurses' work as the design related implications of such an approach seem largely uncharted.

Keywords: Knowledge sharing, Health care, Nursing, Collaborative work, Overview, Narratives, Sensemaking.

1 INTRODUCTION

Knowledge sharing in health care relies on a mixture of formal and informal concerns (Moser & Law 2006). From a knowledge management perspective this has brought about a tensions between narrative and codified forms of knowledge; a tension that is well illustrated in nursing work. Historically, the holistic nature of nursing has made it hard to separate and explicitly record nursing actions. Nursing has been conceived as an intermediate profession, not having to leave a trace (Bowker et.al 2001). Consequently, nurses' written accounts have been considered less relevant for the patient record, and are among the first to be removed when patients are discharged (Star & Strauss 1999). In practice, however, the ways in which nurses organise their work and carry out their responsibilities relies to a large degree on oral practice as the primary method for communicating information. Informal and personalised recordings of work have been used extensively at the expense of formal, written documentation and specific facts (Manias & Street 2000). This has been considered a problem since continuity and quality of health care depends on the existence of effective mechanisms for communicating information between different healthcare members and, in particular, between nurses from one shift to the other. Current efforts of implementing electronic patient records (EPR) in western hospitals address this problem by focusing on the formal and written aspects of nursing (Sexton et.al 2004), revitalising the tension between narratives and codified forms of knowledge. By exploring the tension between narrative and codified forms of knowledge, in this paper we look closer at how the introduction of EPR and the formalisation of health care transform knowledge sharing and coordination of work.

Narrative and codified forms of knowledge is widely recognised within the knowledge management literature. From a technological point of view, sharing knowledge is often focusing on capturing and codifying the content of knowledge as the only way to make it usable across contexts. Such a perspective has been vastly criticized as it neglects the interactive and narrative side of knowledge (Walsham, 2001, Boland & Tenkasi 1995), and downplays the contextual side to the level of non-existence (Fitzpatrick 2003). In the same way, the perspective of human interaction tends to disregard the role of codified representations of knowledge (Nonaka & Takeuchi 1995). In this paper we do not engage ourselves in a debate about one or the other, but appreciate both as important to the knowledge sharing discourse (Brown & Duguid 2000). We apply a practical and contextual perspective on knowledge (Walsham 2001) and conceptualise knowledge as the ability to act (Orlikowski, 2002). The active and productive processes of knowledge are highlighted, as in "sense-making, in which the unique thought worlds of different communities of knowing are made visible and accessible to others" (Boland & Tenkasi 1995, p. 359). By this we do not imply that technologies to embed knowledge entities are misplaced. Rather our argument is that these are always dematerialised knowledge entities. Peoples' ability to make sense of them is thus intrinsically tied to the specific socio-technical setting through which they are recorded and actually used (Timmermans & Berg 2003). We lend ourselves to a socio-technical perspective and consider knowledge as a network of interdependent entities where "individual pieces [of knowledge] are linked together into complex structures in various ways" (Hanseth 2004, p. 104). Knowledge sharing then is a collective, heterogeneous and ongoing accomplishment, distributed, delegated and coordinated across time and space (Berg 1999). Our work should thus be seen as related to existing contributions in the CSCW literature on the heterogeneity of knowledge and the simultaneous transformation of artefacts and work during processes of appropriation (Berg 1999, Ellingsen & Monteiro 2003a, Winthereik & Vikkelsø 2005). In the case of nursing this perspective entails a firm analytical, as well as operational, understanding of the communication and cooperation taking place around specific patients.

Our work is based on the study of the implementation of an EPR- module for nurses in a Norwegian hospital. A part of this process was to formalise nurses' work related to handover conferences. Basically the transformation involved changing the handover from being a collaborative and coherent story narrated by nurses present during the handover conference to become a story made by oncoming nurses individual reading of information found in the patient record. The empirical material was collected from November 2004 to December 2005. Main methods of data collection have been an alternation between observing work and carrying out qualitative interviews. Collected data include

approximately 450 hours of observation, tape recording of handovers and meetings, 31 interviews, examination of various formal and informal documents, and informal discussions with employees.

In our analysis we compare the handover conference prior to and after the transformation, identifying the notion of *overview* as crucial to the process of sharing knowledge and ensuring continuity of care. Our analysis focuses on the role of narratives in maintaining and sharing overviews. Based on our findings we argue that the EPR, and the formalisation of the handover conference, seems to mainly contribute to the distributed nature of nurses' work, at the expense of the collaborative nature. Nevertheless, in our case various mechanisms were created to balance the situation. In the next section we describe our case, followed by the analysis in Section 3 and 4. Finally we discuss our findings and draw some conclusions and implications for the implementation and design of EPR for nurses.

2 RESEARCH SETTING AND THE CASE

The study was carried out in the in-patient ward at the department of rheumatology in a Norwegian hospital. The ward is organised as a primary care unit, has 18 beds and treats 650 patients a year with an average length of stay of 8 days. Three physicians and approximately 20 nurses work together with a physiotherapist, an occupational therapist, and a social worker.

Rheumatic diseases are chronic conditions requiring different types of expertise. Hence, treating patients suffering from a chronic disease is a collective and cooperative effort, and nurses play a key role in managing and coordinating the individual patient trajectory. Nursing input to care involves various tasks, such as post-surgery observations, pain management, and counselling patients who are anxious, depressed or have psychosocial problems. Their role as intermediaries is fundamental for the collective, heterogeneous and cooperative nature of health care work and, more importantly, their ability to communicate care within and across institutional boundaries is crucial for the quality and continuity of care commonly required by patients. In their work they thus depend on the existence of effective mechanisms for communicating information between different health care members, and in particular between nurses from one shift to the next. This is typically carried out in the handover conference, where the purpose is to provide nurses with an opportunity to informally debrief, clarify and exchange patient information.

At this ward there are three handover conferences a day; morning, afternoon and evening. We are mainly focussing one the one taking place in the afternoon, which in 2004-2005 underwent a change from being carried out orally to become a written accomplishment. The overall change process went on over a one-year period. By the end of June 2005, the whole process had come to an end.

In the next two sections we provide an account of the handover as it was carried out prior to and after the new practice had been established. To limit the length of our case-description and the scope of our analysis, we do not focus on the transformation itself, but portray the old and the new handover conferences at times when they were well established and routinely integrated into the work-practice.

2.1 The old oral handover conference

The old handover conference started at 3 o'clock in the afternoon. With all oncoming nurses present in the small interviewing room, one after the other, nurses from the dayshift came in and reported on patients. Information was handed over verbally, and at the end all oncoming nurses had received the same report on all patients.

While briefing, the reporting nurse would usually draw on information from two artefacts; the binder and the patient list. The binders included official nursing documents like the kardex (main card, the written report, information from and to relatives, etc), the admission note, ordinances from the physician and so on. The patient list was an unofficial A4-paper listing all admitted patients arranged based on their room. All nurses got an updated copy of the list, to annotate as they felt needed, at the beginning of every shift.

Typically the reporting nurse would start the brief by asking: "Do you know this patient?". If the oncoming nurses didn't know the patient or if it had been some time since they last where on duty, the brief would usually be rather comprehensive. If the patient was a new or a complicated case, the

reporting nurse would also give a rather extensive report. More often than not, this would include all relevant information from when the patient first was admitted (situation at home, diagnosis, symptoms, nursing problems, type of treatment, etc…). In the example below a brief is given on a newly admitted patient by nurse Anne:

> [Anne, the reporting nurse, is looking at the patient list] *Room number 612, bed no. 2, Jonas Olsen, born 1965* [She stops, opens the binder and leafs through it while talking] *Came in as an emergency patient today. His diagnosis is Reiters disease. He has had it since he was 22 years old and he is now almost 40. So he has had it for some time now. He experiences pain and stiffness in the whole body* [She closes the binder and picks up the patient list again]*…Dr Hansen received him, and he is currently discussing with the other physicians what to do with the patient. They might give him a…* [Again she looks at the list, before she continues]*… solomedrol-cure, but I do not know yet, because they [the physicians] weren't quite clear about how to approach the illness. … He was in fact only supposed to take a range of X-ray today. The primary physician ordered these, and the pictures were supposed to be sent back to him. But he has been admitted instead. I have called and told this to his primary physician. He is scheduled for X-ray tomorrow morning at …*[Anne opens the binder again before she continues] *…0840. I have told him about this, and how to prepare. The rest … which actually is X-ray of the whole body … they said that they should take them as soon as possible.... The patient believed he could sleep at home. He lives in the city. But I have made a bed for him here because ha said he was so sorry that he needed to rest a bit.*

The overall story is not produced by Anne alone, but rather by her interacting with the patient list and the various documents found in the binder. Anne doesn't actually remember when the X-ray was scheduled, but is able to find the time in a copy of the ordinance-sheet that is kept in the binder. Oncoming nurses used their own blank patient list to record information, even though most of the information could be found in various official documents. In this particular case, none of the oncoming nurses asked any questions, but they all made rather extensive notes on their personal patient lists. Anne's description of the psychological state of the patient at the end of brief is an example of information not usually recorded in the official, written documentation. Still, it provides important input to the oncoming shift on how they should approach the patient.

An important feature about the brief provided by Anne is the role of the oncoming nurses. Their presence clearly contributes to the accomplishment of the brief. Knowing that the patient has just been admitted to the ward, Anne gives a rather extensive brief. By being silent, the oncoming nurses clearly signify their lack of knowledge about the patient. However, more often than not they would ask questions or make supplementary comments to the brief, clearing up ambiguities, adding details and thus improving both its quality and relevance. In particular this was noticeable for long-term patients, or patients that previously had been admitted to the ward, as they would usually be well known by the majority of the nurses. A common feature in the old oral handover conferences was that an integrated story was built on the spot, tailored according to the needs of the nurses present. Orchestrated by the reporting nurse, oncoming nurses, the binder, the patient list and so on would all contribute to build a coherent story.

At 3.30 in the afternoon, all patients had been reported on and the handover conference was over. Immediately afterwards the oncoming shift would gather in the departments conference room to decide the allocation of patients. This activity was facilitated and documented on a large whiteboard that was placed on one of the walls in the room. More often than not discussions would arise on the allocation. Issues like nursing load (how demanding individual patients were), personal knowledge about individual patients, nurses individual competencies and so on influenced the outcome of the process. Finally, before starting their work in the ward, collective tasks like making a printout of the X-ray program, delivering blood samples, selecting a responsible ward nurse, etc, was distributed among the nurses.

2.2 The new written handover conference

In the new handover conference, oncoming nurses no longer got information on all admitted patients, but only on those they had been assigned. The handover-'network' had changed from being a story 'broadcasted' by the reporting nurse to a story made by oncoming nurses reading of pieces of

information found in various places. Hence, in the new handover conference, the reporting nurses no longer had to line up, waiting for the preceding nurse to finish her brief. Most of the paper-based forms found in the old binder had been replaced by documents in the EPR. The only exception was the main card (holding demographic information, administrative information, earlier treatment, etc) and the ordinances form (task list where new tests and changes in medication was ordered by the physician).

The oncoming shift now started the handover by reading the nursing documentation on patients that they had been assigned. Hence the allocation of patients had to be made prior to the handover. Nurses on the dayshift thus did this task. A visible sign of this change was found on the whiteboard in the conference room where an extra column had been added to make room for the names of the oncoming nurses. To allow all nurses access to the EPR at the same time, reading took place in the nurses' office that recently had been granted three new computers as a part of the EPR-introduction.

Upon entering the ward, oncoming nurses went directly into the conference room, looked briefly at the whiteboard to find out which patients they had been assigned, took a newly updated patient list from the table, picked the right binders from the shelf and went into the nurses' office to read the documentation.

Below we follow nurse Jonas as he is reading the record. The nurses' office is strikingly silent. Jonas has opened the EPR. The patient list helps him to quickly locate the right patients. For the first patient, Jonas barely looks at file list appearing on the screen since, as he explains to the observer:

> "*Well, I know this patient fairly well. Besides, nothing has been written since I last were on duty… look here* [he opens the record], *no new file created since the 13th*". (Nurse Jonas)

Jonas opens another record. The patient is newly admitted. From the file list, Jonas opens and reads the admission note. It is dated the day before. The document is written as free text, but organised according to a set of keywords. This template of keywords has been made commonly available to make recording more coherent and efficient. The admission note is rather extensive, and while reading Jonas writes down a few keywords on his patient list. Done that, Jonas takes a quick look at the nursing care plan, whose documents are also included on in the file list. He skims quickly trough the plan before closing the record. The same procedure is followed for the third and the fourth patient. When we ask how he manages to keep an overview, given the rather long list of documents included in some of the records, he answers:

> "*Well, you know, I have actually been working here for some time now. I know my way around. Also the rotation scheme, and the fact that we practice primary care help us get to know the patients very well. (…) in the EPR the weekly summary is useful if I don't know the patient very well.*" (Nurse Jonas)

The weekly summary is a document created every Thursday, by the responsible nurse, summarising the current state of patients being committed for longer than a week. Although the quality of the summary varied, it soon became an important part of the nursing documentation and was frequently used during handover conferences.

Jonas shuts down the EPR and picks up the binders. They are read in the same order as the EPR records, adhering to the sequence of names as they appear on the patient list. Jonas makes an additional note on the list nearby one of the patients. It has been recorded on the main card that the patient will be discharged the next day, despite the fact that he is still rather heavily medicated, Jonas makes a comment on the patient list to remember to discuss the issue with the reporting nurse. Some minutes later he picks up the binders and moves to the conference room.

In the conference room a nurse from the dayshift asks Jonas if he has any questions regarding their common patient. Jonas looks at the patient list before asking about the heavily medicated patient. The discussion goes on for several minutes, and while discussing they pick up the patient chart from the table and take look closer at the prescribed medication. Jonas makes a remark about reducing medication before discharging the patient. The nurse from the dayshift concurs, and they both conclude that the next step to take is to further discuss the issue with the patient, as well as the physician. Having done that, Jonas is yet again left alone, waiting for the next reporting nurse to show up. The room is rather noisy. Nurses come and go, and several separate discussions are carried out

simultaneously. Today Jonas has been assigned patients that during the day shift had been cared for by four different nurses. Consequently, he has to talk to four different nurses from the dayshift.

At half past three the overall process had come to an end and all nurses from the dayshift had left the conference room. Immediately afterwards, the oncoming nurses gathered around the table. A short oral brief was provided on all admitted patients, despite the fact that this was not an official requirement in the new written handover practice. It was carried out the same way as in the old oral handover conference, only now without any nurse from the dayshift present.

Figure 1 below illustrates the premises where the handover conferences took place as well as important documents used in the process. The broken line indicates nurses' movements in the old handover conference, while the unbroken line shows how it was done in the new handover practice.

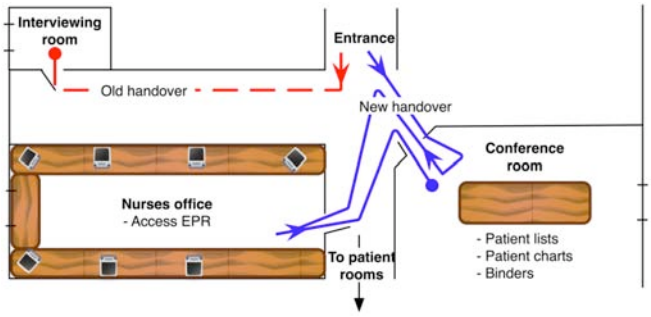


Figure 1. The premises where the handover conference took place as well as important documents used in the process of handing over information.

3 THE OVERVIEW

The new handover and the introduction of the EPR-module for nurses can, to a certain extent, be considered a success. The quality of written documentation has improved and overtime is reduced. The success of the project, however, cannot be inferred from the technology alone, but rather from a fairly deliberate reorganisation of the socio-technical arrangements constituting the handover conference. As will be argued more thoroughly below, the project was primarily focussing on the formal and structural at the expenses of the practical and cooperative aspects of nurses' work. As such, main focus was on improving coordination of work by making sure tasks and responsibilities were properly handed over to the oncoming shift. However, depicting the handover merely as a rational process of transferring just enough knowledge to get the work done might contradict the collaborative nature of nursing. Continuity of care, it is our observation, relies on nurses gaining an appropriate level of *overview*. A rather straightforward concept, but still crucial in the process of sharing knowledge.

3.1 Vertical vs. horisontal overview

On the notion of overview, we distinguish between vertical and horisontal overview. Vertical overview denotes the need to get a detailed overview of an individual patient and his or her specific needs. For example, in Section 2.1 Anne, with the help of different artefacts and colleagues, builds an overview of an individual patient. Similarly the weekly summary, in the new handover conference, is a vertical overview shaped as a written narrative.

Horisontal overview refers to the need to get a picture of all the patients in the ward, addressing general concerns relevant for all nurses working on a shift. As illustrated in the example below:

> *"A patient on the ward has a problem with drugs. In such cases the medicine room is locked at all times and medicine to the patients is locked in there as well and we have one-to-one follow-up on patients that uses medication"* (Nurse)

The patients' drug problem had implications for the overall deliverance of care at the ward, and was thus relevant for all nurses in a shift. In other situations having sufficient knowledge about all patients was merely considered a fate of good manners, supporting nurses' effort of providing an encouraging atmosphere for patients. As clearly summarised by a nurse:

> *We often meet people in the hallway that ask where specific patients are lying, we get phone-calls, emergency situations might arise and so on. We need to have a certain level of overview on all admitted patients and know if there are any specific precautions that we need to take (…) specific things are typically communicated in the handover conference and recorded by the nurses on their private patient list* (Nurse)

3.2 Formal vs. informal content

To get an overview requires the integration of medical and non-medical information. Nurses often find themselves in situations where they have to go beyond the mere medical treatment to be able to make reasonable judgments on why patients behave the way they do. Take a look at the example with Anne in section 2.1. Slightly surprised and a bit depressed by the news that he has to be admitted for further examination, the patient asks for a bed to rest in. Anne's unfolding of the sequence of events and the current status of the patient is put across as a story. Although it is not explicitly mentioned, the psychosocial condition of the patient evidently can be sensed from the overall story. This type of information is rarely described in the written documentation, but is crucial for the deliverance of proper care.

3.3 The narrative nature of the overview

As illustrated in the case description, both in the old and in the new handover conference, the knowledge needed for carrying out work is distributed. It is well documented that the EPR, and other comparable integrated systems, more often than not, tend to fragment relevant information (Goorman & Berg 2000). Narratives, written as well as oral, emerge as central in the construction of the overview. As argued by several within the CSCW field, stories and narratives, inherently redundant, do not disappear whatever might be the objective with integrated systems like the EPR or the like (Ellingsen, & Monteiro 2003a, Cabitza et.al 2005). They rather seem to be 'converted' in the sense that they reappear in different artefacts, in different places at different times (Munkvold et.al forthcoming). Even though this line of reasoning seems to contradict the mainstream perspective among e.g. managers and nursing professionals, arguing that oral practices typically bring about unproductive practices (Kennedy 1999), in our case they seemed to play an important role in the practice of maintaining overview. Narratives thus can be said to be what Ellingsen & Monteiro (2003b) denote as mechanisms for producing working knowledge.

A crucial distinction in our case, between the old and the new handover conference, was the way the narrative helped the construction of the overview. In the example with Anne it was built on the spot through an oral account, while in the example with Jonas the overall overview was built based on smaller narratives embedded in different places (e.g. weekly summary, oral discussion taking place in the conference room, etc). This change will be further explored below.

4 MAINTAINING OVERVIEW – CONVERTED NARRATIVES

In this chapter we look closer at how narratives, in tandem with 'codified' representations of work, enabled the nurses to build an overview. The remainder of the analysis is thus based on the following three arguments. First, in addition to provide input to the work of the oncoming shift, the collaborative process of making overviews was vitally important in sense-making processes. Second, narratives naturally integrate content and context. They are powerful means to understand what happened and why (Brown & Duguid 2000, p. 106). Still, and as we will illustrate, the means by which this integration took place changed as the practice was transformed. Third, overviews denote temporary closure, and thus serve as important mechanisms to enable work to go on.

4.1 Narratives and sense-making

Overviews do not come as pre-packaged entities but rather evolves in networks and through sense-making-processes (Boland & Tenkasi 1995, Weick 1995). There is a reciprocal relationship between the process of bringing heterogeneous representations of knowledge together and nurses' ability to carry on with their work. Overviews, we argue, are narrative accounts that are produced with the purpose of (i) reducing the amount of articulation work needed to get the work done and (ii) aid higher level processes like building trust, foster learning, reducing uncertainty and the like.

First; the handover conference was vitally important for coordinating work by making sure tasks and responsibilities were properly handed over to the oncoming shift. The vertical overview allowed an easy transition from one responsible nurse to the next, while the horisontal overview enabled nurses to perform as 'healthcare mediators', i.e. the ones "who weave together the many facets of the [health care] service and create order in a fast flowing and turbulent work environment" (Allen 2004, p. 279). For the ongoing coordination and articulation of work, summarising narratives, as represented by the patient list, the weekly summary, the oral brief, etc, were thus critically important in creating continuity and a high quality patient care delivery.

Second; depicting the handover merely as a rational process of transferring knowledge might contradict secondary outcomes related to the collaborative nature of nurses updating themselves on the state of affairs. These secondary outcomes, we argue, are closely related to the process of building the overview. E.g. the storytelling taking place in the oral handover conference was not only a way to handle over tasks, but also a way to aid higher level processes like learning from each other, building trust, facilitating self-confidence, reducing uncertainty and the like. For example, measures and observations were thus regularly discussed during the process. As one nurse said:

> *"Maybe the best thing with the oral report is that it enables a feedback and discussions around observations and measures where I am uncertain. For instance if I am uncertain about how to interpret my observations I can discuss it with the oncoming nurses" (Nurse)*

Although the responsible nurse was expected to handle the patient alone, he or she actually relied on other nurses to have a certain level of knowledge about all admitted patients. Hence, in the process of building the overview it was considered significant to engage several in the problem encirclement process:

> *"People have different competencies and thus having a collective brief actually makes it valuable in the sense that we learn a lot while discussing patients. (…) It also makes me more secure when I know that the other nurses have got the same brief as me. Not only because they need it, but because I need to know that they know" (Nurse)*

Several nurses reported the oral way of updating to be superior in facilitating cooperative sense-making processes. In particular this was the case for newly admitted patients, if it had been long since the oncoming nurse had been on duty or if the oncoming nurse was a substitute. The process of handing over information to the next shift was more an occasion to make sense of the state of affairs than it was a rational process of handing over information.

It is our observation that the introduction of the EPR and the formalisation of the handover conference seems to be preoccupied with the formal and structural at the expense of the practical and cooperative aspects of nursing. For instance narratives and informal interaction, inherently embedded in their practice, were vitally important to be able to handle ambiguity and make sense of the patient. In the oral handover conference, these sense-making processes were highly collective and collaborative. Stories were built on the spot as an effort of framing experiences and maintaining an overview, and subsequently, as a way to reduce the amount of articulation work needed to get the work done.

4.2 Narratives and integration of content and context

The introduction of the EPR and the formalisation of the handover conference fragmented knowledge about work in order to make it usable across contexts. As a consequence, new mechanisms had to be introduced to craft knowledge into workable entities, usable in everyday practice. The nurses were in this sense involved in a continuous process of decontextualisation and contextualisation of knowledge.

Not decountextualised as in complete separation from work, but rather as a way to recontextualise it within the frames of a new enterprise (Linell 1992). Narratives were used to build the overview both before and after the reorganisation, but the process by which this was achieved changed from being *tailored* on the spot according to the needs of the oncoming shift in the oral handover conference, to become a process of *navigating* the various documents and people constituting knowledge about the state of affairs in the written handover conference.

Tailoring on the spot, as was the case in the oral handover conference, centred the reporting nurse at the very heart of the process. Being the one with the best knowledge about recent changes in the patient status, he or she was considered best qualified to decide what should be emphasised and not during the brief. Performing the handover orally was thus an obvious opportunity to tailoring the brief according to the preferences, knowledge and experience of the reporting nurse as well as the receiving nurses. The final story effectively summarised information that otherwise was distributed in separate documents (patient chart, written report, patient list, etc). Not only was this an efficient way to remember, it was also an opportunity to selectively remove 'useless' information in order to enable a continuous flow of work. Notice how Anne in section 2.1 while briefing, provides a rather rich story, assuming that none of the oncoming nurses know the newly admitted patient. Her story does not only include the physiological and medical status of the patient. Information not recorded in the formal documents, like the psychosocial state of the patient, is implicitly added, enriching the overall story. In this way important input on how oncoming nurses should approach the patient is provided. Anne's account is carried out as a process of integrating from various artefacts. Decountextualised and heterogeneously distributed information entities were re-contextualised as a narrative account in the oral brief, tailored on the spot according to the needs of the oncoming shift.

Rather than facilitate tailoring, in the new written handover-practice the important issue became how to enable *navigation*. The example with Jonas in section 2.2 gives us a clue. The overview is not built on the spot. It has been transformed from a highly collective and co-located process, to an individual effort of navigating between various people, artefacts and places. Rather than being facilitated by the reporting nurses, Jonas now, to a larger degree, had to handle the process of building the overview himself. Storytelling, as in the old oral practice had, to some extent disappeared, and become re-engraved in artefacts and by other means. Among the most significant changes was the establishment of the weekly summary, that replaced bits and pieces of the work that earlier had been dealt with on a more continuous basis in the oral brief. The introduction of the EPR had distributed knowledge about patients even more than before. Hence in the weekly summary knowledge about patients was summarised and simplified, making updating oneself on the state of affairs more efficient. It both provided an entry into the local textual universe constituting the record (Heath & Luff 2000), and served as a marker where important observations were summarised and recommendations concerning further treatment were highlighted. The weekly summary mainly served as a mean to maintain a vertical overview. Typically oncoming nurses, not familiar with the patient, would read backwards from the last written report to the last weekly summary in the process of building an overview.

While important, the written accounts did not provide sufficient information according to the specific needs of the oncoming nurse. Thus the overall process of handing over information was concluded by a one-on-one, face-to-face discussion between the leaving and the oncoming nurses. Jonas thus, more than was the case in the oral handover, gradually built a picture of the status of his patients by navigating between the various documents and people he encountered in the process. Narrative accounts had in this sense changed to become materialised, as smaller, fractional stories embedded in different places on the trajectory were navigation took place.

4.3 Narratives and sharing of overview

Overviews usually materialise as various interpretations moulded together. They are delegated the role of approval - closures fundamentally important for work to go on (Bijker et.al 1987). In the process of producing them, knowledge entities are selectively enacted to preserve earlier accounts, while at the same time new layers are added to make them usable within the frames of a new situation (Ellingsen & Monteiro 2003b). The overviews are in this sense continuously negotiated and changed according to the changes in the network of elements constituting them. Materialised, or 'frozen', overviews are thus intrinsically tied to the specific situation where they are recorded and used. They enable work to go

on, but are useless as disconnected entities. Only through the process using and producing them are the nurses able to make sense out of a heterogeneous network of knowledge entities. In this perspective overviews can be said to be temporary closures, deliminating what needs to be known and what can be 'forgotten' (Bowker & Star 1999, p. 257)

Narratives play a key role in supporting different levels of closures within the cooperative ensemble. For example, in the old handover conference the oral story was allowing nurses to build both a vertical and a horisontal overview (through the oral brief) – it was a process of collectively closing knowledge. Closure was what enabled them to go on with their work. Not in the sense that every nurse had a complete overview, or that they all had an identical understanding of the state of affairs, but rather that an agreement was made which enabled work to go on. Importantly so was the awareness of having produced the overview together. Various interpretations were moulded together, creating a coherent story, and consensus was achieved. At the end of the handover, everybody knew what the others knew and did not know.

The situation changed after the introduction of the EPR. As illustrated in the example with Jonas (section 2.2), by navigating between different people and documents, Jonas builds a vertical overview of his patient by integrating various knowledge entities into one coherent story. This overview represents an individual closure because is not initially shared with his colleagues and as such is an enactment of knowledge that is only intended for Jonas to support his own work. The weekly summary, on the other hand, has a different status. The vertical overview that it provides is built by the reporting nurse and as such is an individual closure. After that, however, this written narrative becomes a shared artefact and a patrimony of the community. As stated by Jonas in section 2.2, typically oncoming nurses, not familiar with the patient, would now read backwards from the last written report to the last weekly summary to get an adequate overview for their work. The weekly summary thus provides a vertical overview that serves as a collective closure in terms of disentangling important knowledge entities and crafting them into a coherent story. At the same time it complies with formal requirements of documentation and accountability. Collective closures in the new written handover conference were also achieved through oral accounts; first by the discussion between nurses immediately after the oncoming nurses had read the written documentation (in the conference room); second in the oral brief taking place after the dayshift had left the ward. This second oral brief clearly illustrates the importance of sense-making processes as in 'knowing that the other nurses know'. A nurse gave the rationale for this during an interview:

> *"We have become better in documenting what we do. At the same time during the handovers something's seems like missing, its like too little information is handed over, and we lack the level of overview needed to be able to do what we are supposed to do. So whenever we can, we [nurses in the afternoon shift] sit down and go trough all admitted patients orally". (Nurse)*

5 CONCLUSION AND IMPLICATIONS

In our analysis we have revealed the handover conference as an occasion for collaborative sensemaking processes. The nurses' efforts of producing narrative accounts signify a struggle to produce stability out of a highly fragmented record and a rather conditional practice. Even during processes of transformation these mechanisms seemed to remain. Tailored stories in the oral handover conference became smaller isolated narratives attached to the places in the trajectory were navigation was carried out in the written handover practice. In other words mechanisms were established so to preserve sensemaking as a part of the handover conference. An important feature in these sensemaking processes was related to how they enabled flow of work. Here we have identified horisontal and vertical overview as crucial. The first denote a collective consensus about the state of affairs on the ward aiding higher level processes like building trust, facilitating self-confidence, nurturing learning, reducing uncertainty and so on, while the second denote the integration of various knowledge entities in order to enable individual nurses to understand the whole patient. Both contribute to facilitate sensemaking processes as they reduce the amount of articulation work needed to get the work done.

Efficiency and quality were two fundamental objectives with the introduction of the EPR and the transformation of the handover practice. In concrete terms this entailed an improved written documentation and the formalisation of the handover practice. Yet, as we have illustrated, it is by no

means given how efficiency and quality is achieved, and how knowledge is shared in concrete nursing practices. We thus argue for a need to further explore the narrative (and collaborative) nature of nurses' work, as the design related implications of such an approach seem largely uncharted.

Three concrete implications relevant for design and implementation can be drawn from this paper. Firstly, there is a need to acknowledge the rather contradictory objectives related to the design and implementation of EPRs in nursing. It is our observation that current EPR systems seem to remain within a rational perspective, primarily contributing to fulfil organisational accountability at the expense of practical applicability. As Svenningsen (2003) argue, and as verified in this paper, current 'rational' efforts seems to contribute to amplify the tension between documentation and flow of work. To counter this tendency there is a need to balance the design and implementation of EPRs to facilitate, not only rational processes as in 'what should be done', but also to enable sensemakingprocesses as in 'what is going on'. In the context of the handover conference, it is this latter perspective that produces the buffer between documentation and flow of work, and accordingly, is crucial for delivering efficient, continuous and high quality care.

Berg (1999) highlights two basic features inherently embedded in the patient record. It accumulates knowledge and coordinates lines of work. The means by which this is achieved in changing practices however is not given. In our case, the introduction of the EPR and the formalisation of the handover conference changed the process of building the overview from that of tailoring to that of navigation. Our second design related implication then: To make the EPR an useful tool related to the practice of handing over information (and thus aid efforts of coordinating lines of work), narrative accounts need to be embedded as smaller more isolated elements attached to the specific places on the trajectory were navigation takes place. In the written handover practice in our case, the nurses sometimes needed further clues on what to emphasise when reading, both to enable efficient reading, but also to help them comprehend the sequence of events and their causes. Isolated narratives, thus, could be supplemented with traces based on which resources had been used when the report was written. This again would have helped oncoming nurses to better understand the reasons why certain things had been prioritised and documented.

Our third and final implication is first and foremost related to the need to make space for oral practices when implementing new technologies. Oral interaction is not only an efficient way to share knowledge, it also enables closure and aids processes beyond the mere handing over of information like building trust, foster learning and the like.

6 ACKNOWLEDGMENTS

We would like to thank the staff at the department who participated in this study. Also thanks to the people at the Norwegian Centre of Electronic Health Records for providing an encouraging atmosphere while collecting the empirical material for this study. Finally we are grateful for comments and feedback on earlier versions of this paper from Thomas Østerlie, as well as feedback from the anonymous reviewers on the abstract we submitted to the conference.

7 REFERENCES

Allen, D. (2004). Re-reading nursing and re-writing practice: towards an empirically-based reformulation of the nursing mandate, Nursing Inquiry, Special Centenary Issue. 11(4): 271-83.

Berg, M. (1999). Accumulating and coordinating: occasions for information technologies in medical work. Computer Supported Cooperative work 8, 373-401

Bijker, W. E., Hughes, T. P. and Pinch, T. (1987). The Social Construction of Technological Systems. MIT Press, Cambridge, Mass.

Boland, R. J. Jr. and Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. Organization Science. 6(4) 350–372.

Bowker, G. and Star, S. L. Sorting Things Out. (1999). Classification and Its Consequences. MIT Press.

Bowker, G., Star S. L. and Spasser, M. (2001). Classifying Nursing Work. Online Journal of Issues in Nursing. Available at http://www.nursingworld.org/ojin/tpc7/tpc7_6.htm (accessed April 20, 2006)

Brown, J.S. and Duguid, P. (2000). The social life of information. Boston: Harvard Business School Publishing.

Cabitza, F., Sarini, M., Simone, C. and Telaro, M. (2005). When once is not enough: the role of redundancy in a hospital ward setting. GROUP 2005, 158-167
Ellingsen, G. and Monteiro, E. (2003a). A patchwork planet: Integration and Cooperation in hospitals. Computer Supported Cooperative Work 12(1) 71-95.
Ellingsen, G. and Monteiro, E. (2003b). Mechanisms for producing a working knowledge: Enacting, orchestrating and organizing. Information and Organization, 13, 203-229.
Fitzpatrick, G. (2003). Emergent expertise sharing in a new community. In Ackerman, M., Pipek, V., Wulf, V. (eds.): Sharing Expertise: Beyond Knowledge Management. MIT Press. Cambridge 81-110
Goorman, E. and Berg, M. (2000). Modelling nursing activities: electronic patient records and their discontents. Nursing Inquiry. 7(1) 3-9
Hanseth. O. (2004). Knowledge as infrastructure. In C. Avgerou, C. Ciborra and F. Land (eds). The Social Study of Information and Communication Technology: Innovation, Actors and Contexts, Oxford University Press, Oxford.
Heath, C. and Luff, P. (2000). Technology in Action. Cambridge University Press.
Kennedy, J. (1999). An evaluation of non-verbal handover. Professional Nurse. 14(6).
Linell, P. (1992). The embeddedness of decontextualisation in the context of social practices. I. A. Heen Wold (ed), The dialogical alternative. Towards a theory of language and mind. 253-272. Oslo: Scandinavian University Press.
Manias, E. and Street, A. (2000). The nursing handover: uncovering the hidden practices of nurses. Intensive and Critical Care Nursing 16. 373-383
Moser, I. and Law, J. (2006). Fluids or flows? Information and qualculation in medical practice. Information Technology & People 19(1), 55-73
Munkvold, G., Ellingsen, G., and Koksvik, H. (forthcoming). Formalising work – reallocating redundancy. In Proceedings of the Conference on Computer-Supported Cooperative Work. 2006
Nonaka, I. and Takeuchi, H. (1995). The Knowledge-Creating Company. Oxford Univ. Press. Oxford UK
Orlikowski, W. J. (2002). Knowing in practice: Enacting a Collective Capability in Distributed Organizing. Organization Science. 13(3) 249-273.
Sexton, A., Chan, C., Elliot, M., Stuart, J., Jayasuriya, R. and Crookes, P. (2004). Nursing handovers: do we really need them? Journal of Nursing Management 12. 37–42
Star S. L. and Strauss, A. (1999). Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work. Computer Supported Cooperative Work 8, 9-30
Svenningsen, S. (2003). Electronic Patient Records and Medical Practice: Reorganization of Roles, Responsibilities, and Risks. PhD-Series 10.2003, Samfundslitteratur, Copenhagen.
Timmermans, S and Berg, M. (2003). The practice of medical technology. Sociology of Health & Illness. Issue.25. 97–114
Walsham, G. (2001). Knowledge Management: The Benefits and Limitations of Computer Systems. European Management Journal. 19(6) 599-608.
Weick, K. E. (1995). Sensemaking in organisations. Thousand Oaks: SAGE Publications Inc.
Winthereik, B. R. and Vikkelsø, S. (2005). ICT and Integrated Care: Some Dilemmas of Standardising Inter-Organisational Communication. Computer Supported Cooperative Work 14, 43-67.

Paper six:
Standardization of work: co-constructed practice

Standardisation of work: co-constructed practice

Gunnar Ellingsen
Department of Telemedicine, University of Tromsø, 9000 Tromsø, gunnar.ellingsen@unn.no

Eric Monteiro
Department of Computer and Information Systems, Norwegian University of Science and Technology, 7491 Trondheim, eric.monteiro@idi.ntnu.no

Glenn Munkvold
Department of Information Technology, Nord-Trøndelag University College, 7729 Steinkjer, glenn.munkvold@idi.ntnu.no

Standardisation of work: co-constructed practice

Abstract

There is strong pressure to achieve greater uniformity, standardisation and application of best practices in the service professions, a sector which is growing in presence and importance. At the same time, there is a conflicting demand for the delivery of high-quality (or highly priced or 'knowledge intensive') specialised or localised services. Our paper analyses information systems' embedded efforts of standardising service work through an in-depth interpretative study of an ongoing standardisation initiative within the field of nursing. Nursing provides a graphic illustration of the dilemmas involved in the standardisation of service work. In nursing, standardisation is commonly a feature of projects to improve both efficiency and quality in health care. In contrast to the dominant conception of standardisation as a largely top-down, imposed process, we offer a view of standardisation as incomplete, co-constructed with users and with significant unintended consequences. The paper contributes by i) developing a theoretical perspective for the standardisation of information-system-embedded service work and ii) operational and practical implications for system design and health care management.

Keywords: standardisation, classification, healthcare, nursing, service work

1 Introduction

Today, corporate and public-sector entities are under strong and growing pressure to respond to inherently conflicting concerns: on the one hand, achieving economies of scale through the dissemination of 'best practices' and of standardised routines and procedures; on the other hand, an increasing demand for individualised services and products (Brunsson & Jacobsson, 2000; Bowker & Star, 1999**;** de Guy & Salaman, 1992). This dilemma is especially acute in the field of service delivery, as Leidner (1993) reminds us, because high-quality services are characterised specifically by the perception that they are not standardised but that they are sensitive to specific customers' needs (Alvesson**,** 2001).

Given the deeply embedded role of information systems (IS) in the ongoing transformation of modern organisations, we explore the effects of the conflicting forces involved in standardising service work in practice, analytically as well as operationally.

Standardisation within information systems is not new. There is a long history of formal or de jure standardisation of programming languages, communication protocols and exchange formats (Schmidt & Werle, 1998). There is an even stronger tradition of de facto standards for applications, operating systems and file formats (Kahin & Abbate 1995; Hanseth et al., 1996). What has received considerably less attention in IS research, however, is the study of IS-based initiatives for the standardisation of work and routines (Timmermans & Berg, 1997; Bowker et al., 1995). Given the growing presence and importance of the service sector, it is vital that IS research extends its focus from the standardisation of artefacts and products to include standardised, IS-embedded service work as well.

Our paper is based on an in-depth interpretative study of an ongoing IS-based intervention for the standardisation of one type of service work, namely nursing. The relevance of our case – the standardisation of planning, documentation and delivery of care for elderly, psychiatric patients at one ward at the University Hospital in Northern Norway – is associated with characteristic aspects of the case. Modern nursing is embedded in a highly *politicised* and *institutionalised* arena where governmental and managerial rules, regulations and policies are negotiated against local concerns and priorities. The need to curb large and seemingly ever-increasing health care *expenditure* is an explicit feature of managerial agendas for the increased standardisation of health care work (Timmermans & Berg, 2003). In contrast to many wards in Western hospitals, the ward which we selected for our study has a strong presence of *interdisciplinary* work. The effective treatment of elderly psychiatric patients cuts

across disciplinary boundaries between nursing, medicine and physiotherapy. From the perspective of knowledge sharing, nursing provides a good illustration of the tensions and trade-offs between narrative forms of knowledge and (efforts of) codified forms (Bruner, 1990; Boland & Tenkasi, 1995; Orr, 1996).

A key feature of using IS as a means to standardise service work lies in the challenge – manifest in health care delivery – to aim for efficiency and productivity gains as well as for improvements in quality *simultaneously*. Our intention is to develop an understanding of information systems embedded in the standardisation of service work. More specifically, we critically discuss prevailing approaches portraying standardisation as an "iron grid" imposed from the top down which subjects merely have to comply with (Schmidt & Werle, 1998). We outline an alternative, transformative perspective on standardisation as incomplete, co-constructed with users and with significant unintended consequences. A particularly interesting aspect of this is the way in which the same effects tend to emerge in a wide range of settings, i.e. for other users, in other circumstances and in other locations. Furthermore, we contribute by highlighting practical operational, implications for IS design and management derived from our conceptualisation of standardisation.

In the rest of this paper, section 2 describes in more detail some experiences and conceptualisations of standardisation in health care. Standardisation initiatives relating to nursing are discussed in particular. Section 2 elaborates on our transformative, co-constructive perspective on standardisation of service work, which forms the conceptual core of our paper. In section 3 we describe and reflect on methodological issues around our in-depth case study of standardising work at a ward at the University Hospital of Northern Norway during the implementation of IS-based nursing plans. Section 4 contains a chronological case narrative, describing the background, process and perceptions associated with introducing and using nursing plans to standardise documentation and content of work. Section 5 contains an analysis, and is divided into four parts. The first three parts discuss degrees of deviations from intended use of the standardised plan: from smaller adjustments and tinkering to more radical transformations which warrant our label of “co-constructions”. The fourth and final part of the analysis in section 5 addresses operationally relevant, design-related suggestions for improvement. Section 6 contains concluding remarks.

2 Perspectives on standardisation and health care

2.1 Standardisation in health care: efficiency and quality

Standardisation is embedded in efforts to improve efficiency and quality in health care (Timmermans & Berg, 1997; Winthereik & Vikkelsø, 2005; Klein, 2003). Given the very significant levels of health care expenditure throughout the Western world, the reasons for concern over efficiency are immediately obvious. The USA spends 14 % of GDP on health care (Light, 2000), the average in the EU is 8.6 % (BBC News, 2000) and in Norway it is 10.3 % of GDP (WHO, 2003). Despite efforts to contain it, expenditure keeps increasing. To illustrate from the Norwegian context, the period 1980 to 1995 saw a 1.2 % inflation-adjusted increase in expenditure per year in somatic hospitals, which increased to 4.8% per year between 1995 and 2000 (SHD, 2000-2001).

Ensuring sufficient quality of treatment and care is another pressing issue for health authorities. In a US Institute of Medicine report from 2000, the Committee on Quality of Health Care in America estimates that medical errors (e.g. errors in administering drugs or planned treatments) are the leading cause of death in the United States (Kohn et al., 2000; IOM, 2001). Similarly, investigations in Norwegian health care indicate that fatal adverse drug events represent a major problem in hospitals, especially in elderly patients with multiple diseases (Ebbesen et al., 2001). It is also suggested that between 5% and 10 % of all hospital admissions are caused by the wrong use of medication (Buajordet et al., 2001; Ebbesen et al., 2001).

Improving both efficiency and quality is an enormous undertaking, especially since the notions of efficiency and quality are often seen as contradictory terms (Law, 2003, p. 10). Yet standardisation is a key element in attempts to improve efficiency and quality in health care. Governmental efforts to achieve standardisation take on many forms. Timmermans and Berg (2003) distinguish between four broad categories of standards: design standards, performance standards, terminological standards and procedural standards. Design standards represent detailed and structural specifications of social and technical systems, ensuring compatibility, logistics and integration. Performance standards represent outcome specifications, identifying the result of an action. An example is the Norwegian initiative in 2003 to establish national quality indicators as an external benchmarking measurement. The purpose was to present to the public a summary of which hospitals could provide the best quality of treatment and care, and to facilitate the growth of market mechanisms in health care.

The third and fourth categories are the most relevant ones for this paper. Terminological standards have had an important role in modern medicine for a long time. For example, the global World Health Organisation (WHO) based ICD[1] (International Classification of Diseases), NANDA[2] (North American Nursing Diagnosis Association) and SNOMED[3] (the Systematised Nomenclature of Medicine. Standardised terminologies have been developed and used to ensure consistency of meaning across time and place, enabling large-scale planning opportunities for local users as well as for national health authorities and international health organisations.

The fourth category of standardisation is derived from the ongoing process of standardising medical work through clinical guidelines, protocols and care plans[4]. The purpose is to establish 'best practices' to "delineat[e] a number of steps to be taken when specified conditions are met" (Timmermans & Berg, 2003, p. 25). Such standards are assumed to increase both quality and predictability, thus "maximis[ing] the likelihood that the same thing is being done to each patient" (Coiera, 2003, p. 146), and also taking account of the cost factor:

> "Over the past three decades, public and private purchasers turned to managed care plans to stimulate greater hospital competition and reduce hospital expenditures and costs" (Devers et al., 2003, pp. 419-420).

2.2 Nursing: plans as standardised care

The implementation of electronic clinical nursing plans is an example of the third and fourth type of standards outlined above: terminological standards and the standardisation of medical work. Nursing plans are closely aligned with health authorities' aspirations for quality assurance and cost control. For the nursing profession, however, there is an additional agenda associated with the professionalisation and legitimisation of nursing:

> "Ultimately, the documentation practices reflect the values of the nursing personnel." (Voutilainen et al., 2004, pp. 79-80)

---

[1] http://www.who.int/classifications/icd/en/ (accessed March 20. 2006)

[2] http://www.nanda.org/ (accessed March 20. 2006)

[3] http://www.snomed.org/snomedct/ (accessed March 20. 2006)

[4] We use the terms 'care plan' and 'nursing plan' as equivalents throughout this article.

Traditionally, nurses have struggled to achieve status for their profession as independent from rather than subordinate to physicians, and hitherto nurses' documentation has been relatively 'invisible' (Bowker et al, 2001; Star & Strauss, 1999). An effective nursing classification system can therefore be seen as a precondition for the increased professionalisation of nursing.

Care plans are integral to this initiative. Basically, a care plan is an overview of probable nurse-related diagnoses or problems associated with a particular patient group, combined with relevant interventions. It is perfectly aligned with the expectations of increased efficiency and quality outlined above:

> "It is expected that nurses obtaining appropriate and accurate information when they need it will improve the chance of making better decisions about patient care." (Lee & Chang, 2004, p. 38).

Similar expectations are echoed in Norwegian policy documents (KITH, 2003a, pp. 10-11; Nurses' Forum for ICT, 2002). The latter argues that:

> "An EPR may easily present current guidelines or procedures and then it is possible to document just the deviation (…) this may simplify the documentation and increase the quality of nursing" (Nurses' Forum for ICT, 2002, p. 17).

At the core of the nursing plan is its shared terminology. As with the ICD for physicians, the classification systems embedded in the nursing plan are tailored to nurses' work. Nurses apply this terminology to describe the patients' problem (i.e. nurse diagnoses): they link each problem with one or several interventions, detailing what to do in particular situations.

Some of the best-known systems are NANDA (North American Nursing Diagnosis Association), NIC[5] (Nursing Intervention Classification), NOC[6] (Nursing Outcome Classification) and ICNP[7] (International Classification on Nursing Practice) (Hellesø & Ruland, 2001).

---

[5] http://www.nursing.uiowa.edu/centers/cncce/nic/ (accessed March 20. 2006)

[6] http://www.nursing.uiowa.edu/centers/cncce/noc/ (accessed March 20. 2006)

[7] Without going into the matter in depth, we recognise that there are other classification systems for nursing diagnoses and practice as well. These include the CCC (Clinical Care Classification), previously known as the HHCC (Home Health Care Classification) System

In contrast to the ICD, which is more than a hundred years old, classification systems for nurses are a relatively new phenomenon. The first initiative dates back to the early 1970s, when the North American Nursing Diagnosis Association developed NANDA (McCloskey & Bulechek, 1994). Today, further development of NANDA is based on consensus decision-making. Every second year, diagnoses are presented and validated at NANDA conferences. The most recent edition of NANDA, from 2005-2006, contains 167 diagnoses classified into nine domains. Each diagnosis has the following attributes: a label, a definition, defining characteristics and related factors[8].

Both NIC and NOC can be used together with NANDA, as the three systems cover different parts of the nursing process (NANDA applies to problems, NIC to interventions and NOC to outcomes). The NIC taxonomy was developed by the Iowa Intervention Project, which was established in 1989. The first version of the NIC classification was published in 1992, and it is updated every fourth year[9]. The current version was published in 2004 and contains 514 nursing interventions grouped into 30 classes and 7 domains.

Nursing care plans have gained widespread international attention recently, especially with the implementation of electronic patient records (EPRs) in hospitals (Lee, 2005; Lee et al., 2002**;** Timmons, 2003; Getty et al., 1999**;** Lee & Chang, 2004). This is because EPRs are recognised as convenient vehicles for formalising nursing work and documentation as well. This trend is evident in Norway (DIPS, 2005; KITH, 2003a; 2003b; Hellesø & Ruland, 2001). However, given the high expectations and extensive initiatives outlined above, the actual *use* of care plans has so far been disappointing. Studies have indicated that "nurses have problems integrating the nursing process and care planning into their daily record-keeping" (Björvell et al., 2002, p. 35). In a survey cited by Sexton et al. (2004, p. 38), "nursing care plans were

---

(http://www.sabacare.com/ (accessed March 20. 2006), the Omaha system and the Patient Care Data Set (Hyun & Park, 2002, p. 100)). The ICNP covers the whole range of diagnoses, interventions and outcomes (Hellesø & Ruland, 2001). A project to establish ICNP was initiated in 1989 by the International Council of Nurses as an effort to unify the existing nursing languages (Hyun & Park, 2002). The ICNP is still a 'young' system, as version 1 was launched in 2005 by the Taiwan International Council of Nurses (http://icn.ch/index.html (accessed March 20. 2006)).

[8] http://www.nanda.org/ (accessed March 20. 2006)

[9] http://www.nursing.uiowa.edu/centers/cncce/nic/ (accessed March 20. 2006)

referred to in handover only 1% of the time and this was probably because care plans were not being updated". One explanation may be that the "nursing process is thought to be time-consuming to document" and its value was questioned (Waters, 1999, p. 80). For instance, some observers have argued that care plans were more significant for the professionalism of nurses than for patient care (Lee & Chang, 2004). In other cases, cultural differences caused difficulties in using a global classification system such as NANDA (Lee et al., 2002).

Due to the infrequent use of care plans, they have not been discussed extensively. Some notable exceptions exist: Bowker et al. (1995) related the NANDA and NIC terminologies to the legitimacy and visibility of the nursing profession. While thoroughly covering these terminologies, they do not describe the actual work of nursing in much detail. Wilson (2002), on the other hand, analysed a case from a UK-based hospital where the nurses rejected a care plan system because it was never associated with nursing. The nurses argued that the system made them prioritise record keeping at the expense of delivery of care.

2.3 Standardisation as co-constructive practice

We develop our analytical perspective on standardisation in two steps. First, we discuss the traditional approach to standardisation, which focuses imposing standards top down in a fairly prescriptive manner. The key points here are that the standard is fixed and the users merely adapt to the standard. Secondly, we move from this traditional approach to a *co-constructive* perspective in which standardisation and work practice mutually shape and constitute each other. We thus emphasise standardisation as a socially constructed negotiation *process*.

The traditional approach to global standardisation assigns a very important role to international standardisation bodies as providers of standards. The International Organisation for Standardisation (ISO[10]) based in Geneva, Switzerland, is one of the most important of these bodies, and represents more than 140 countries (EHTEL, 2002). Since NANDA and ICNP have a global scope, they have both asserted compliance with ISO 18104.

Another international standardisation body important in healthcare is the HL7[11] accredited by the American National Standards Institute[12]. HL7 is today the largest health information standards developer in the world. It focuses on the electronic interchange of clinical, financial

[10] http://www.iso.org/iso/en/ISOOnline.frontpage (accessed March 20. 2006)

[11] Health Level Seven at http://www.hl7.org/ (accessed March 20. 2006)

[12] American National Standards Institute at http://www.ansi.org/ (accessed March 20. 2006)

and administrative information among independent healthcare-oriented information systems (Tsiknakis et al., 2002, p. 11).

For the European healthcare sector, the CEN/TC251 is a major standardisation body. It is responsible for organising, coordinating, and monitoring the development of standards in health care (van Bemmel & Musen, 1997, p. 515). In Norway, standardisation in health care is coordinated by the Norwegian Centre for Informatics in Health and Social Care (KITH).

A striking feature of these organisations is that their scope on standardisation is extended. From dealing with technical standards and terminologies, they are now increasingly "interlocking with and being reinforced by the drive toward evidence-based medicine" (Timmermans & Berg, 2003, p. 7). This implies that processes, work practices and guidelines are of increasing concern. An illustration is the ISO standard IWA-1 (2005), which aims at:

> "provid[ing] additional guidance for any health service organisation involved in the management, delivery, or administration of health service products or services, including training and/or research, in the life continuum process for human beings, regardless of type, size and the product or service provided" (ISO IWA, 2005).

Still, the common strategy for both international and national standardisation agencies is to develop standardisation far away from local work practice. Sometimes, local work practice is even defined as the real obstacle to standardisation. For example, the former chairman of CEN/ TC 251, De Moore (1993) asserts firmly that it is important to eliminate standards evolving from local contexts:

> "to make sure that unsuitable circumstances (e.g. proliferation of incomplete solutions) are not allowed to take root…[so] standardisation must be started as soon as possible in order to set the development in the right track" (De Moore, 1993, p. 4).

However, a major flaw in this position is that it downplays to the level of non-existence the challenges of implementation, i.e. the *process* of standardisation (Akrich, 1992). Empirical studies demonstrate vividly how political negotiations influence standardisation processes (Bowker & Star, 1999; Lachmund, 1999; Hanseth & Monteiro, 1997). Bowker and Star (1999, pp. 120-121) use the example of the issue of still births in the 1920s: Catholic countries fought to recognise the embryo as a living being, statistically equivalent to an infant, while Protestant countries were far less likely to do so. Similarly, Hanseth and Monteiro (1997) describe how the emergence of standards for exchanging laboratory results between laboratories and general practitioners saw different arguments framed as trade-offs between

different technical costs and benefits, while the real issue at stake was a race between different actors, promoting technologies which seemed most beneficial for them.

Through their work on clinical protocols, Timmermans and Berg (1997) argue similarly that while standards attempt to change and replace current practices, they also need to incorporate and extend those routines. The standard is expected to function in a work practice consisting of existing interests, relations and infrastructures.

Timmermans and Berg (1997) also point out that users are anything but mindless slaves to standards. Rather, minor and not so minor deviations are practiced routinely. They describe other tinkering strategies to make the protocol work, such as searching for the right protocol for their patient, introducing deviations and adaptations, and even circumventing the protocol. At times the users go beyond the boundaries of the protocols, making ad hoc decisions and even repairing the deviations of others. However, an important point is that such tinkering with the protocol is not a failing, but a *prerequisite* for the protocol to function: it allows leeway to adjust the protocol to unforeseen events (ibid, p. 293).

To sum up, the design and use of a standard are *co-constructed*. In this way, the global standard both shapes and is shaped by local work practice. In the words of Timmermans and Berg (1997, p. 297), standardised work always involves 'local universalities'. Our contribution in this regard is that we combine this theoretical insight with an in-depth empirical study, demonstrating how standardisation unfolds in practice.

3 Method

3.1 Research setting

The Department of Special Psychiatry (SPA) is located in the countryside outside Tromsø, some 5 kilometres away from the rest of the University Hospital in Northern Norway (UNN). It is the only institution in the health region which accepts involuntary admissions of patients suffering from psychiatric disorders. The department's area of expertise encompasses psychogeriatrics, drug addiction associated with serious psychiatric problems, and aggressive behavioural disturbances, including patients with sentences imposing psychiatric therapy. Approximately 350 people work at the institution, which admitted 155 patients in 2005.

Our study was carried out in the psychogeriatric ward at the Department of Special Psychiatry. Patients in this ward are aged 65 years or more, and suffer from dementia, senility

or anxiety. The ward has 15 rooms, and treats 95 patients a year with an average length of stay of 6-8 weeks. Some 45 people work permanently here, including nurses, unskilled workers and substitutes[13], social workers, occupational therapists and physiotherapists. In addition, three physicians and one psychologist pay regular visits. The staff turnover in the ward is high, with up to 5 new unskilled workers starting each month.

In the day room, one often finds nurses talking quietly to the patients, in a calming manner. However, this may change as one patient suddenly starts to yell and shout, unable to control his anxiety or aggression. Then additional nurses are quickly called for and a set of predefined measures is put into action.

Due to the somatic and psychiatric complexity of the patients' conditions, the ward relies on an interdisciplinary approach to treatment and care. Nursing observations are particularly important, as one of the physicians explained:

> "In this ward, medical treatment has little effect on the patients. Therefore, environmental therapy becomes especially important (…). Several of our patients come from closed units and have a history of smashed doors and walls. After a couple of days in here they are meek as a lamb." (Physician)

3.2 Research method

Adhering to an interpretative research approach (Klein & Myers, 1999; Walsham, 1995), our main aim was to understand the standardisation of work as it unfolds in the practice of everyday nursing. Data collection methods consisted of i) semi-structured interviews, ii) participant observations and informal discussions, iii) document analysis, and iv) participation in internal project meetings.

Fifteen interviews were carried out between May and December 2005, at ten of which two of the authors were present. On average the interviews lasted 1-1.5 hours. They were taped and subsequently transcribed.

[13] Unskilled nurses and substitutes fill the same role as qualified nurses and are referred to as nurses in this paper.

Field trips / Position	1st visit May	2nd visit June	3rd visit August	Total
Norwegian Nurses Association	1			1
Project manager (hospital)		1		1
Nurses	1	3	4	8
Physician		1		1
Psychologist			1	1
Project group nurses (local)	1	1	1	3

Figure 1: Categorisation of the 15 interviews involved in our study

In total, 80 hours of observation were conducted, mainly in the duty room during reporting, but also during other activities such as nurse handovers, interdisciplinary cardex and treatment meetings. Handwritten field notes were written up as soon as possible after each observation session. While observing, we attempted to cover a range of actors and interactions. For instance, in the observation of work activities and discussions, we looked for potentially different interpretations of the same phenomenon.

The third and fourth methods of data collection were document analysis and participation in internal EPR-project meetings. This included both collecting and reading relevant documents about the project itself (specifications, news letters, training material) as well as the nursing documentation (reports, plans and cardexes). During the second and third visit to the ward, we also attended four internal EPR project meetings where we were increasingly able to provide feedback on our findings.

The overall process of collecting and analysing data was open-ended and iterative, with the earlier stages being more explorative than later ones. Empirically and analytically, all three authors have an extensive history of involvement in the health care domain, including a shared interest in the design and use of EPRs. The first author has studied the implementation of EPRs at UNN for several years. The second author has a long history of involvement in national and international projects dealing with health information systems. The third author

has been following the implementation of electronic nursing documentation at three Norwegian hospitals in addition to UNN.

Our analytical categories emerged gradually from internal discussions, reading of field notes and external presentations. However, first-order conceptualisation (van Maanen, 2002) started at the field site. When possible, we reflected on our observations and discussed potential issues to pursue further. At the end of each day, we discussed our observations and made plans for the following day. Between each field trip, notes from our individual observations, transcribed interviews and collected documents were shared and discussed. An important product of this work was a document of second-level issues and concepts (van Maanen, 2002), which was also used in discussions with the second author.

During our first field visit we spent a significant amount of time engaged in informal discussions with key actors in the project, partly to gain legitimacy, and partly to inform the issues of our study (Klein & Myers, 1999). Plans for our field study were made in cooperation with the head of the department. Having generated general insight into the project during our second field visit, we directed our attention towards the psychogeriatric ward. At this stage, theories on standardisation (Timmermans & Berg, 2003) had been identified as a major theme for our study, thus guiding our data collection strategy (see Principle of abstraction and generalisations in Klein & Myers, 1999, p. 72).

The combination of observation and interviews was particularly useful both to validate our observations and to provide access to data that was not otherwise readily available.

We validated our interpretations by presenting preliminary results at several seminars. Firstly, we presented our findings to the staff using the EPR in the Department of Special Psychiatry. Secondly, we presented and discussed our findings on two occasions with research colleagues at the Norwegian EHR Research Centre (NSEP). Finally our work was presented to the full executive board of the vendor of the EPR, which we will refer to as ‘HealthSys’.

4 Case: standardisation of nurse work

4.1 Motivation and start-up

During 2004 and 2005, the University Hospital of Northern Norway (UNN) was the site of a large-scale EPR implementation project. The aim was to establish a common EPR infrastructure which cut across departmental (clinic and laboratories) and professional (physicians, secretaries and nurses) boundaries.

HealthSys is a major Norwegian-based vendor of health-based information systems, currently serving about a third of the Norwegian EPR market. In addition to the EPR, HealthSys offers laboratory systems, patient administration systems and radiology systems. Together, these systems are promoted as parts of an all-encompassing hospital system. The project at UNN started in 2003 with the decision to acquire all of the HealthSys modules. Figure 2 illustrates local initiatives at the Department of Special Psychiatry in the context of hospital level initiatives.

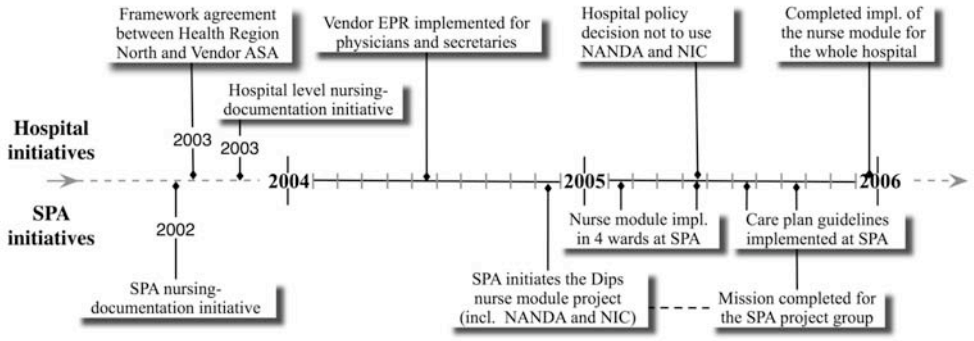


Figure 2: Timeline illustrating EPR initiatives at the Department of Special Psychiatry (below the timeline) in the context of hospital level initiatives (above the timeline)

A major goal in the project has been to replace the existing paper-based nursing documentation. The HealthSys EPR contains a nursing module which has been developed to support the nurses' daily reports (several per day) and a structured nursing plan which supports planning and overview. The electronic nursing module was implemented in the Department of Special Psychiatry in April 2005 (an example of the interface is provided in Figure 3).

The Department of Special Psychiatry was highly motivated to implement the nursing module in its four wards. The departments' keen interest was associated with increased political attention towards improved quality in the psychiatric sector. At the same time, the Norwegian Nurses Association was interested in promoting the nursing profession in the health sector. The nursing plan was seen as a means towards achieving this goal (Nurses Forum for ICT, 2002; also see earlier discussion). National interests and rhetoric were thus translated into local demand for improved documentation practice:

> "We must concentrate on documenting what is important and exclude [details such as] whether someone has eaten four slices of bread with jam or whether the husband brought five roses when he paid a visit" (project group nurse 1)

Some of the nurses even suggested that the nursing plan might contribute to improved efficiency and a better overview of the process of planning. In that sense, the former content of the reports, such as diagnoses, interventions and other repetitive patient-related information, could be transferred from the reports to the nursing plan:

> "In fact, if you are involved in planned care, you should hardly have to write daily reports at all as everything should be in the nursing plan. For instance, if the plan states that the patient needs help related to feeding and anxiety (…) and we adhere to it each time, we need not reiterate this in every report" (project group nurse 2)

In the spring of 2004, the Department of Special Psychiatry conducted a workshop on electronic nursing documentation. The vendor, HealthSys, also participated. In November 2004, the department established a project with the aim of implementing the EPR nursing module. Two nurses and one secretary were recruited internally to run the project. They spent two days a week preparing for the implementation of electronic nursing documentation in the department's four wards. This included training users who lacked basic computer skills, regularly coordinating activities between the local project and the central EPR project at UNN, and reading reports from and visiting other hospitals engaged in similar projects. They also developed a help system for basic nursing procedures in the new EPR.

In sum, this contributed to a relatively smooth start-up process of the system in February 2005, both in the psychogeriatric ward and in the three other wards in the department.

4.2 The nursing module in the new EPR

For each patient there is only one nursing plan. Basically, the nursing module is divided into two very different parts. The first part is the report section where users write reports on a patient several (usually three) times a day. Although there is some structure in this section (see Figure 3), the users have the flexibility of writing free text, i.e. constructing a narrative of the patients' problems. The second part is the nursing plan section consisting of international codes, identifying diagnosis and related interventions for a patient. In spite of the difference between the report and the nursing plan, they are interconnected and mutually dependent. Each time a report is written or read in the upper part of the screen, the patients' current nursing plan is presented in the lower part.

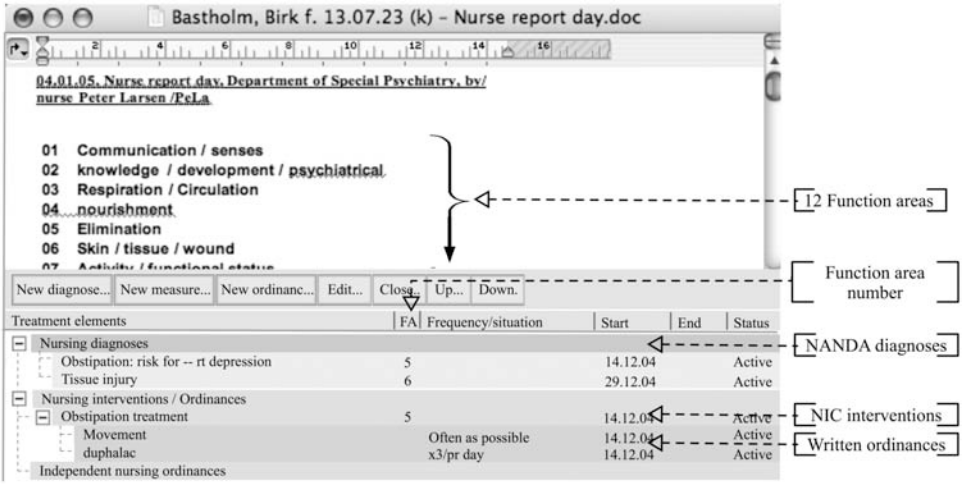


Figure 3: The interface of the nursing module. Each time a report is written, the current care plan is presented in the lower part of the screen. The function area number represents a possible connection between the report and the plan.

The content of the report is structured according to the 12 function areas (see Figure 4).

01	Communication / senses
02	Knowledge / development / psychiatric
03	Respiration / Circulation
04	Nourishment
05	Elimination
06	Skin / tissue / wound
07	Activity / functional status
08	Pain/ sleep / rest / well-being
09	Sexuality / reproduction
10	Social / planning of discharge
11	Spiritual / cultural / lifestyle
12	Other things / tasks delegated from physicians and observations

Figure 4: The 12 function areas in the report, which also is used to organise NANDA diagnoses and NIC interventions in the care plan.

The nursing plan is based on the NANDA and NIC classification systems. One NANDA diagnosis may spawn one or several NIC interventions. For each NIC intervention there may

be several instructions (direct actions). The instructions are written in plain text extensions in the plan.

NANDA and NIC are structured into 12 function areas in the report. This is not a part of the international NANDA and NIC classification schemes; it has been introduced by the vendor, HealthSys, to make it easier to find specific diagnoses and interventions in a given function area. The function area for a given NANDA/ NIC code is also shown in the plan, indicated by a number. This makes it easier to write a report and indicates the categories in the report to be filled in, based on the function areas in the plan. More specifically, the user writing the report is expected to use the plan with its diagnosis, interventions and instructions as a basis for the reports. Only deviations from the plan are expected to be documented in the report, thus keeping the content of the report to a minimum.

> "The goal is to write as little as possible in the report and to write in relationship to what is in the nursing plan and describe deviation from it" (Project group nurse 2)

A NANDA diagnosis and a NIC intervention may fit within several function areas, emphasising the challenge of finding the links between the two classification systems. There is no formal connection between diagnoses and interventions, because one diagnosis may require several interventions and one intervention may cover several diagnoses.

4.3 The use of the nursing module in the psychogeriatric ward

The users emphasise two key outcomes of the electronic nursing documentation project in the psychogeriatric ward. Firstly, the EPR nursing module implementation is generally perceived as a success as it provides a clear overview:

> "People attending the meetings have already read the reports, nursing plans and everything. So now we focus on the core of the case (…) and don't have to read everything aloud during the meetings" (Nurse 1).

An experienced nurse on regular night duty, covering all the four wards in the department, elaborated:

> "Now, when I come to the psychogeriatric ward (…), I just open the nursing plan and see the diagnoses instantly. Since the plan contains standardised codes, I get a quick overview of the patients' troublesome areas, thus informing me of what to expect" (Project group nurse 3)

From this rather positive outcome we move on to the second consequence of the implementation. In spite of a well-planned project, the project members had to cope with an unexpected situation: the users realised that adding new diagnoses and interventions required intensive mouse-clicking through various windows, dialogue boxes and menus in the application. In short, they felt that the user interface was not user-friendly (enough):

> "You have to [actively] select a function area, which should have appeared automatically … then you have to respond to 'Do you want to save?' repeatedly … [also] there are poor search possibilities when removing interventions" (Nurse 2)

Furthermore, even though the NANDA diagnoses and the NIC interventions represent relatively wide categories, additional work was required to find the right category. The users had to spend significant amounts of time searching for diagnoses and interventions.

Another difficulty was that the broadness of the categories made the codes useless as standalone codes:

> "By themselves, the codes are completely open and many of them say absolutely nothing" (Nurse 3)

4.4 The EPR nursing module and the broader context

While the psychogeriatric ward was positive about using the EPR nursing plan, the other three wards in the Department of Special Psychiatry were more reluctant. We believe that the reluctance may be understood in two ways. Firstly, the *turnover* frequency of the patients in the other wards was not as high as that in the psychogeriatric ward. Consequently, these patients and their needs were already known, and there was less need for communication and overview. Moreover, the plan in one of the wards (the security ward) had a different role to that of the nursing plan in the EPR. Their plans, straightforward A4 paper sheets, were 'negotiated contracts' between the staff and the psychiatric patients.

Secondly, reluctance to use the EPR in the other wards must also be understood in terms of how the classification systems NIC and NANDA were assumed to imply fragmentation of the nurses' work in general. Classification systems for nurses were considered to be a threat to the traditional holistic way in which nurses provided care to patients. This view was not confined to wards in the Department of Special Psychiatry; it mirrored a concern in many of the other departments participating in implementing the nursing module. At a meeting for the hospitals' head nurses in May 2005, one of them asked rhetorically:

> "Will there be two languages now, one for the clinic and one for research and statistics [based on NIC and NANDA]?" (Head nurse 1, from another department)

As a result, the group of head nurses decided not to proceed with NIC and NANDA at that time. This decision, however, did not influence the project at the Department of Special Psychiatry as they already had been using the EPR nursing module for several months. The lack of enthusiasm for nursing plans in the rest of the hospital meant that when the implementation of the nursing module in December 2005 was completed, it was only the Department of Special Psychiatry (or more precisely, the psychogeriatric ward), which had gained in-depth experience of the new system.

5 Analysis

The purpose of our analysis is to map and discuss how structurally imposed standardisation efforts mesh with the everyday practice of health care delivery. Our point of departure (see section 2) is that the standards to be imposed had the status of intentions. They were embedded or institutionalised into work routines through a process of *transformation* – in part intended, in part non-intended – of both the standards and configurations of work. In this sense, standardisation needs to be recognised as *co-constructed practice*.

5.1 The invisible work of fitting categories

The core idea of a plan-based approach to nursing at UNN is to work out a list of pairs of NANDA/NIC for every patient. In other words, the plan consists of a number of pairs where each pair consists of one nurse diagnosis (coded in NANDA) tied to one intervention (coded in NIC). Despite this conceptual simplicity, a lot of non-obvious work is involved in establishing each of the NANDA/ NIC pairs. This corresponds closely to what feminists termed *invisible* work, and which subsequently has been identified in numerous settings and forms by IS scholars (Schmidt & Bannon, 1992; Star, 1991). For instance, Bowers (1994) points out the essential, yet 'invisible', element of maintenance and constant support throughout the implementation process.

Establishing the NANDA/ NIC pair involves a substantial amount of relatively time-consuming searching. Typically, one might start off by attempting to determine diagnosis code. NANDA, however, contains 167 distinct diagnosis codes, which are difficult to remember. There are two ways to search for NANDA codes at UNN. The user can search directly by entering the first letter of the word of the diagnosis. Alternatively, the user may

delimit the returned values by selecting a function area (see Figure 5, which illustrates the selection of function area 3). By choosing a function area, the user retrieves approximately 13 of NANDA's 167 diagnoses. It is then relatively easy to browse through all the diagnoses in this category.

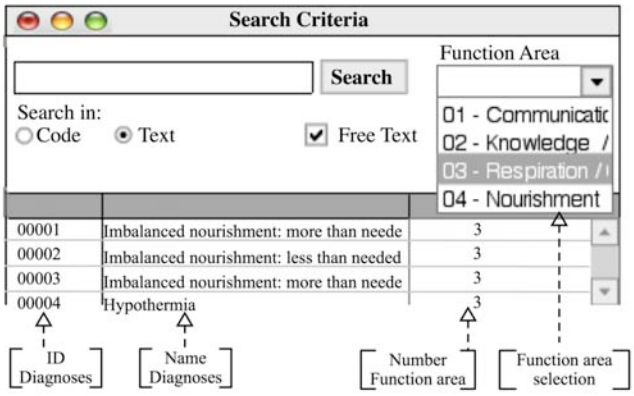


Figure 5: Interface for searching among NANDA diagnosis codes. To search, the user can either use free text or select one of 12 function areas. The figure shows the latter search method.

The search for NIC interventions is accomplished in a similar way, but there are 514 NIC interventions. The training manual in the department suggests that even if a function area is selected, there are still too many interventions to browse through, and hence encourages the use of a search word before the search button is used. Still, the exact match is sometimes difficult to obtain:

> "Sometimes you don't find the interventions you need and end up having to take what is closest. You also have to say things in other words. In addition, you have to say how often an intervention is going to occur. The biggest difficulty is that you cannot write freely". (Nurse 4)

There is no formal relationship between diagnoses and interventions, because one diagnosis may require several interventions and one intervention may cover several diagnoses. The only link is through the associated function area. As a NANDA diagnosis and a NIC intervention may belong to, and cover, several function areas, the challenge of identifying the links between the two classification systems tends to be time-consuming.

Both NANDA and NIC are constructed as general-purpose classification schemes, i.e. are intended to cover all types of (western) hospitals. As the ward we studied is highly specialised, this implies that only a subset of the total NANDA and NIC codes are relevant; the codes used are clustered around only a small proportion of the 167/514 which are available. Specifically, function area 02 (see Figure 4) addressing 'Knowledge / development/ psychiatric' is favoured in a majority of cases "as a general rule" (Nurse 3). Moreover, the relatively few codes within function area 02 are too crude to capture the variations in practice in the ward.

The relatively open categories within function area 02 are not precise enough to inform the subsequent actions which are planned. In response, the nurses actively refine the broad categories by adding '--' and a subsequent amendment. Figure 6 illustrates how open categories are broken down and specialised by filling in '--' and free text. In the plan these amendments appear directly after the NANDA diagnoses in the plan, marked by '--'. In figure 6, six of the eleven diagnoses have an amendment.

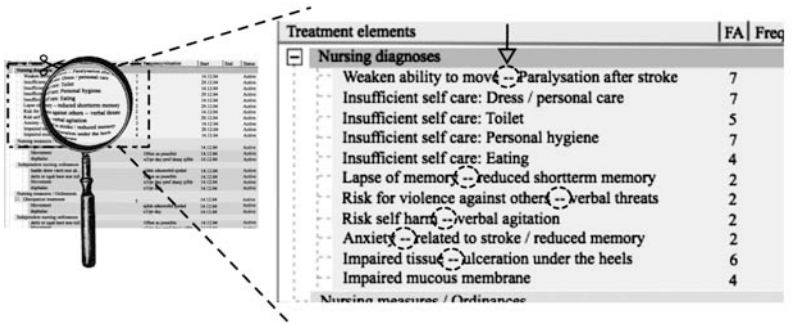


Figure 6: The figure illustrates how open categories are broken down and specialised. The double hyphen '- -' is used to separate free text information (nurses' elaboration) from standard text (NIC interventions).

One nurse explains the need to add details to the NANDA diagnosis 'Risk for violence against others' (see Figure 6):

> "Look here, this is the diagnosis 'Risk for violence against others', but we have to add 'verbal threats', 'threatening behaviour when we activate restrictions for him'. We have to add these things to understand the patient" (Nurse 4)

The practice of elaborating the given categories through specialisation illustrates a general dilemma concerning the trade-offs in calibrating the level of *granularity* in schemes of

categories and standards: a crude level of granularity (i.e. open categories) imply that relatively little work is required when writing, but a corresponding amount of work for the reader is required and *vice versa*. Building empirically on the ICD, Bowker and Star (1999) elegantly explain a similar trade-off between general practitioners (writers) and health policy institutions (readers).

5.2 Transforming categories

The classification schemes of NANDA and NIC are not merely tinkered with or adjusted marginally as illustrated above. They are transformed and reconfigured actively by the nurses through their gradual institutionalisation. This goes well beyond reactive 'adaptation' and indicates what Berg and Timmermans (2000, p. 45) accurately identify as the *constitutive* element of the users. The users of classification schemes are not meek subjects of an imposed standard; they participate in altering – ultimately transforming – that very standard. Without this transformation, the standard would not work.

A practical and real concern, especially for the more elaborate plans, is to maintain a clear sense of which diagnoses are linked to which interventions. In the current system, the only way to make these connections was via the function areas. Figure 7 illustrates how the NANDA diagnosis 'Anxiety' (circled in the yellow part) is linked to three different interventions (circled in the blue parts). Given this, a key concern was to manipulate the sequence of the diagnosis and interventions to ease readability in general and communicate in a more nuanced way about degrees of urgency in particular. The patient whose plan is depicted in figure 7 suffered from numerous conditions, but one of the most important was neglect[14] on her left side caused by a stroke. She therefore became extremely anxious, which resulted in frequent shouting and yelling. As the nurse working out the plan said while pointing to the NANDA code 'Anxiety':

> "To reduce anxiety is *the* most important intervention to avoid the shouting and yelling (…) the problem is that the intervention related to this diagnosis appears so far

[14] After a stroke, some people suffer from a syndrome called 'neglect' People with neglect may not appear to process sensory information from the left side of their body. http://ww2.heartandstroke.ca/Page.asp?PageID=33&ArticleID=2570&Src=stroke&From=SubCategory

down in the plan that it is difficult to see the relationship between the diagnosis and the intervention" (Nurse 3)

To emphasise and communicate this to subsequent readers of the plan, she moved this intervention (broken line in Figure 7) to the top of the list of NIC interventions to signal utmost urgency.

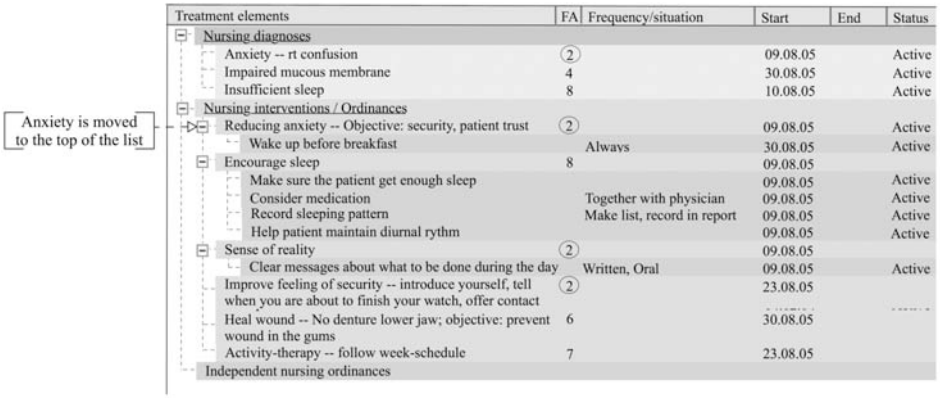


Figure 7: The plan for a patient suffering from numerous conditions. Notice how the intervention 'Reducing Anxiety' has been moved to the top of the list to indicate its increased importance.

Another way in which the content of and practices around plans were transformed was the way *redundancy* was (re-)introduced to make them more robust. As previous scholars have noted (Perrow, 1984; Ellingsen & Monteiro, 2003), certain instances of redundancy of information, despite contradicting fundamental principles in traditional IS and database design (Bass et al., 2003), fill productive and practical roles in ongoing work.

For instance, although certain information was already contained in the plans, sometimes the daily report repeated the content of the plan. Consider this extract from the daily report which Nurse 3 wrote for a diabetic patient:

> "Be aware of the restrictions concerning fruits, cakes, etc. The patient is not capable of regulating the amount of these things. See the nursing plan" (extract from the report)

This information was already captured in the plan, so why repeat it here? Nurse 3 explained:

> "Sometimes things are registered *twice*, that is, what is in the report you may also find in the nursing plan. This has to do with experience… I know that the report is read aloud at the change of shift meeting while the nursing plan is not" (Nurse 3)

In response to an inability to decide uniquely how to classify interventions, a common strategy is to *duplicate* the information by entering it in both possible places, but slightly rephrased to 'cover up' the duplication. Consider the patient with neglect on her left side. The nurse was not quite sure where to put the instructions 'talk to' and 'inform'. She finally decided to place them under the NIC intervention 'reducing anxiety'. But after further reflection, she decided that this instruction might equally well be placed in the NIC intervention category 'neglect – left side'. Therefore, she rephrased the instructions 'talk to' and 'inform' into 'explain what is going on' and added it to the 'neglect – left side' category as well. She admitted that this meant that similar instructions were entered in several categories, but as she said: "It has to be like this in order to be visible in both places" (see Figure 8).

Intervention: Reducing anxiety
Instruction: **Talk to**
Instruction: **Inform**
Intervention: neglect – left side
Instruction: **explain what is going on**

Figure 8: An example of how similar instructions are entered in two different NIC-intervention categories to make them visible in both places.

A common (but often downplayed) feature of health work is the constant and considerable element of insecurity about what to do next (see e.g. Berg, 1997). Rather than following clear plans, care delivery frequently takes the form of stepwise explorations with high degrees of uncertainty. Consider what the nurse says, having selected a nursing plan for a patient.

> "This patient was so crazy when we admitted her that we did not know what to do. Look what they have done here … it was cunningly done … they have put a question mark ("?") behind the diagnosis because they did not know whether she suffered from hallucinations or not" (Nurse 2)

This signalled that the patients' problem had not yet been defined. In the field for NIC interventions, this was followed up by suggestions. For instance, for the NIC intervention

'active listening', the amendment "with regard to development of dementia, delusion or confusion" was added. This encouraged staff to observe the patient closely. Another strategy was to suggest different options, encouraging the staff to try them in turn:

> "Try out these things to make the patient eat: type of food, specific locations, ask the patient each time what he wants, provide specific remedies to keep the spoon, black briquette under the plate, be present, etc." (Project group nurse 3)

In this way, the staff got to know the patient and to define the problem. After a while the plan would be tightened up and become more precise. In sum, the extent and character of the transformation of the apparently ready-made categories in NANDA and NIC demonstrate their essential, or indeed, constitutive, role.

5.3 Relocating disorder

Berg and Timmermans (2000) highlight how the ordering effects sought through processes of standardisation simultaneously produce disordering effects. They argue that "[T]he order and its disorder (…) are engaged in a spiralling relationship—they need and embody each other" (ibid, p. 37). What they suggest is that an information system with an apparently clear purpose may abruptly become something different, serving completely different purposes. Moreover, the system may induce surprising consequences, as the order which the system creates for some aspects creates a corresponding disorder for others. In a similar way, Law and Singleton (2005) argue that objects (information systems) may inherently constitute several realities, and may sometimes be "complex, multiple and (in some cases) mutually exclusive" (ibid, p. 342). We provide two examples of this. Firstly, we illustrate how the standardisation of nursing plans unintentionally subverted the possibilities for interdisciplinary cooperation, i.e. how benefits for nurses simultaneously produced disadvantages for the psychologists and physicians. Secondly, we indicate how the nursing plan abruptly invoked another rationality regarding the purpose of the nursing plan, namely as a resource management tool.

Earlier, we have pointed out how the psychogeriatric ward relied on interdisciplinary work between the nurses on one hand and the physicians and psychologists on the other. The narrative contained in the old reports had been the glue in this collaboration:

> "Several of the nurses sum up in their own words after we have had a treatment meeting [for a patient] (…) they write good and extensive notes, especially when something extraordinary has happened (…) Therefore, when I write my own report I often refer to the report written by the nurse" (psychologist)

Furthermore, in the old paper-based version of the reports, other professionals sometimes added amendments to the reports originally written by one of the nursing staff, thereby making the report more complete. An example from one of the paper-based reports is when a physiotherapist expanded on the comment provided by the nurse who had written that the patient had exercised with the physiotherapist, but soon got tired. The handwritten amendment was inserted just below the nurse's report:

> "The patient followed the instructions more poorly than yesterday, but managed to get up and sit down satisfactorily. He walked a round in the walkway. There was no apparent pain in the thighs and knees" (physiotherapist)

As opposed to the reports, the nursing plan is a distinct tool for the nursing staff, which excludes the participation of physicians and psychologists. Consider how the nursing plan was targeting purely nursing work:

> "Previously, we have been very concerned about mediating what the physician has prescribed, the results of tests, diagnoses, etc, but nothing about how to approach an anxious patient (…) Alternatively, if we make a good nursing plan, we will see the patients' problem from the perspective of the nursing staff" (Project group nurse 1).

The physicians shared the same understanding. One of them commented:

> "In the same way as the nurses don't involve themselves in what kind of medication is given (except for antidepressants and antipsychotic medication), the nursing plan is primarily used by the nurses" (physician)

As the plan failed to support interdisciplinary work, it may also limit the communication between the nursing staff and the patients, which was an important feature of the plans in the security ward (see case description). In this ward, a nursing plan functioned as a contract between the personnel and a patient. Along similar lines, a head nurse from one of the somatic departments reported at the head nurse meeting:

> "We produce documentation together with the patients, and we translate between ourselves and the patients (…) but the patients haven't got a language suited to classification schemes. The question then becomes one of how to deal with this in the future" (Head nurse 2, from another department)

We have elaborated on how the process of creating order for nursing work (the nursing plan) has created disorder for interdisciplinary work (through the reports). Following Berg and

Timmermans (2000, p. 36), we argue that the nursing plan does not only perform its own order, it also always contains it. Extensive use of the nursing plan emphasises its role in professionalising nurses' work, but at the same time it undermines the use of reports and thus interdisciplinary work. Conversely, low use of the plan requires extensive use of the reports. Actually, we are facing two mutually exclusive realities of the nursing plan (Law & Singleton, 2005, pp. 342-343).

Along similar lines, an information system may appeal to a new reality, and become something completely different - in this case, the nursing plan turned into a resource management tool. Resource management in the psychogeriatric ward was a complex issue, depending on the current condition of the patient, the legal clauses in effect, the going-out status and follow-up. 'Going-out status' indicates whether a health worker needs to accompany the patient outside the ward or not. 'Follow-up' indicates what kind of attention a patient might need, and how often. Having a good overview of such issues was extremely important, as "suicidal patients can never go out alone, but must always be accompanied by one of the health personnel" (Nurse 5). The rhetoric around the plan was modified to include resource management as well,

> "The ideal situation would be to document going-out status and follow-up in the nursing plan; then we could have an overview of the resources needed and how they developed" (Project group nurse 2)

The users themselves had a key role in the transformation process of the plan. Even if the important factors, going-out status and follow-up, were not explicitly part of the plan, the staff used them implicitly to obtain an overview of the resources needed:

> "By reading this plan, I can see that this patient will require a lot of time and resources" (Nurse 1)

Also in the maintenance of the nursing plan, it became increasingly important to include the resources needed. For instance, when a nurse was updating the nursing plan, one of the project leaders passed by and reminded her to include the staff resources needed:

> "You must include that this patient needs one-to-one follow-up (…) we have to be precise about which resources are needed in order to succeed with the nursing plan" (project group nurse 2)

Although it had been intended primarily as a vehicle for tracking the ongoing delivery of nursing care, the nursing plan implementation process became increasingly entangled with

managerial concerns for resource management and control. The use of clinical information was thus lifted out of its primary context in order to be used for completely different purposes.

5.4 From 'Implications for design' to interventions

Interpretative studies of the use of information systems, typically geared towards in *situ* descriptions of work practices and user perceptions, are potentially a rich resource for determining the requirements for system design. There is an old and ongoing debate regarding the exact nature of this relationship (Hughes et al., 1992; Plowman et al., 1995). In a recent and poignant instance, Dourish (2006) is concerned about the strong tendency for interpretative studies in general and ethnographic studies (including ours) in particular to be reduced to a mere "toolbox of methods for extracting data from settings", so "aligned with the requirements-gathering phase of a traditional development model" (ibid., p. 543).

We agree with Dourish's general concern about making ethnographic research more relevant for design of information systems. However, an implicit assumption in his formulation of the 'problem of implications for design' is that he is only concerned with the requirements themselves (i.e. their content and functions). In this sense, the 'problem of implications for design' has a strong bias towards the local and singular work setting. This downplays how the researchers negotiate their results in distinct *arenas* with different stakeholders.

Inspired by insights from studies in the fields of science and technology, we move beyond localised, artefact-centric 'implications for design' to network-based *interventions* (Braa et al., 2004). Rather than handing over a context-free set of requirements derived from our study ('a bullet list' (Dourish, 2006, p. 549)), we must consider the requirements as just one element that needs to be negotiated with the stakeholders in distinct arenas. Our results were tailored to the different needs and expectations of stakeholders; in other words, we varied the form, granularity and perspective significantly across arenas. This variety mirrored power relations and different expectations towards us as researchers. This "provide[d] the opportunities to build the relationships to forge alliances across potentially disparate interests" (Balka, 2005, p. 12), thus making our research 'practically relevant' (Bal & Mastboom, 2005, p. 7).

We identified and subsequently intervened in five different arenas. These were associated with: the vendor, the users, hospital management, the Norwegian Nurses Association and the research community. To illustrate how the content varied across these arenas, we describe our

interventions with two of them, one associated with the vendor and one associated with the users.

The first visit to the vendor was made by the first author in December 2005. He was invited to present results from his study of the HealthSys EPR implementation at UNN in 2004 (documented in Ellingsen & Monteiro, 2005). Prior to this meeting, one of the researchers had presented his findings to senior management at another university hospital. HealthSys's CEO knew about this and had expressed concerns to the researcher that the vendor (and its IS portfolio) had not been treated 'fairly', risking the loss of a large contract with that hospital. In a subsequent meeting in the vendor's offices, ten members of the senior management team discussed the issue again with the researcher. A major aim for the vendor was, as the CEO put it, to "put the facts right". The researcher struggled to explain that this kind of (ethnographic) research represented a specific perspective and an interpretation (Dourish, 2006). After two hours of discussion, the researcher realised that the participants were still rather reserved and did not find his contributions particularly relevant. In order to improve the situation, the researcher suggested presenting some findings from the nursing plan project at UNN (documented in this paper). Over the next two hours, the researcher increasingly won the participants' attention, especially as he managed to translate his findings into concrete design suggestions. This enabled the vendor's developers to reflect on how to implement changes to the nursing module. A lively and constructive discussion followed.

Specifically, the researcher described how the users tinkered with the global NANDA and NIC classification systems. The users had localised the codes by adding comments in the amendment fields; they had also registered the same code in several categories, arranged the codes in a specific order, referred to them in the reports, omitted them from the plan, etc. This not only ensured the use of the global NIC and NANDA standards, it also ensured a system that was carefully tailored to the particular work practice and to the users' own purposes. The researcher suggested supporting this localised use by specific design suggestions. This included the highlighting of important diagnoses, supporting the reuse of frequently used information and making maintenance of codes easier.

At a later stage, the vendor and the researchers agreed to strengthen the collaboration, as the vendor was in an early phase of building a completely new version of the nursing module. In this process, HealthSys wanted the researchers to interact with the design and implementation process since the company (due to its extensive growth in the health market) faced serious challenges in preserving their long tradition of involving users in the design process. In this

way, the vendor was responding to the challenge of scale recognised in projects moving from a local to a global scope (Braa et al., 2004).

Initially, the user arena was easier both to establish and to operate in than the vendor arena. The Department of Special Psychiatry had worked with the nursing module for some time and, despite their expressed satisfaction with the module, they struggled with the functionality of the system. This made our research approach valuable to them for two reasons. Firstly, they perceived us as a relevant discussant. For instance, did the quality of their work improve, and did the quality of the nursing documentation improve? Secondly, the users lacked a 'hotline' to the vendor, and they hoped that we could assume a mediating role.

When presenting our results at a departmental workshop and at several occasions for the department's top management of nurses, we focused on the users' *work practices.* This being familiar, it encouraged the users to engage actively in the discussions voicing their expectations and perceptions, to identify what was currently missing and what they hoped to achieve overall through use of the nursing module. As one of our findings, we discussed how the initial objective of replacing the written report with the plan was largely an illusion. The daily written report served several purposes, such as communicating to the other professions and repeating the content of the plan; ultimately it was a prerequisite for the nursing plan as a good plan required effective reports.

In summary, when engaging with the vendor we focussed on the *product* (HealthSys's nursing module), and when engaging with the users we focussed on their *work practice*. In this regard, our design suggestions were not fixed once and for all, but rather served as the starting point for discussions, reflections and negotiated changes. We also experienced that intervening in several arenas, and thus being 'intermediar[ies] between the different actors (Bal & Mastboom, 2005, p. 8) was of increasing value for the stakeholders. For instance, the users knew that we were in communication with the vendor, so they requested that we mediate their concerns. Similarly, HealthSys knew that we operated frequently in several arenas, and our contributions in the vendor arenas were very much appreciated by the company. We believe that our engagement in these arenas enabled us to 'influence the project's course' (Bal & Mastboom, 2005, p. 7) and accordingly, create a *sustainable* network of action (Braa et al., 2004).

6 Conclusion

The objective of standardisation has been, and surely will continue to be, changing. The boundary between qualitative phenomena and their (attempted) quantification has historically been an evolving, but contested one. For instance, the quantification (thus standardisation) of initially qualitative phenomena such as temperature, time and music came about in the Middle Ages through socio-technical negotiation processes (Crosby, 1997). It is evident that the historical expansion of the scope of quantification has been met with fierce opposition or, at times, violence (Scott, 1998).

Closer to the immediate topic of this paper, a similar and more recent trend may be observed within the key standardisation institutions such as the International Standardisation Organisation (ISO). From an earlier focus on standardisation of artefacts and products (for example regarding size, technical performance and interoperability), ISO is increasingly involved in the standardisation of previously qualitative issues such as quality (ISO 9000), environmental management (ISO 14000) and social accountability (SA 9000).

The standardisation of service work, which has been our empirical focus, should be recognised against backdrop of these broader trends towards greater standardisation and quantification of non-standard or qualitative 'entities'. With this increased presence of standardisation and quantification comes the increased importance of developing conceptual frameworks to analyse the dynamics of IS-embedded standardisation initiatives.

Standardisation of service work, as exemplified by nursing, provides a particularly valuable platform as it confronts the inherent tension of attempting to achieve improved quality of care while simultaneously enjoying efficiency gains.

The perspective we have developed identifies key mechanisms of transformative, co-constructive practices that constitute standardised service work. It thus contributes to the analytically based, empirically underpinned, critique of an overly simplistic understanding of what is involved. Simultaneously, as we have demonstrated above, it may function as a platform for interventions. It would be analytically fallacious merely to argue for the unattainability of standardisation by identifying shortcomings in specific cases.

7 References

Akrich, M. 1992. The de-scription of technical objects. In *Shaping technology/ building society*, 205 -224. ed. Bijker, W.E. and Law, J. MIT Press.

Alvesson, M. 2001. Knowledge work: ambiguity, image and identity, *Human Relations*, 54(7): 863-86

Bal, R. and F. Mastboom. 2005. Evaluation ZorgDomein – how we got entangled in interorganizational health care politics and survived as STS researchers. *Workshop on Practices of Assessment and Intervention in Action-Oriented Science and Technology Studies*, Amsterdam, 2005

Balka, E. 2005. Disparate Interests, Common Goals? Moving an Action-Oriented Health Technology Assessment Agenda Forward in Canada. *Workshop on Practices of Assessment and Intervention in Action-Oriented Science and Technology Studies, Amsterdam*, 2005

Bass, L., P. Clements and R. Kazman. 2003. *Software architecture in practice*. Second edition. Boston, MA. Addison-Wesley

BBC NEWS. 2000. The health gap – Britain and Europe. January 18, 2000. http://news.bbc.co.uk/1/hi/health/608905.stm (accessed March 20. 2006)

Berg, M. 1997. *Rationalizing medical work : decision-support techniques and medical practices*. Cambridge Mass. MIT Press.

Berg, M. and S. Timmermans. 2000. Orders and their others: on the constitution of universalities in medical work. *Configurations* 8: 31-61.

Björvell, C., R. Wredling and I. Thorell-Ekstrand. 2002. Long-term increase in quality of nursing documentation: effects of a comprehensive intervention. *Scand J Caring Sci*; 16: 34–42.

Boland. J.R. and R. V. Tenkasi. 1995. Perspective making and perspective taking in communities of knowing. *Organization Science*, 6(4): 350--372.

Bowers, J. 1994. The work to make a network work: studying CSCW in action. *In CSCW Proceedings*, 287-298.

Bowker, G. C. and S. L. Star 1999. *Sorting Things Out: Classification and Its*

Consequences. MIT Press.

Bowker, G., S. L. Star and M. Spasser. 2001. Classifying Nursing Work. *Online Journal of Issues in Nursing*. Available at http://www.nursingworld.org/ojin/tpc7/tpc7_6.htm (accessed March 20. 2006)

Bowker, G., S. Timmermans and S. L. Star. 1995. Infrastructure and organizational transformation: classifying nurses' work. In *Information technology and changes in organizational work*, 344 – 370. ed. W. Orlikowski, G. Walsham, M.R. Jones, and J.I. DeGross. Chapman & Hall. London

Braa, J.,E. Monteiro and S. Sahay 2004. Networks of action: sustainable health information systems across developing countries, *MIS Quarterly*, 28(3):337-362, Special issue on Action research

Bruner, J. 1990. *Acts of Meaning.* Cambridge, MA. Harvard University Press.

Brunsson, N. and B. Jacobsson. 2000. *A world of standards*, Oxford. Oxford University Press.

Buajordet I., J. Ebbesen., J. Erikkesen., O. Brers., and T. Hilberg. 2001. Fatal Adverse Drug Events: the paradox of drug treatment. *Jour. Inter. Med.* 250:327-341.

Coiera. E. 2003. *The Guide to Health Informatics*. Second Edition. Arnold, London.

Crosby, AW. 1997. *The measure of reality. Quantification and Western society, 1250-1600*, Cambridge Univ. Press.

De Moore, G. 1993. Standardisation in health care informatics and telematics in Europe: CEN 251 activities. In . *Progress in standardization in health care informatics*. 1-13, ed. De Moore, C. McDonald and J. Noothoven van Goor. IOS Press: Amsterdam

de Guy, P. and Salaman, G. 1992. The cult[ure] of the customer, *Journal of Management Studies*, 29(5):615-33.

Devers, K.J., L. P. Casalino., L. S. Rudell., J. J. Stoddard., L. R. Brewster and T. K. Lake. 2003. Hospitals' Negotiating Leverage with Health Plans: How and Why Has It Changed? *HSR: Health Services Research* 38:1, 419-446.

DIPS 2005. *Sykepleiedokumentasjon i DIPS [Nursing documentation in DIPS]*. http://www.dips.no/dipsnew.nsf/d8008ff72aa2b44dc1256b3e004c5b12/0b430e9f46b06b32c1256b4c003501ea?OpenDocument (accessed March 20. 2006).

Dourish, P. 2006. Implications for Design. Proc. ACM Conf. Human Factors in Computing Systems CHI 2006 (Montreal, Canada), 541-550.

Ebbesen J., I. Buajordet., J. Erikssen., O. Brørs., T. Hilberg., H. Svaar and L. Sandvik. 2001. Drug-related deaths in a department of internal medicine. *Arch Intern Med.* 161:2317-2323.

EHTEL. 2002. *Legal aspects of standardisation in health Telematics.* Prepared by the Thematic Working Group 6 (Law & Ethics). Available at http://www.ehtel.org (accessed March 20. 2006).

Ellingsen, G. and E. Monteiro. 2003. A patchwork planet: Integration and Cooperation in hospitals. *Computer Supported Cooperative Work.* 12(1),71-95.

Ellingsen, G. and Monteiro, E. 2005. The slight surprise of integration, In: *Designing ubiquitous information environments: socio-technical issues and challenges*, 261–274. ed. C. Sørensen, Y. Yoo, K. Lyytinen and J.I. deGross, Springer, New York, 2005

Getty M., A. A. Ryan and M. L. Ekins. 1999. Comparative study of the attitudes of users and non-users towards computerized care planning. *Journal of clinical nursing*. (4) 431-439.

Hanseth, O. and E. Monteiro. 1997. Inscribing behaviour in information infrastructure. *Accounting, Management and Information Technologies*. 7(4):183-211.

Hanseth, O., E. Monteiro and M. Hatling. 1996. Developing information infrastructure standards: the tension between standardisation and flexibility. *Science, Technology & Human Values*, 21(4): 407-426.

Hellesø, R. and C. M. Ruland. 2001. Developing a module for nursing documentation integrated in the electronic patient record, *Journal of Clinical Nursing.* 10: 799-805.

Hughes, J., D. Randall and D. Shapiro. 1992. Faltering from Ethnography to Design. *In Proceedings of CSCW '92*, 115-122.

Hyun, S., and H.A. Park. 2002. Cross-mapping the ICNP with NANDA, HHCC, Omaha System and NIC for unified nursing language system development, *International Nursing Review*, 49(2):99-110.

IOM. 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. IOM.

Washington, DC: National Academy Press.

ISO IWA-1. 2005. *Quality management systems -- Guidelines for process improvements in health service organizations.* ISO. IWA. http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=41768&ICS1=11&ICS2=20&ICS3=

Kahin, B. and J. Abbate. eds. 1995. *Standards policy for information infrastructure*. Cambridge, MA. MIT Press.

KITH. 2003a. *Kravspesifikasjon for elektronisk dokumentasjon av sykepleie, Nasjonal standard [Requirements specification for electronic documentation of nursing, National Standard]*. http://www.kith.no/upload/1101/R12-03DokumentasjonSykepleie-rev1_1-NasjonalStandard.pdf (accessed March 20. 2006)

KITH. 2003b. *Veileder for elektronisk dokumentasjon av sykepleie [Guide for electronic documentation of nursing]*, KITH Rapport R 14/03. www.kith.no/upload/1105/R14-03VeilederElektroniskDokSykepleie-v1.pdf (accessed March 2006)

Klein, G., 2003. ISO and CEN Standards for Health Informatics – Synergy or Competiton, In *Advanced Health Telematics and Telemedicine. The Magdeburg Expert Summit Textbook*, 259-265. ed. B. Blobel and P. Pharow. IOS Press, Amsterdam

Klein, H.K. and M. D. Myers. 1999. A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 23(1), 67-94.

Kohn, L. T., J. M. Corrigan and M. S. Donaldson. eds. 2000. *To err is human: Building a safer health system*. IOM. Washington, DC: National Academies Press.

Lachmund, J. 1999. Making Sense of Sound: Auscultation and Lung Sound Codification in Nineteenth-Century French and German Medicine. *Science, Technology & Human Values*, 24(4):419-450

Law, J. 2003. *Landbroke Grove, Or How to Think about Failing Systems*. Manuscript. http://www.comp.lancs.ac.uk/sociology/papers/law-ladbroke-grove-failing-systems.pdf. December. (accessed March 20. 2006)

Law, J. and V. Singleton. 2005. Object Lessons, *Organization*, 12(3):331-355.

Lee, T.T. 2005. Nurses' concerns about using information systems: analysis of comments on a computerized nursing care plan system. *In Taiwan, Journal of Clinical Nursing*, 14, 344–353. 2005

Lee, T.T and P.C. Chang. 2004. Standardized care plans: experiences of nurses. *In Taiwan Journal of Clinical Nursing* 13, 33–40.

Lee, T.T., C. H. Yeh and L. H. Ho. 2002. Application of a computerized nursing care plan system in one hospital. *Journal of Advanced Nursing* 39(1), 61–67

Leidner, R. 1993. *Fast Food, Fast Talk: Service Work and the Routinization of Everyday Life*. University of California Press.

Light, D. W. 2000. The Sociological Character of Health-Care Markets. In *The handbook of Social Studies in health and medicine, 394-408,* ed G. L. Albrecht, R. Fitspatrick, and S. C Scrimshaw (eds.). London. Sage Publications.

McCloskey J. C. and G. M. Bulechek. 1994. Standardizing the language for nursing treatments: an overview of the issues. *Nursing Outlook*, 42(2):56-63

Nurses' Forum for ICT. 2002. *Dokumentasjon av sykepleie i pasientjournalen. En veileder fra Sykepleiernes forum for IKT og Dokumentasjon*. Version 1.1 August. www.sykepleierforbundet.no/Fag/Ny%20veileder.%201.mars.pdf (accessed March 2006)

Orr, J. 1996. *Talking about machines: An ethnography of a modern job*, Cornell, CA: Cornell Univ. Press.

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

Plowman, L., Y. Rogers and M. Ramage. 1995. What are Workplace Studies For? *In proceedings of ECSCW'95*, 309-324. ed. Marmolin, H., Sundblad, Y. and Schmidt, K. Kluwer Academic Press. Amsterdam

Schmidt, K. and L. Bannon. 1992. Taking CSCW Seriously – Supporting Articulation Work. *Computer Supported Cooperative Work*, 1:7-40.

Schmidt, S. K and R. Werle 1998. *Coordinating technology. Studies in the International Standardization of Telecommunications*. MIT: Cambridge, Mass.

Scott, JC. 1998. *Seeing like a state*, New Haven:Yale Univ. Press

Sexton, A., C. Chan., M. Elliot., J. Stuart., R. Jayasuriya and P. Crookes. 2004. Nursing handovers: do we really need them? *Journal of Nursing Management*. 2004, 12, 37–42.

SHD. 2000-2001. Legislation of Health Enterprises. Proposition to the Odelsting No. 66 from the Ministry of Health and Social Affairs. http://www.dep.no/hd/norsk/publ/otprp/030001-050012/index-inn001-b-n-a.html (accessed March 20. 2006)

Star S. L. and A. Strauss. 1999. Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work. *Computer Supported Cooperative* Work 8:9-30

Star, S.L. 1991. Power, Technology and the Phenomenology of Conventions: On Being Allergic to Onions. In *A Sociology of Monsters: Essays on Power, Technology and Domination*, 26-56, ed. Law, J. London: Routledge.

Timmermans, S. and M. Berg. 1997. Standardization in action: Achieving universalism and localisation through medical protocols, *Social Studies of Science*, 27, 111-34.

Timmermans, S. and M. Berg. 2003. *The gold standard: the challenge of evidence-based medicine and standardization in health care*. Philadelphia: Temple University Press.

Timmons, S. 2003: Nurses resisting information technology *Nursing Inquiry*. 10(4): 257-269.

Tsiknakis, M, D. G. Katehakis and S. C. Orphanoudakis. 2002. An Open, Component-based Information Infrastructure for Integrated Health Information Networks, *International Journal of Medical Informatics*, 68(1-3):3-26.

van Bemmel, J. H. and M. A. Musen. Eds. 1997. *Handbook of Medical Informatics*, Berlin, Germany. Springer-Verlag.

Van Maanen, J. 1979. The Fact of Fiction in Organizational Ethnography, Administrative Science Quarterly, 24(4): 539-550.

Voutilainen, P., A. Isola and S. Muurinen. 2004. Nursing documentation in nursing homes – state-of-the-art and implications for quality improvement. *Scand J Caring Sci*; 18; 72–81.

Walsham, G. 1995. Interpretive case studies in IS research: nature and method. *European Journal of Information Systems*, 4(2), 74-81.

Waters, K.R. 1999. Individualized care: is it possible to plan and carry out? *Journal of Advanced Nursing*, 29(1), 79-87.

WHO. 2003. World Health Organization. Core Health Indicators for Norway. http://www3.who.int/whosis/core/core_select_process.cfm?country=nor&indicators=nha&language=en (accessed December 11. 2006)

Wilson, M. 2002. Making nursing visible? Gender, technology and the care plan as script. *Information Technology & People*, 15(2):139-158.

Winthereik, B. R and S. Vikkelsø. 2005. ICT and Integrated Care: Some Dilemmas of Standardising Inter-Organisational Communication. *Computer Supported Cooperative Work*. 14:43-67.

Paper seven:
Common Information Spaces along the illness trajectories of chronic patients

Common Information Spaces along the illness trajectories of chronic patients

Glenn Munkvold[1] and Gunnar Ellingsen[2]
[1] Nord-Trøndelag University College, Department of Information Technology, Norway; [2] Dept. of Telemedicine, University of Tromsø, Norway.
glenn.munkvold@idi.ntnu.no; gunnar.ellingsen@unn.no

Abstract The notion of Common Information Spaces (CIS) is extensively used as a framework to analyse cooperative work. Drawing on recent contributions to the discourse on CIS, this paper develops a perspective on how information is shared in heterogeneous contexts. We study the introduction of an electronic nursing plan in the psychogeriatric ward at the University Hospital of North Norway. The plan was expected to improve information sharing among the healthcare practitioners and in that sense contribute to their CIS. However, although the nursing plan was regularly updated, it was less used *in practice* than initially expected. We suggest that this can be ascribed to the temporal and evolving character of both medical information and work. Drawing on the notion of trajectories, we elaborate on these findings and develop a perspective on CIS, emphasising its situated, temporal and negotiated character.

Introduction

The notion of Common Information Spaces (CIS) is extensively used within the CSCW field as a framework for analysing cooperative work. A CIS denotes the context in which information is shared between actors whose work practices interleave. With a particular focus on the interrelationship between actors, artefacts, information and the situations in which these meet, it aims at refining our understanding of how artefacts support coordination and articulation work in cooperative settings (Schmidt and Bannon, 1992; Bannon and Bødker, 1997; Randall, 2000; Bossen, 2002).

CIS comes in many forms and is used in various contexts (for example, see Bannon and Bødker, 1997). As illustrated by Bossen (2002), it is of particular interest as a framework to analyse problem-solving activities in heterogeneous work settings. These typically involve places and situations with a high degree of intercommunication and "where the meanings of the shared objects are debated and resolved" (Schmidt and Bannon, 1992, p.27).

In this paper, we explore the notion of CIS by drawing on empirical data from the healthcare context. Healthcare services today typically are profoundly fragmented across technical, organisational and professional boundaries, thus resembling the heterogeneity described above. Knowledge about treatment and care is increasingly dispersed among many people and many technologies, and single doctor-patient relationships are gradually being replaced by a shared-care approach in which the individual patient's healthcare is handled by a team of professionals, each specialising in one particular aspect of care (Grimson et al., 2000). Throughout the illness trajectory, patients today face individual healthcare practitioners and/or organisations whose knowledge of each other's activities is limited. Accordingly, expressions such as shared care, integrated care and continuity of care are commonly used to denote more general ambitions of creating coherent and effective health care services for patients across disciplinary and institutional boundaries (Winthereik and Vikkelsø, 2005).

Fundamental to the ongoing efforts of overcoming institutional and interdisciplinary boundaries are infrastructural arrangements such as electronic patient records (EPRs), standards, procedures, classification schemes and the like (Grimson et al., 2000). These form the link that is assumed to enhance information sharing and coordination of work so that patients are given a coherent service where every professional perspective is accounted for. The assembly of infrastructural arrangements and the various work practices they entrench delineate what is denoted as CIS in the CSCW literature.

Empirically, we have studied the implementation of the nursing care plan at the psychogeriatric ward in the University Hospital of North Norway (UNN). The ward serves elderly patients who suffer from a combination of chronic and psychiatric conditions. Work at the ward thus entails extensive cooperation across professional boundaries. Aligned with contemporary efforts to promote the nursing profession in the health sector, the nursing plan was expected to improve information sharing among the healthcare practitioners. This included an improved documentation practice together with enhanced predictability and a clearer overview. However, although the nursing plan was regularly updated and contained current status information about all patients, we observed that it was less used in practice than its primary users, the nurses, wanted. For example, the plan was used to a lesser degree in close cooperative settings such as during admission of patients, in nursing handover conferences and in interdisciplinary meetings.

We suggest that this can be ascribed to the temporal and evolving character of both medical information and work. Drawing on the notion of trajectories, we elaborate on these findings. In particular, we pay attention to how the nursing plans were integrated into the work practice. Our main objective is to contribute to a conceptualisation of CIS (see Reddy et al., 2001; Bossen, 2002; Rolland et al., 2006) by providing a temporal dimension to *how* information is made common in heterogeneous work practices. Analytically, we draw on the notion of trajectories (Strauss et al., 1985; Timmermans and Berg, 1997) in which we explore how work is accomplished along the trajectories of chronic patients. In this sense, trajectories "refer not only to the physiological unfolding of a patient's disease but the total *organization of work* done over that course, plus the *impact* on those involved with that work and its organization" (Strauss et al., 1985, p.8). We proceed along the following dimensions:

Firstly, we explore what kind of information sources and artefacts are in use in cooperative settings that cut across professional boundaries. We elaborate on the nature of CIS (manifested by the points at which the work trajectories of physicians and nurses intersect) as situated, temporal, regularly (re)negotiated and achieved in practice. The nursing plan, we argue, is only one entity in a larger information infrastructure. Its particular value is in constituting the nursing perspective on the care process, as the medical cardex does for the physicians' perspective.

Secondly, we discuss how medical data is not fixed and self-contained, but evolves over time during the patient's illness trajectory. To portray this evolving trajectory, the plan had to be linked with a variety of information entities and practices. We develop our argument by providing an example from the nursing handover conference, which is a setting where it is crucial to know how a patient is progressing.

Thirdly, we illustrate the unpredictable nature of the plan. We analyse the trajectory of the nursing plan and stress its uncertain and contingent character and how it eventually became an infrastructural entity that appealed to a new reality. In our case, it increasingly became entangled with managerial concerns for resource management and control.

The remainder of this paper is organised as follows. First we elaborate on the theoretical foundation for the paper. We then describe the setting for our empirical investigation and describe the method used, followed by a description of the case. Subsequently the case is analysed. In the conclusion, we consider some implications contributing to the conceptualisation of CIS.

Theory

Related work on Common Information Spaces

The notion of CIS was originally proposed by Schmidt and Bannon (1992) as a response to the, at that time, somewhat objectified perceptions of how information is shared among actors whose work activities interleave:

> "Cooperative work is not facilitated simply by the provisioning of a shared database, but rather requires the active construction by the participants of a common information space where the meanings of the shared objects are debated and resolved, at least locally and temporarily" (Schmidt and Bannon 1992, p.27).

Human interaction is always mediated by representations of information. Hence our experiences and the way we perceive the world can never be replicated perfectly. Schmidt and Bannon (1992) in particular point out that information entities always have to be interpreted by human actors. By doing so, a clear distinction is made between the carrier of information and its meaning. The common information space then is said to encompass "the artifacts that are accessible to a cooperative ensemble as well as the meaning attributed to these artifacts by the actors" (Schmidt and Bannon, 1992, p.28). At the core of their argument is how information is continuously decontextualised to make it commonly available, and how it is subsequently recontextualised within the framework of its new work context (Schmidt and Bannon, 1992). In this process, the notion of articulation work is crucial as a mechanism to handle the contingent nature of cooperation and preserve the flow of work (for example, see Strauss et al. 1985; Gerson and Star 1986). A main objective in CIS, then, is to reduce the complexity in articulation work.

Bannon and Bødker (1997) refine the notion of CIS by providing an account of how information is made common. They argue that a CIS is dialectical in nature - both open and closed at the same time. "Openness" refers to the way information is always malleable and interpretatively flexible in local communities of practice. 'Closed' refers to the way information goes through a process of closure and becomes boundary objects (Star and Griesemer, 1989) - immutable and portable across different communities of practice. A further refinement of the CIS, they argue, needs to address the interplay between these two perspectives (Bannon and Bødker, 1997, p.87). In their refinement of the concept, they identify five domains in which the degree of closure is increasingly visible. At the one end they identify coordination centres, such as control rooms, in which the participating actors are co-present and where it is crucial that the CIS remains open and malleable. At the other end they place the web, in which information is packaged and made available to a larger, distributed audience.

The assumed idea of commonality is however problematised by Randall (2000). In demonstrating how classification scheme maintenance increasingly becomes difficult as the number and range of users increases, Randall argues that:

> "… the very notion of CIS is radically underspecified. It is not possible to distinguish its putative features by reference to technology, to information or to organizational structure. At very least we might begin to recognise that the problems of classification use in CIS are likely to range along a continuum which stretches from shared, small group, work tasks to complex inter-organizational chains." (Randall, 2000, p.17)

A more recent contribution in this respect is proposed by Bossen (2002). Based on ethnographic fieldwork within a hospital ward, Bossen delineates seven parameters that can be used to position a CIS. The parameters include the degree of distribution of work, the multiplicity of webs of significance, the level of required articulation work, the multiplicity and intensity of means of communication, the web of artefacts, the immaterial mechanisms of interaction, and the need for precision and promptness of interpretation (Bossen, 2002, p.176). Erickson and Kellogg (2003) add to this picture by describing how artefacts are socially translucent and thus make visible the various professional activities in cooperative settings.

In studying how information is incorporated into the diverse work practices of an intensive care unit, Reddy et al. (2001) contribute to our understanding of the dialectical nature of CIS. In studying how a group of healthcare practitioners made use of a shared information system, they found that the particular strength of a computer-based system was its ability to decouple information from its representation. Although the healthcare practitioners had a common focus on patient care, decoupling enabled the production of more specialised representation of information, which subsequently allowed the various professionals to work more effectively together.

Rolland et al. (2006) provide another relevant contribution. Based on a study of different CIS in a major international oil and gas company, they argue that some CIS appear as much more situated, momentary and malleable when embedded within extremely heterogeneous contexts. They claim that infrastructural arrangements for a CIS that attempts to cut across various communities of practice and heterogeneous collections of information inevitably will produce new instances of fragmentation (Rolland et al. 2006, p.499).

Nursing Care Plans as infrastructural arrangements in CIS

Nurses are commonly referred to as the ones "who weave together the many facets of the [health care] service and create order in a fast flowing and turbulent work environment" (Allen, 2004, p.279). Therefore, their associated tool, the nursing plan, is an infrastructural arrangement that will inevitably play a key role in producing CIS. Located at the very core of patient care delivery, nursing care plans are assumed to contribute to higher quality of care and better cost containment (Reed and Stanley 2003; Sexton et. al 2004). In addition, it is assumed that a nursing plan provides for appropriate treatment and continuity of

care for the patient within and across institutional boundaries (Reed and Stanley 2003). As argued by Voutilainen et al (2004, p. p72):

> " (…) its [the nursing plan's] primary purpose is to ensure the individuality and continuity of care (…) When documentation is accurate, individual, pertinent and up-to-date, it promotes consistency and effective communication between nurses and the other team members involved in care."

Similar arguments are also echoed in Norwegian policy documents (KiTH 2003, p. 18)

> "(…) documentation of this work process [nursing process] is also called the care plan, it is interdisciplinary and can be used by all professions."

Basically, a nursing plan is an overview of nurse-related diagnoses (problems) combined with relevant interventions for a patient with a chronic disorder. At the core of the nursing plan is its shared terminology. The nurses apply this terminology to describe the patients' problem (i.e. nursing diagnoses) and link this to one or several interventions, detailing what to do in certain situations and several outcomes to enable an evaluation of what nursing care can affect. Some of the most well-known systems are that of the North American Nursing Diagnosis Association (NANDA), the Nursing Intervention Classification (NIC) and the Nursing Outcome Classification (NOC) (for example, see Gordon, 1998).

Another 'promise' associated with the electronic nursing plan, and a more structured documentation process, is that it is expected to replace a variety of existing dispersed information sources in the hospital. In terms of sharing information, this is considered to be a major problem, for example during handover conferences:

> [The nursing handovers] however often lack formal structure and this is compounded by a lack of guidelines for the nurse giving the report. Consequently, the information presented may be irrelevant, repetitive, speculative or contained in other information sources" (Sexton, 2004, pp.37-38).

Integrating the information in the plan is implicitly assumed to enhance information sharing among the nursing practitioners. However, the literature reveals a nursing community whose actual compliance with a structured documentation process is rather low (Björvell et al., 2002; Sexton et. al 2004). Studies have indicated that "nurses have problems integrating the nursing process and care planning into their daily record-keeping" (Björvell et al., 2002, p.35). In a survey cited by Sexton et al. (2004, p.38) "nursing care plans were referred to in handover only 1% of the time and this was probably because care plans were not being updated".

Trajectories

In hospitals, there have been many efforts in integrating heterogeneous information sources (Ellingsen and Monteiro, 2003), thus contributing to a CIS. However, work in hospitals is clearly depending on the patient case and how the

patient's illness develops. This draws attention to a temporal and evolving character of both medical information and work. Thus, adding a temporal dimension to CIS is necessary. Therefore, we draw on the notion of trajectories (Strauss 1993; Strauss et al. 1985). Strauss describes it as follows:

> "(1) the course of any experienced phenomenon as it evolves over time (an engineering project, a chronic illness, dying, a social revolution, or national problems attending mass or "uncontrollable" immigration) and (2) the actions and interactions contributing to this evolution" (Strauss 1993, pp53-54)

The lens provided by such an approach is particularly useful for explicating (i) the multiple perspectives and meanings surrounding new medical technologies and (ii) how these evolve over time. In this regard, Orlikowski and Yates (2002, p. 687) emphasis that there is "ongoing constitution of multiple temporal structures in people's everyday practices".

Healthcare work is shaped by the patient's illness and how this illness is expected to develop. The term "trajectory" has been suggested to conceptualise the chain of tasks associated with the course of the illness of a patient. This concept emphasises that patients follow a trajectory that refers to a past, a present, and a possible future. As indicated above, this refers not only to the physiological unfolding of a patient's disease but to the total organisation of work done over that course, plus the impact on those involved with that work and its organisation (Strauss et al. 1985, p.8). Reddy et al. (2006, p. 37) emphasises the temporal logic with illness trajectories by underscoring that:

> A patient's particular illness trajectory also creates a structured ''timeline'' of activities, events, and occurrences – a temporal trajectory.

This is illustrated by the way nurses (from a care perspective) continuously construct "histories" and "futures" when writing reports between nursing shifts (for example, see Munkvold et al. 2006).

However, the resulting patient trajectory will never be the result of consciously developed plans or a particular sequence of decisions. Rather, it is the emergent effect of the interlocking of entities doing subtasks. This, (Berg, 1997, p.138) explains, gives rise to an understanding of plans as a kind of trajectory which "is continually reset on the spot, as the outcome of the continual articulation work". The nursing plan, for example, conceptualised as a process, is a trajectory that is constantly changed, altered, negotiated in response to changes in the surrounding nodes that constitute the heterogeneous network of planning.

Method

Research setting

The research was conducted at the University Hospital of North Norway (UNN), which has some 5000 employees, including 450 physicians and 1000 nurses. The

hospital has 600 beds, of which 150 are psychiatric. The actual study took place in the psychogeriatric ward, which is one of four wards in the Department of Special Psychiatry

The psychogeriatric ward is a closed unit. Nobody can enter or leave it without explicit permission (such as a key). The ward has 15 rooms, and treats 95 patients a year with an average length of stay of 6-8 weeks. There are 45 people working permanently here, including nurses, unskilled workers and substitutes, social workers, occupational therapists and physiotherapists. In addition, three physicians and one psychologist pay regular visits. The turnover at the ward is high, with up to 5 new unskilled workers starting each month.

Patients here are 65 or older and have usually been diagnosed with a psychiatric disorder such as dementia or anxiety. Many of them have been transferred here from high-security closed units, where they have come close to breaking doors and walls. They might thus constitute a danger both to themselves, to other patients as well as staff. The first room you come into is the day room. Typically the patients sit in this room, often with a nurse nearby. The room is usually strikingly silent. Occasionally, low whispering can be heard when nurses talk with the patients. As some patients may have severe psychoses with serious mental and behavioural disorders, the situation might change abruptly and dramatically. A patient might start to yell and upset other patients. In such situations, resources are mobilised quickly. The activities in which the staff were involved (writing, feeding, discussion, meetings, etc) are suspended and attention is focused on the agitated patient.

A set of formal regulations is important in shaping the resources needed to treat individual patients. Broadly, these differentiate between patients who have been admitted voluntarily and those who have been committed to the ward involuntarily. For example, a patient who has been committed must be treated and followed up one-to-one and is not allowed to leave the ward without being accompanied by a member of the staff.

The diagnoses mentioned above and the fact that medical treatment may have little or no effect on these disorders result in a work environment whose activities are directed towards a interdisciplinary approach to care and treatment. In this ward, environmental therapy and individual attention are considered crucial in creating a safe and stable situation for patients. Observations made by the staff are considered particularly important for the treatment that is given, for instance, in feeding situations, self-care, etc.

Research method

This study adheres to an interpretive research tradition (Walsham 1993; Klein and Myers 1999) in which reality is assumed to be socially constructed. The interpretative approach assumes no predetermined relationship between

information technologies and social contexts. As researchers we thus "[seek] an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993, page 4-5).

The methodological strategy of this study is based on the qualitative research paradigm. We are inspired by ethnography in particular, and rely to a large extent on participant observations as a primary method.

The empirical material was collected from May to December 2005. In addition to observing work, we conducted semi-structured interviews, engaged in informal discussions, analysed various documents and participated in internal project meetings.

In total we conducted 80 hours of observation, including nursing handovers, interdisciplinary meetings (e.g. cardex and treatment meetings), and the process of updating the nursing plan and writing reports. Handwritten field notes were transcribed shortly after each observation session. While observing, we made an effort to cover different types of actors and interactions in order to highlight potentially different interpretations of what was going on.

Fifteen interviews were conducted. The interviews lasted an average of 1 to 1.5 hours. In addition, we spent some time in project meetings as well as studying various documents, such as project specifications, newsletters and training material. The overall process of collecting the data was open-ended and iterative, with the earlier stages being more explorative than the later ones.

The analysis of the data is based on a hermeneutic approach, where a complex whole is understood "from preconceptions about the meanings of its parts and their interrelationships" (Klein and Myers, 1999). This implies that the different sources of field data are all taken into consideration in the interpretation process.

Case

Implementing the nursing module

The introduction of the electronic nursing module took place in the context of a larger, hospital-level implementation of a new EPR infrastructure, also containing a nursing module. A decision to replace the existing EPR, in 2003, marked the start of a prolonged undertaking to create an all-encompassing information infrastructure cutting across departmental and professional boundaries.

The Department of Special Psychiatry was highly motivated to implement the nursing module in its four wards. Expectations related to improved efficiency and a better overview of the planning process were also important. Not only should it improve the care provided by nurses; another important aspect was the way it could facilitate coordination of work across disciplinary boundaries.

> "I believe that this system [care plans] might help us better articulate what we do. I believe this is a huge challenge within the psychiatric sector: that we are able to explain to others what we do and how we think" (Nurse).

The implementation process was carried out over a half-year period. Three persons (two nurses and one secretary) were recruited internally to run the project. For two days a week, they were able to pay full attention to the implementation of the nursing module in the department's four wards. After some months of in-house training, the system was introduced in February 2005, both in the psychogeriatric ward and in the three other wards in the department. By May 2005, all wards had started to use the new nursing module.

The nursing module included functionality for writing daily reports and for creating nursing care plans - one plan per patient. The first part was the report section, where users wrote reports on a patient several (usually three) times a day. In this section, the users could write free text (that is, construct a narrative of the patients' problems). The second part was the nursing care plan. Unlike the report, it was highly structured and contained international codes for identifying diagnosis and related interventions for a patient.

The nursing plan was based on the NANDA and NIC classification systems. A NANDA diagnosis might spawn one or more NIC interventions. Also, for each NIC intervention there might be several ordinances or instructions (direct actions). The ordinances are written as plain-text extensions in the plan (see figure 1).

Treatment elements	FA	Frequency/situation	Start	End	Status
Nursing diagnoses					
Anxiety -- rt confusion	2		09.08.05		Active
Impaired mucous membrane	4		30.08.05		Active
Insufficient sleep	8		10.08.05		Active
Nursing interventions / Ordinances					
Reducing anxiety -- Objective: security, patient trust	2		09.08.05		Active
Wake up before breakfast		Always	30.08.05		Active
Encourage sleep	8		09.08.05		
Make sure the patient get enough sleep			09.08.05		Active
Consider medication		Together with physician	09.08.05		Active
Record sleeping pattern		Make list, record in report	09.08.05		Active
Help patient maintain diurnal rythm			09.08.05		Active
Sense of reality	2		09.08.05		
Clear messages about what to be done during the day		Written, Oral	09.08.05		Active
Improve feeling of security -- introduce yourself, tell when you are about to finish your watch, offer contact	2		23.08.05		
Heal wound -- No denture lower jaw; objective: prevent wound in the gums	6		30.08.05		
Activity-therapy -- follow week-schedule	7		23.08.05		
Independent nursing ordinances					

Fig. 1: The nursing plan with diagnosis, interventions and ordinances

The user writing the report was expected to use the plan with its diagnosis, interventions and instructions as a basis for the reports. Whenever deviation from the plan occurred, it was supposed to be documented in the report. As a result, the content of the report was kept to a minimum:

> "The goal is to write as little as possible in the report, and to write in relation to what is in the nursing plan and describe any deviation from it" (Project group nurse)

In other words, the written report and the nursing plan were mutually dependent. For a complete understanding of the case, the users thus had to read them both. The plan provided the current status of the patient's nursing diagnosis (problems) and interventions, while to understand how it had evolved the nurses had to read the written reports. Deviations from the plan, what had happened over time, and how the nursing plan had changed were only documented in the reports.

In use, the nursing module was considered to be successful, especially by the nurses. It was also argued that the plan facilitated communication and had potential:

> "People attending the meetings have already read the reports and the nursing plans. So now we focus on the core of the case (…) and we don't have to read everything aloud in the meetings" (Nurse).

> "After having used the system for a while, I think we will improve and become more precise in what we write in the reports" (Nurse).

Two important arenas for information sharing

As indicated by the quotations above, nursing plans were assumed to enhance information sharing within and across disciplinary boundaries. In this ward, it is in particular at regular meetings that the various professionals meet and try to make sense of patient cases. One obvious reason for this is that the physicians have responsibility for patients in several wards, and thus are not always available outside the regular cardex meetings. Likewise, for the nursing practitioners, the meetings between working shifts are crucially important in ensuring coherence and continuity over the patient trajectory.

The interdisciplinary *cardex meeting* is held twice a week. Its main purpose is to clarify and exchange patient information and discuss further treatment. The name, cardex, denotes the presence of the various documents holding information about patients, and in particular the medication charts. The meeting is held in the conference room, which is the only room suitably configured for such occasions. The room contains a very large conference table with a dozen chairs around it. In one corner is a computer, the only one in the room. Its screen is positioned away from the centre of the room, so that it is visible only to the person using it. A projector is safely fastened to the ceiling above the conference table, and on the wall behind the door is a large whiteboard. The whiteboard is extensively used. It holds an overview of all the patients, indicating their names, the main therapist and care provider, their follow-up status and going-out status, and in some cases general information such as the date and place planned for the patient's discharge from the ward. Finally, next to the whiteboard is a small table holding various magazines, registration forms and documents.

The cardex meeting is well organized. It has a prearranged division of labour and a given sequence of action. Managing the process is the coordinator, usually a nurse. He or she is the only person with direct access to the EPR during the meeting. The coordinator thus initiates the individual reports by browsing through the various documents and forms found in the EPR. During this process, an oral account is produced on the spot. Another nurse has been assigned the role of taking the minutes. She makes sure that vital questions and decisions are recorded in the minutes of the meeting. Also present are the physicians. They have been delegated the responsibility of handling medical concerns. Hence on the table in front of them are the medication charts, filed in one large binder. The remaining participants (nurses, physiologists, physiotherapists, etc) listen and, whenever appropriate, fill in with comments and questions. Typically, everybody brings a personal notebook. From time to time during the meeting, they make their own personal notes in their notebooks.

The *handover conference,* on the other hand, is vital in ensuring continuity between shifts. Only nurses are present during these meetings, which are essential as they provide the nurses with an arena to informally debrief, clarify and discuss patient information. In this ward there are four handovers a day, of which two are considered to be main handovers. The main handovers take place between the work shifts in the morning and in the afternoon. Like the cardex meetings, the main handover conferences take place in the large conference room. Two key tasks are carried out during these meeting. First, an oral briefing is given for each patient, primarily based on the written reports from the last 24 hours. Second, day plans are set up for the individual patients. In this respect the handover conference typically drifts from collective discussion to individualised preparation (planning).

Typically, an experienced nurse is delegated the task of coordinating the meeting. His or her description of the state of affairs is put across as a story. Various artefacts are used during the process, such as the written report, the ward list, and the whiteboard. In fact, as the coordinator does not have a complete overview of all patients, this presentation is highly reliant on the availability of a mixture of patient representations.

Analysis

The analysis is structured as follows: Firstly, we present the nature of CIS as where the work trajectories of physicians and nurses intersect (manifested by the intersection points of physicians' and nurses' work trajectories) as situated, temporal, regularly (re)negotiated and achieved in practice. Secondly, we discuss how medical data is not fixed and self-contained, but evolves over time during the patient's illness trajectory. Thirdly, we analyse the trajectory of the nursing plan and highlight its uncertain and contingent character.

CIS: temporal, contingent and achieved in practice

Instead of perceiving CIS as a common resource or shared space fixed in time and space, we argue that CIS is a short-lived arrangement, achieved in practice, and that constantly needs to be renegotiated. We develop our argument by focussing on the negotiations between physicians and nurses in interdisciplinary meetings in the course of the patients' illness trajectory. In their research on oncology protocols, Timmermans and Berg (1997, p. 276) argue along similar lines:

> "[E]ach actor follows a trajectory which refers to a past, a present, and a possible future' (…) The doctor who orders the protocol, while, for example, following a research trajectory, sees the patient as one case in a project. The trajectory of the nurse who administers the protocol might be characterized by the tasks of her shift"

Following a similar line of argument, we argue that the CIS around a patient can be conceptualised as multiple disciplinary trajectories with only brief intersection points where the different professionals coordinate their activities. Below, this is spelled out more specifically by illustrating two of the most common trajectories, the care trajectory associated with nurses and the medical trajectory associated with physicians. Consider the first treatment meeting where the professional team of care providers tries to make sense of the case, including collecting information from very different sources. Notice in particular how professional boundaries delimiting the work of physicians and of nurses are being maintained and 'reinforced':

> "Typically the nurses would be delegated the task of collecting information from home care, nursing homes and the like. The physician [responsible therapist] would be responsible for talking to the primary [referring] physician and ensuring that appropriate testing and examinations are carried out. For instance, Madres, MMS, Obsdement (…) and filling out the proper forms, etc. The psychologists carry out neuropsychological testing (…), we have a social worker who takes care of the individual plan, the physiotherapist has to do his thing, and so on" (Physician)

A similar situation occurs when the patients are discharged from the ward, only now in the opposite direction. The nurses prepare their own summaries for the nursing home, while the physician produces a formal discharge letter for the general practitioner. Accordingly, different artefacts and information sources (discharge letters, nursing summaries, etc.) enforce different professional perspectives.

However, if we look more closely at the heart of the interdisciplinary work in the ward, namely the interdisciplinary meetings, we can sense how the intersection points between physicians and nurses are really of a *momentary and contingent* character. The following field-note extract from a cardex meeting illustrates this:

> The coordinator (Lisa) is managing the process. Positioned behind the computer, she is going through the information for all the patients in the ward based on the patient ward list in the EPR. Also seated at the table are the three physicians. On the table in front of them is a large binder holding the medical cardexes as well as the Physician's Desk Reference book. The rest

of the staff is spread around the room. Based on the nursing reports in the EPR, the coordinator has started to elaborate on recent changes and the current status of a patient with anxiety and extreme hypomania:

Coordinator: *"The patient claims that she has benefited from earlier stays"*

Psychologist: *"Her son says that she has been taking better care of herself since the transfer to the nursing home?"*

Having remained in the background, silently listening to the discussion, the head physician interrupts the psychologist:

Head physician: *"Only standard specimens have been ordered for this patient…?"*

The head physician's head is bowed as he carefully reads the laboratory requisition lying on the table in front of him. He has the full attention of the other two physicians in the room. With the physicians' attention on the laboratory requisition, one of the nurses has started talking to the rest of the staff:

Nurse A: *"The patient had a tendency to complain about her own disorder. We have however made it clear to her that there should be no talking about her own disorder in the day room"*

With this comment, nurse A is in fact not responding to the comment made by the head physician, but rather adding details to the account put forward by the coordinator. The staff's attention is directed towards the coordinator. Meanwhile, the three physicians have quietly started an internal discussion about the specimens ordered. They are still occupied in this discussion as the coordinator ends the overall brief (signalling that the nurses are done) by asking if anyone has any further questions. There is no response and they move on to the next patient.

For the next patient, a similar situation emerges. In this case, however, one of the physicians replies to what the coordinating nurse says:

Coordinator: *"The patient's mood is unstable. He starts sweating rather quickly. Participated on a trip to Prestevannet earlier today and was very satisfied with that"…*

Physician A, whose attention suddenly seems to have been attracted, interrupts the coordinator:

Physician A: *"Sweating???"*

Coordinator: *"Well… like he was tense …"*

Another physician, Physician B, writes something into the medical cardex, while at the same time looking in the Physician's Desk Reference (a book describing medication).

Physician B: *"Maybe we should reduce this specific medication"*

Physician B points at the patient chart, whereupon a discussion about medication starts between the three physicians. Physician B grabs the Physician's Desk Reference book and opens it again. The rest of the staff is silently listening; some are occupied with writing information into their own personal notebooks. For instance, a nurse makes a note in her notebook to remember to call the homecare service, and the psychologist writes something in her personal calendar to remind her that a specific test needs to taken. The professionals collectively agree on booking a treatment meeting for this patient.

Having completed the meeting, the various professionals (the nurses, physician, psychologist, etc.) would often write separate reports on what has been said and decided in the meeting.

Although both nurses and physicians want the best for the patient, they have different goals, practices and perspectives, making complete information sharing

illusive. Work around a patient should rather be seen as taking place in parallel paths. At certain (intersection) points in the meetings, the various professionals poll the others, checking for potential changes to their own work.

In this light, the nursing plan is merely one element in a larger infrastructural arrangement, reflecting the nursing perspective on the care process as the cardex does for the physicians.

The evolution of medical data over time in the course of the patient's illness trajectory

Medical data is often considered to be fixed, self-contained and independent. In this sense, these data are considered to be pure facts, and all that is necessary to see. However, regarding medical data as "isolated givens, overlooks how medical data mutually elaborate each other" (Berg and Goorman, 1999, p. 54-55). One such mutual elaboration is how medical data evolves over time: "[i]n the course of a patient's illness trajectory, data items are constantly reinterpreted and reconstructed" (Berg and Goorman, 1999, p. 55). This underscores the temporal dimension with illness trajectories and accordingly how "[t]emporality (…) lead[s] to expectations about the future based on past events" (Reddy et al. 2006, p. 48).

To illustrate this, Berg and Goorman (1999) showed how the sequence of blood pressure measurements of a post-operative patient in an Intensive Care Unit (ICU) was tightly interconnected:

> "Consider the following sequence of blood pressure measurements in the post-operative patient mentioned above: at 6 am, 120:70; at 9 am, 125:75; at 11 am, 115:65. If all other clinical signs would remain unchanged, then this series of readings would be most likely read as a 'stable blood pressure'. But if the 1 p.m. reading were to be 100:50, then the 11 am reading would be reinterpreted as the beginning of the decline" (Berg and Goorman, 1999, p. 54-55).

A key problem for the nursing plan was exactly that it was not able to support an "evolvement" view on medical data on the patient's illness trajectory. It could only show the current status (diagnosis and interventions). As these data were dependent on each other, the nursing plan was used less than expected. Below, we elaborate on this problem by focusing on an extract from the field notes made during a handover conference. Among the four handover conferences during a day, this one is taken from the one carried out in the afternoon:

> With only nurses present, main handover conferences are normally carried out in the conference room. Typically, an experienced nurse is delegated the task of coordinating the meeting, and today Anne has been assigned this role. Her description of the state of affairs is put across as a story. During the process various artefacts, like the written report, the ward-list, and the whiteboard, are used. In fact, not having the complete overview of all patients, her presentation is highly reliant on the availability of a mixture of patient-representations.
>
> Anne has positioned herself behind the only computer in the room. On the screen in front of her is the ward list. It holds an overview of all admitted patients and provides access to the

individual records during the brief. The ward list is visible only to Anne, so during the discussion reference is frequently made to the comparable overview found on the whiteboard. The whiteboard is the only visible description of patients which is observable for all nurses during the handover. Anne starts off with the first patient:

Coordinator (Anne): *"The patient has been isolated this weekend due to aggressive behaviour. As you can see on the whiteboard, he has one-to-one follow-up.*

Handling the patient requires a considerable effort from the nurses. Behind the patients' name on the whiteboard, a column called 'going-out status' says "*No going out*", while another one called 'follow up' says "*one to one*". The oncoming nurses' attention is now directed towards the whiteboard.

Anne continues: "*The nursing care plan has been changed. Suicide is no longer a risk, so it has been removed from the care plan."*

Anne's remark about changes in the care plan is not deduced from the care plan module in the EPR, but from the last written report. In fact recent changes in the care plan are only to be found in the written reports. The care plan module only holds an up-to-date overview of nursing diagnosis and interventions. Hence identifying changes in the care plan entails having to browse through separate written reports:

Nurse: "*The electronic nursing care plans provide only the status, and not how things change over time"*

Anne has opened the nursing care plan to refresh her memory on the patients' current status. It does not seem necessary to add anything more, so she closes the window on the screen and looks at the rest of the group.

Anne: "*The patient is isolated in his room, but with the door open. One nurse is always nearby to keep him safe"*

She is interrupted by one of the incoming nurses: *"But the patient loves to go for a walk…"*

A discussion arises among the nurses regarding the patient's 'going-out status'. On the one hand the aggressive behaviour of the patient makes him difficult to handle; on the other hand outside access is an important part of the therapy.

Anne follows up on the patient: *"Today, when [nurse] Lise had her lunch, I sat in isolation for about an hour with the patient. He really seems nervous. Besides, he also had an [ECT] today."*

Electroconvulsive therapy (ECT), a rather controversial treatment method, is normally used when other forms of therapy, such as medications or psychotherapy, have not been effective. Usually ECT treatment is given three times a week for a month or less. Anne is trying to search backwards in the written reports to find out when the series of ECT treatment actually started, but is unable to find it. The remainder of the handover is accomplished in a similar way. An account is given for all patients. Typically all written reports from the last 24 hours are used. Occasionally older reports are studied, as when Anne was trying to find out when the ECT series had started.

This field extract underscores the importance of an historical overview of how medical data changed and how the patient developed. The nursing plan was therefore only used to a minor degree in handover conferences. Instead, the users still focussed on the reports. One of the nurses explained:

"We have some really unstable patients and this means that the plan changes all the time (…). We need to trace the changes that are made for the different entries and themes in the nursing

> plan (…) look at this! This is hopeless [she is pointing at the nursing plan]. Here are some important data from 08.02, but it is not possible to see how they have changed. The patient has had a lot of different wound treatments, but I don't even know when the first one was done"

This sequence illustrates how the patient developed (improved) along his illness trajectory. Perceiving this directly in the nursing plan alone is impossible. Also, this situation provides an overview of how long an intervention has been active. In contrast, the nursing plan did not provide information about when a diagnosis was initiated and the measures were taken out of the reports and put in the nursing plan; it only gives an overview of the current situation.

As elaborated in the field note extract above, suicidal patients can never go out alone, but must always be accompanied by one of the health personnel. Therefore, the two related parameters: 'going-out status' [whether a health worker needs to accompany the patient] and 'follow-up' are extremely important for the resource management in the ward; not least how these parameters develop:

> "We are very interested to see how the patient develops. For me as a night watch nurse, covering several wards, it is particularly important (…) For instance, at one stage, you could see that the patient was not allowed to go out on a given date. Some time later, he could go out accompanied by two staff members, and at the moment, he must be accompanied by one staff member, etc."

The uncertain and contingent character of the nursing plan trajectory

It is often "thought that the trajectories of technological projects are contingent and iterative" (Law and Callon, 1992, p.49). From this perspective, implementing a large information system (cf. the nursing plan) into an organisation is seen as a rational process where goals, a clear overview and good planning lead the way to a given outcome. Sometimes, to be sure, this will be the case. However, "[there is] no necessity about such a progress. If all is smooth, this is because contingency has operated in that way" (Law and Callon, 1992, p.50).

For instance, an information system may appeal to a new reality, and become something completely different. In this case, the nursing plan turned into a resource management tool. Resource management in the psychogeriatric ward was a complex issue, depending on the current condition of the patient, the legal clauses in effect, the going-out status and follow-up. 'Going-out status' indicates whether a health worker needs to accompany the patient outside the ward or not. 'Follow-up' indicates what kind of attention a patient might need, and how often. Having a good overview of such issues was extremely important as "suicidal patients can never go out alone, but must always be accompanied by one of the health personnel" (Nurse). The rhetoric around the plan was modified to include resource management as well:

> "The ideal situation would be to document going-out status and follow-up in the nursing plan; then we could have an overview of the resources needed and how they developed" (Project group nurse)

The users themselves had a key role in the transformation process of the plan. Even if the important factors, going-out status and follow-up, were not explicitly part of the plan, the staff used them implicitly to obtain an overview of the resources needed:

> "By reading this plan, I can see that this patient will require a lot of time and resources" (Nurse)

Also in the maintenance of the nursing plan, it became increasingly important to include the resources needed. For instance, when a nurse was updating the nursing plan, one of the project leaders passed by and reminded her to include the staff resources needed:

> "You must include that this patient needs one-to-one follow-up (…) we have to be precise about which resources are needed in order to succeed with the nursing plan" (project group nurse)

Although it had been intended primarily as a vehicle for tracking the ongoing delivery of nursing care, the nursing plan implementation process became increasingly entangled with managerial concerns for resource management and control. The use of clinical information was thus lifted out of its primary context in order to be used for completely different purposes.

Conclusion and implications for CIS

This paper develops a perspective on how to conceptualise CIS in which various perspectives are accounted for. We explore how CIS are *achieved in practice* by drawing on the notion of trajectories. A perspective on CIS is developed that emphasises its situated, temporal and negotiated nature. We demonstrate how it encompasses several disconnected trajectories (professional, medical and technological) and how each follows its own logic only with brief intersecting points. Also we stress the *temporal* dimension of the multiple trajectories - and how they evolve over time in the course of the patient's illness trajectory. Based on this, we call for a furthering of the discourse on trajectories and temporality within CSCW. From a practice perspective this implies adhering both to objective and subjective perspectives of time (Orlikowski and Yates, 2002) and how work unfolds along different temporal dimensions.

Ambitions, aims and goals related to medical technologies change and expand over time and in relation to multiple stakeholders. For example in our case, the nursing plan started out as tool for nurses, yet gradually turned into a resource management tool. Whether this is a trend that ultimately will turn the nursing plan into a major tool for management is of course too early to judge. Nevertheless, such transformations of ambitions are typical of information system projects and should not come as a big surprise. Primary work transforms into something different, and where technologies find new areas of application.

Implementing the nursing plans with the aim of improving information sharing is extremely difficult. In order to succeed, the first and indeed most important thing to do is to move beyond simplistic strategies of replacing the existing information sources. The strategy to pursue is rather to find mechanisms that strengthen the relations between the different nodes. Implicitly this also involves paying closer attention to the non-common – that is, the information that remains local to the various professionals. In this respect, we call for the need to rethink 'implication or design' by focussing more on process rather than the product.

References

Allen, D. (2004): 'Re-reading nursing and re-writing practice: towards an empirically-based reformulation of the nursing mandate', *Nursing Inquiry, Special Centenary Issue*, vol. 11, no. 4, 2004, pp. 271-83.

Bannon, L. and Bødker, S. (1997): 'Constructing Common Information Spaces', *Proceedings of the European Conference on Computer Supported Cooperative Work,* ECSCW'97., Kluwer, 1997, pp.81-96.

Berg, M. (1997): *Rationalizing medical work: decision-support techniques and medical practices*, Cambridge, Mass: MIT Press.

Berg, M. and Goorman, E. (1999): 'The contextual nature of medical information', *International Journal of Medical Informatics*, vol. 56, no. 1, pp. 51 - 60.

Björvell, C., Wredling, R. and Thorell-Ekstrand, I., (2002): 'Long-term increase in quality of nursing documentation: effects of a comprehensive intervention'. *Scand J Caring Sci.*, no. 16, pp. 34–42.

Bossen, C. (2002): 'The Parameters of Common Information Spaces: The Heterogeneity of Cooperative Work at a Hospital Ward', *Proceedings of Computer Supported Cooperative Work,* CSCW'02, ACM Press, 2002, pp.176-185.

Ellingsen, G. and Monteiro, E. (2003): 'A Patchwork Planet: Integration and Cooperation in Hospitals', *Computer Supported Cooperative Work,* vol 12, no.1, pp. 71-95.

Erickson, T. and Kellog W.A. (2003): 'Social Translucence: Using Minimalist Visualisations of Social Activity to Support Collective Interaction', In K. Höök, D. Benyon and A.J. Munro eds. *Designing Information Spaces: The Social Navigation Approach*, Springer, 2003, pp.17-42.

Gerson, E. M. and Star, S. L. (1986): 'Analyzing due process in the workplace', *ACM Transactions on Office Information Systems*, vol. 4, no. 3, July 1986, pp. 257-270.

Gordon, M. (1998):' Nursing Nomenclature and Classification System Development', *Online Journal of Issues in Nursing*, Available from: http://www.nursingworld.org/ojin/tpc7/tpc7_1.htm (accessed March 22. 2007).

Grimson J., Grimson W. and Hasselbring W. (2000): 'The SI Challenge in Health Care', *Communications of the ACM.*, vol.43, no.6, June 2000, pp.48-55.

KITH (2003): *Requirements specification for electronic documentation of nursing. National standard 2003*, Available from: http://www.kith.no/upload/1101/R12-03DokumentasjonSykepleie-rev1_1-NasjonalStandard.pdf. (accessed March 22. 2007)

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

Law, J. and Callon, M. (1992): 'The life and death of an aircraft: A network analysis of technical change', in W.E. Bijker and J. Law (eds), *Shaping Technology/Building Society: Studies in Sociotechnical Change,* Cambridge, MA, MIT Press, 1992, pp. 21-52.

Munkvold, G., Ellingsen, G. and Koksvik, H. (2006): 'Formalising work – reallocating redundancy', *Proceedings of the Conference on Computer-Supported Cooperative Work 2006*, ACM, pp. 59 – 68.

Orlikowski, W. and Yates, J. (2002): It's About Time: Temporal Structuring in Organizations, *Organization Science*, Vol. 13, No. 6, pp. 684-700

Randall, S. (2000): 'What's Common about Common Information Spaces?', Paper presented at the Workshop on Cooperative Organisation of Common Information Spaces, Technical University of Denmark, 2000, Available at http://www.itu.dk/people/schmidt/ciscph2000/Randall.pdf (accessed March 22. 2007).

Reddy, M. C. Dourish, P. and Pratt, W. (2001): 'Coordinating Heterogeneous Work: Information and Representation in Medical Care', *Proceedings of the Seventh European Conference on Computer Supported Cooperative Work,* ECSCW'01, Kluwer, 2001, pp.139-158.

Reddy, M.C., Dourish, P, and Pratt, W. (2006): Temporality in Medical Work: Time also Matters. *Computer Supported Cooperative Work* vol.15, pp.29-53

Reed, J. and Stanley, D. (2003): 'Improving communication between hospitals and care homes: the development of a daily living plan for older people', *Health and Social Care in the Community*, vol. 11, no.4, 2003, pp356–363.

Rolland, K H, Hepsø, V and Monteiro E. (2006): 'Conceptualizing Common Information Spaces Across Heterogeneous Contexts: Mutable Mobiles and Side-effects of Integration', *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, ACM, 2006. pp. 493-500.

Schmidt, K. and Bannon, L. (1992): 'Taking CSCW seriously: Supporting Articulation Work', *Computer Supported Cooperative Work,* vol.1, no.1, 1992, pp.7-40.

Sexton, A., Chan, C., Elliot, M., Stuart, J., Jayasuriya, R, and Crookes P. (2004): 'Nursing handovers: do we really need them?', *Journal of Nursing Management*, no 12, 2004, pp.37–42.

Star, S. L. and Griesemer J. R. (1989): 'Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39'. *Social Studies of Science*, vol. 19, no. 3, pp. 387-420.

Strauss A., Fagerhaugh S., Suczek B. and Wiener C. (1985): *Social Organization of Medical Work*, Chicago, The University of Chicago Press.

Strauss, A. (1993): *Continual Permutations of Action*, Thousand Oaks, CA: Sage.

Timmermans, S. and M. Berg. (1997): 'Standardization in action: Achieving universalism and localisation through medical protocols', *Social Studies of Science*, vol. 27, pp. 273-305.

Voutilainen, P., Isola, A., amd Muurinen. S. (2004): 'Nursing documentation in nursing homes – state-of-the-art and implications for quality improvement', *Scandinavian Journal of Caring Sciences*, vol.18, no. 1, 2004, pp72–81.

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

Winthereik B.R. and Vikkelsø S. (2005): 'ICT and Integrated Care: Some Dilemmas of Standardising Inter-Organisational Communication', *Computer Supported Cooperative Work*, vol.14, no.1, 2005, pp.43-67.