

Co-constructing standards in nursing

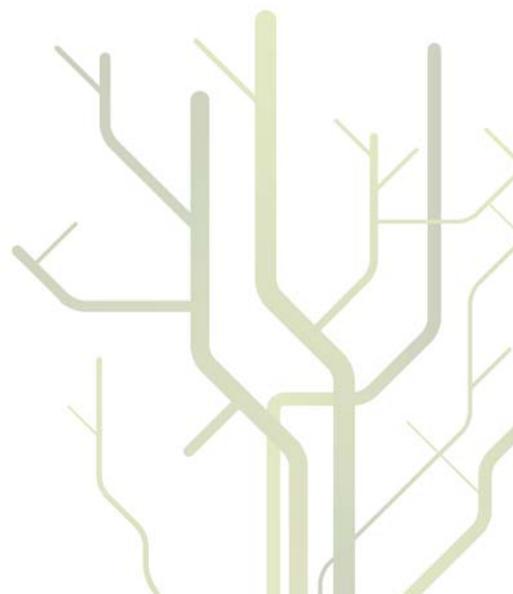
A socio-technical approach to standardization in practice



Torbjörg Træland Meum

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Abstract

This thesis presents an interpretive study of adoption and use of standards in nursing. The study focuses on the content, context and process of standardization and is based on empirical studies in the Norwegian healthcare environment. A key issue is the adoption and use of nursing terminologies and procedural standards in which I aim to provide empirical and theoretical insights into the mechanisms that make standards “do-able”.

This thesis has a strong focus on how standards are perceived and performed in practice where the basic theoretical approach is based on the literature on information infrastructures. The notion of information infrastructures have largely been explored within the information systems (IS) field but also in interdisciplinary research communities such as computer supported cooperative work (CSCW) and medical informatics (MI). By applying a socio-technical approach to standardization I move beyond the notion of standards as standalone systems. Rather, I characterize standardization as a dynamic and evolving process where the interrelation between standards and situated practice is emphasized. My approach to standardization rests on three key issues with practical and theoretical implications. First, I elaborate on the transforming capabilities of standardization. From this perspective, I focus on both the negotiation process in terms of design and development of standards as well as the interplay between standards and situated knowledge. Second, the focus is on coordinating mechanisms and how standards enable continuity of care within and across health care team. Third, the emergent change process of large-scale information systems is highlighted. I consider nursing documentation as part of an information infrastructure (EPR) and nursing terminologies as part of a global infrastructure (International terminologies).

All of the papers included in this thesis are about, more or less, how information infrastructures are maintained and modified, i.e. the dynamics of the socio-technical network. Firstly, this thesis aims to provide increased theoretical insight into the “growing” and changing of information infrastructures. By introducing the concept of sociomateriality, this thesis seeks to contribute to the theoretical discussion on the interrelation between social and material agency. Second, I elaborate on notions of interdependencies between action and artifacts used in nursing. Several of the papers have revealed various “technological gaps” and demonstrated how coordinating mechanisms enabled communication and coordination within and across domain-specific boundaries. Especially I expand on the role of redundant information and workarounds as mechanisms for navigating and bypassing pragmatic gaps. Thirdly, I elaborate on the co-constructive perspective of standardization and underscore the temporal aspect as well as localized improvisation and innovation. Finally, this thesis may also have practical implications beyond the nursing environment and thus enhanced insight into the design and development of process-oriented electronic patient records (EPRs).

Papers

1. Meum, T. and G. Ellingsen (2010): "'Sound of silence" - Changing from oral to a computer-mediated handover." *Behaviour & Information Technology*
2. Meum, T., Wangensteen, G., Igesund, H., Ellingsen, G., Monteiro, E (2010): Standardization – the iron cage of nurses' work. *Stud Health Technol Inform*
3. Meum, T., E. Monteiro, Ellingsen. G: (2011): The Pendulum of Standardization, European Conference of Computer Supported Cooperative Work (ECSCW2011), Springer.
4. Meum, T. and G. Ellingsen (2011): Standardization in Nursing: Cross-contextual Information sharing. ECIS Proceeding, AIS
5. Meum, T. (2013): "Lost in Translation - The challenges of seamless integration in nursing documentation." Accepted for publication in *International Journal of medical Informatics*.
6. Meum, T. (2012): Electronic medication management: a socio-technical change process in clinical practice, ACM 2012 conference on ComputerSupported Cooperative Work (CSCW).

Foreword

This PhD project has been a long journey in various ways, both literally and academically. I travelled from the south to the north of Norway when I started my position as a PhD fellow at the University of Tromsø. Some have said that a PhD project is a lonely journey, and it's true that I started the journey alone. However, I brought with some "luggage" and has since become part of a large national and international network that has inspired and contributed to this thesis.

First and foremost, I became a part of Tromsø Telemedicine Laboratory (TTL), which was a newly established centre for research-based innovation. In particular, I have had the benefit of sharing work environment and become familiar with several of the partners to TTL. Especially I want to mention Monika Johansen, Kari Dyb and Terje Solvoll who are employed at the Norwegian Centre for Integrated Care and Telemedicine and have supported and encouraged me during long working hours. Another partner that I would mention is DIPS ASA where the door has always been open for me, as well as my issues. A special thanks to Sigurd From that has been my "gatekeeper" to this community and thus facilitated for participation in workshops, seminars and conferences.

I started this journey with valuable "luggage" from previous work that has inspired and guided my research. During previous work experience, I have had the pleasure of working with Olaug Haslemo and Torhild Gregersen. This cooperation has continued during my research, and they both have supported my research and have been a link to the healthcare environment. Thanks to you both! I also want to thank the people that I have interviewed and interacted with during my case studies. In particular, I have had a long and close partnership with Gro Wangensteen and Karen Sissel Soleng at the hospital in northern Norway. Their interest in my project and contributions to professional discussions, made me feel at "home". It reminded me also of my roots - namely in nursing practice.

Throughout the research process, I have had the pleasure of working with a special group at TTL, i.e. the research group of Telemedicine and eHealth. First and foremost, I want to express a sincere gratitude to my supervisors who have supported and encouraged me beyond what I had expected. Gunnar Ellingsen, my main supervisor, a big thank for your enthusiasm, dedication and interest in e-health in general and nursing documentation especially. Your supportive attitude has encouraged me to move on and to deal with the ups and downs during the PhD project. Your door has always been open and you have been available for guidance and feedback on my work, whether it was weekdays or weekend days. Also, a big thank for introducing me to a most stimulating academic community that has brought me out into the "big world" and to an international network. Also a sincere thank to my second supervisor, Rolf Wynn, who I had the pleasure to work with and who have shown interest and provided feedback on my work.

A special group within the research group for Telemedicine and eHealth has followed me throughout my PhD project, and I want to express a sincere gratitude to each and every one of you. Liv Karen Johannessen, Eli Larsen, Kristoffer Røed and Rune Pedersen have all played a major role in my life over the past few years. Together we have studied, struggled, travelled and supported each other towards a shared goal, and I have greatly enjoyed and benefited from this community.

Finally, I have had great pleasure and inspiration from an interdisciplinary academic community. Especially from the Information System (IS) and computer supported cooperative work (CSCW) communities, I have had the privilege to participate in PhD workshops and conferences and thus met many people who have inspired my work. It has been particularly useful to present my work and get comments from senior researchers within the field, among them Eric Monteiro, Margunn Aanestad, Tina Blegind Jensen, Peter Axel Nielsen, Christian Nøhr, Bridget Kane and Pernille Bjørn.

Last, but not least, I want to thank my family and especially my mother, who always believed in me and encouraged me to go ahead, even if it meant prolonged stay in the northern areas. Thanks so much for your care and support!

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Torbjørn Meum

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1 Introduction

My interest and motivation of computer-based system in health care was triggered by experiences with the use and adoption of electronic patient records (EPRs). My first experience with computer systems in health care was in the late 1980's when I worked as a nurse at a newly opened cardiac clinic. I was fascinated by the capabilities of modern technologies to record and store information such as vital observations, electronic ordering of laboratory tests as well as electronic nursing discharge summary. During the past 30 years there has been a major progress in the use of information technology, both in everyday life as well as in health care. Today, all Norwegian hospitals have adopted EPR and electronic communication has become part of daily practice at hospitals. Yet, it is only recently that electronic nursing documentation has become common practice. Moreover, a range of clinical tasks is still supported by paper-based routines and paper and computer-based artefacts live side by side. This slow diffusion and lack of use of the EPR has made me wonder what are this technology called EPR and what does implementation of EPR in health care means? My journey has brought me back and forth between local use of EPR systems, national visions and strategies and to the international standardization organizations (ISO). The foci of this thesis have been on nurses' use of EPR with special attention to the use of nursing care plans and standardized terminologies.

1.1 Development and diffusion of EPR standards

Development and implementation of EPR systems have since the 1990s been considered as key instruments to achieve health policy goals in Norway. The use of information technology as a means to increase efficiency and better quality has been echoed in national strategies and visions such as "More health care for each BIT,"(HOD, 1996) Say@h" (HOD, 2001), Teamwork 2007 (HOD, 2004), and "Interaction 2.0" (HOD, 2008).

"We believe in improved quality, increased effectiveness and cost saving through the use of information and computing technology" (Teamwork 2007, p. 2). "Continuity of care for patients and clients through electronic interaction" (ibid. p.5).

The first plan, released in 1997, stressed a shared, unified ICT infrastructure and a shared information and data foundation. The plan emphasized to improve communication and facilitate procedures for updating and storing information and thus provide more time to patient care. The next plan in 2001 emphasized to promote electronic collaboration to strengthen and enhances cooperation between different disciplines and management areas of the health and social services. The latest national strategic plan for 2008 - 2013 was a continuation of previous plans. Although Norway has been among the first to build a foundation for electronic collaboration, the goals are only partially reached. Electronic interactions within and between different health services are still inadequate, and electronic and paper-based practices exist side by side as illustrated in the quote below (HOD, 2008, p. 9).

"I thought it would be a package tour where everything was planned and prepared for me, but it was more a backpacker trip where I had to look after and take responsibility for everything myself."

The quotation is taken from the national strategy "Interaction 2.0" and is a statement from a cancer patient that illustrates some of the challenges rising from the fragmentation of health services. Furthermore, the quote demonstrates the gap between the expectations of the new technology to ensure seamless flow of information and the current situation with "islands of information" in which patients and users' ability to navigate the fragmented information items are essential for the outcome and performance of health care services.

A feature of all national strategies and plans is emphasis on EPRs as a foundation for the flow of information and the necessity of increased standardization in health care.

"A through and general introduction of EPR is presumed to have the most potential gain of all the ICT measures in the health and social sectors. EPR throughout the whole of the health care services is a premise for continuity of patient care in particular for patient with chronic complaints and complex needs" (HOD, 2004, p. 15)".

While the Norwegian Ministry of Health and Social Affairs has been responsible for the preparation of national strategies, the Norwegian Centre for informatics in Health and Social Care (KITH) has been in charge for the development of national EPR standards. The ambition of first version of an EPR standard was on storage and archiving of health information to increase availability and accessibility to patient records. The main focus was to replace the paper version of the medical record and emphasized the structure and principles providing a sustainable foundation for the implementation of EPR in all parts of the health care sector. A basic generic definition of EPR is "a repository of information regarding the health status of a subject of care, in computer processable form (ISO, 2005, p. 2). Accordingly, first-generation EPRs' was more or less a digitized version of paper records. In line with changes in health care environment it has been developed several EPR standards, for example in relation to access control, integration of standardized classification systems, infrastructure and functional requirements. In addition, it has also been developed a standard for documentation of nursing.

Although much has been achieved since the first national strategy in 1997, the full potential and capabilities for ICT investments in health care is far from being realized. The Norwegian EHR Research Centre has carried out a survey of the distribution and application of EPR in Norway (NSEP, 2010). The survey showed that 60% of hospitals had a completely computerized EPR. However, 40% reported that the EPR was supplemented with paper records. A similar survey conducted by the office of the Auditor General of Norway also found that paper records are still important in most hospitals. The survey showed that 65% of doctors said they had to look in the paper records, because all required information was not available in the EPR (Riksrevisjonen, 2008). This means that national strategies for ICT as a tool to increase efficiency and improve quality is not yet achieved.

There have been significant changes in the health care environment over the past decades. Ever since Hippocrates (the founding father of modern medicine) and Florence Nightingale (the founding mother of modern nursing), patient records have been a vehicle for communication and coordination among the health care team. However, during the last century, the medical records have increasingly become a key tool for legal and administrative tasks. In the mid 1900s, it was introduced legal regulation for documentation in the patient record in order to contribute to the safety of patients and the quality of

health care services ¹. Moreover, the increasing use of EPRs has also facilitated the secondary use of health data such as health monitoring with the introduction of a number of mandatory national health registers ². Yet, the legacy of these pioneers in the field of medicine and nursing has been passed on and further developed from chronological narratives towards source-oriented and problem-oriented documentation (Bemmel, 1997). As mentioned earlier, the first version of the EPR was mainly structured as a journal archive for storage and archiving of documents (NOARK- 4)³. At the same time there has been a rapid development of biomedicine and medical technology that have provided new methods of managing the care processes. The rapid advances in medical technology have led to increasing amount of data collected and processed in computer systems such as laboratory Information System (LIS), Picture archiving and Communication System (PACS), measurements and results from monitors and so on. This type of information has become an important part of the health care environment and blurs the boundary between the EPR, medical equipment and purpose specific clinical information systems. This development has also led to increasing specialization and enhanced the need for coordination between and across the health team. This fragmentation of clinical information is also elaborated in a report from the National ICT, which highlights the need for evidence based guidelines and decision support, i.e. process-oriented EPRs (Nasjonal-IKT, 2007).

Some of the features of the EPR as presented above illustrate some of the challenges and the numerous actors and stakeholders involved in the management and use of EPR systems. As shown, the EPR has evolved from a means of communication and coordination among health care workers toward also includes management and surveillance of health services. Thus, the question of what the EPR *is* and its importance depends on whether you are a patient, health professional, politician, supplier, etc. Furthermore, the evolution of the Internet and social media has made health information more accessible to citizens and makes new demands on the organization of health care services and access to their own health information. The demographic changes in society also place new demands on the organization and coordination of health services. The number of elderly is increasing and more and more people suffer from chronic diseases. The recent initiated Coordination Reform in Norway is a national action to meet these challenges, for example, more cohesive patient pathways, and stronger national management and coordination of ICT (HOD, 2009). In sum, all of these challenges underscores the importance of continuity of care and emphasizes the need for increased standardization and cooperation in the healthcare environment.

¹ <http://www.regjeringen.no/nb/dep/hod/dok/nouer/2006/nou-2006-05/7.html?id=157242>

² http://mfr.no/eway/default.aspx?pid=238&trg=MainLeft_5853&MainArea_5811=5853:0:15,2825:1:0:0:::0:0&MainLeft_5853=5825:52966::1:5857:1:::0:0

³ <http://www.arkivverket.no/eng/content/view/full/200>

1.2 Theoretical approaches

Continuity of care is the overall vision for adoption of ICT in health care and requires the right information at the right time on the right patient. Nurses are the largest group of professionals in the health care in general and at hospitals in particular and using and producing large amounts of information across time and space. My theoretical approach to the use of EPRs and nursing care plans has also been a journey back and forth between different theoretical fields and discourses. My starting point was in the field of health informatics that has provided knowledge about “the state of the art” of electronic documentation of nursing and use of standards. In this community, nursing informatics have grown to become a distinct specialty within nursing and is defined as a combination of computer science, information science, and nursing science design to assist in the management and processing of nursing data, information and knowledge to support practice of nursing and delivery of nursing care (Graves & Corcoran, 1989). Research methods that are central to nursing informatics focus mainly on design, development, implementation and assessment of information systems for nursing practice as well as measurements of the effects of these systems on nursing practice and outcomes (Bemmel, 1997, p. 220). Within the nursing informatics community, there have been conducted comprehensive studies on the use of EPRs, standardized terminologies and decision-support systems. The majority of the research in this field has been evaluation studies, comparability between paper-based and computer-based documentation as well as applicability of standardized terminologies (Häyrinen, K., Saranto, & Nykänen, 2008; Kim, Coenen, & Hardiker, 2010; Saranto & Kinnunen, 2009). Despite high expectation for the use of computerized documentation in nursing, a recent European survey showed that general use of terminologies was still lacking (Thoroddsen, Saranto, Ehrenberg, & Sermeus, 2009). Similar, a comprehensive research study in U.S. revealed that health information technology had a modest impact on process measures of quality, but no impact on administrative efficiency or overall cost (Himmelstein, Wright, & Woolhandler, 2010).

The Medical informatics community has traditionally focused on the technological features of computerized systems in health care, i.e. a technological deterministic approach towards development and use of new technology in health care. However, based on the challenges of introducing EPRs in complex healthcare organizations, there has been increasing scientific interest in socio-technical issues. From a socio technical approach it is not a distinctive division between the technical and social, but the focus is on the interrelation between technology and its social environment (Berg, Aarts, & van der Lei, 2003). The term socio-technical approach has roots in several research communities such as Information System (IS), Study of Science and Technology (STS) and Computer Supported Cooperative Work (CSCW). Scholars from these communities have studied the construction of classification, the tension between formal plans and situated practice, the transformative power of standards and how standards coordinate work practice (C. Bossen, 2011; Bowker & Star, 2000; G. Ellingsen, Monteiro, & Munkvold, 2007; L. A. Suchman, 2007; S. Timmermans & Berg, 2003). Some key features of these studies is that standards or new technology is not considered an objective static entity, but as a dynamic interplay between new technology and work practices. Reflections on standardization and new technology have thus moved from an objective, pre-defined reality to include the subjective understanding and multiple interpretation of

new technology. Marc Berg has illustrated this by describing the interrelation between formal tools (the map) and work as it is actually performed (the terrain).

“Since the formal representation is an impoverished version of that which it represents, bridging the gap (in both directions) requires skillful human work (Berg, 1997, p. 406).

Formal tools such as standards have the capabilities to transform work practices in various ways. However, as argued by Marc Berg, “the generative power of this configuration lies in the interrelation of the formal with the informal (ibid. p.406). It is this gap between the map (formal tools) and the terrain (context of work) that has inspired my work and then guided the theoretical foundation of the thesis.

As shown above, my conceptualization of the EPR builds not only on a technical artifact, but also on a complex system of technology, people, procedures, skills and so forth. This statement is based on the international organization for standardization (ISO) definition of EPR system “*as the set of components that forms the mechanisms by which electronic health records are created, used, stored, and retrieved. It includes people, data, rules and procedures, processing and storage devices, and communication and support facilities*” (ISO, 2005, p. 3). Furthermore, my theoretical approach and knowledge to the EPR and standards is based on actor network theory (ANT) to emphasize the dynamic interaction involved in standardization, integration and coordination. According to Bruno Latour, “the fate of facts and machines is in the hand of later users” and “the construction of facts is a collective process” (B Latour, 1987, p. 59). Bruno Latour makes no distinction between “nature” and “social” or “actor” and “network” but claims that all actors achieve their significance by being in relation to other actors. This means that EPR does not have a fixed significance in and of itself, but are entirely defined in relation to other elements in the systems, to other actors in the network (B Latour, 1987; Law, 2008). By applying ANT as a basic theory enables zooming in and out of the socio-technical network. In addition, I use the concept of information infrastructure in order to emphasize the mechanisms that are put in play when standards are materialized in nursing practice.

1.3 Research questions

The high hopes and expected outcomes of the use of standards have made standardization a powerful movement in health care in general and in nursing in particularly. Standards have different intentions and interpretations depending on the user context. Drawing on sociotechnical studies on standardization, I am interesting in how standardization changes the practice of nursing on both a macro and micro level. Considering the growing need for standardization and the slow adaptation of standards in practice, I am interested in the construction of standards in the situated context of use, i.e. the intersection between “map” and “terrain”. The main focus has been on standardized nursing terminologies as well as standardized care plans. My approach to standardization rests on three key issues with practical and theoretical implications. First, I elaborate on the transforming capabilities of standardization. From this perspective, I focus on both the negotiation process in terms of design and development of standards as well as the interplay between standards and situated knowledge. Second, the focus is on coordinating mechanisms and how standards enable continuity of care within and across health care team. Third, the

emergent change process of large-scale information systems is highlighted. I consider nursing documentation as part of an information infrastructure (EPR) and nursing terminologies as part of a global infrastructure (International terminologies).

With these considerations in mind, the overall aim of this thesis is an increased understanding of how technology is transforming nursing practice and how nurses adapt standards to existing work practices. This general aim leads to the following research questions:

RQ 1. *How are standards adopted to the nursing community?*

RQ 2. *How do standards emerge and evolve in different context and how does it affect local practice?*

RQ 3. *How do the interplay between standards and local practices affect and enable collaboration in nursing?*

RQ 4. *What mechanisms ensure sustainable progress of standards over time?*

With these questions, the purpose is to stress the practical importance of standardization, what standards do, coherence between standards and practices and the mechanisms that make standards “do-able”.

1.4 Findings and contribution

The research presented in this thesis is based on several case studies in the interpretive tradition of qualitative research. The empirical data is collected from various disciplines in nursing (psychiatry, medicine, surgery), and from three different hospitals in Norway. The focus has been on the development and use of standards in nursing, with special emphasis on nursing terminologies. In accordance with my theoretical approach, the focus has been on the correlation between nursing documentation in the EPR and its environment, i.e. between text and context. The various case studies have provided insight into the diversity of nursing and the various standards used in daily practice. Although the study initially focused on nursing terminologies, my theoretical and methodological approach also highlighted the standardization process and thus includes standardized procedures and technologies used in everyday practice.

The findings of this study is illustrated in the six papers that are published as conference proceedings or peer-reviewed journals. All papers contribute with empirical and theoretical insights to adoption and use of standards in nursing, and the papers and their relation to the research questions are listed below in Table 1.

	RQ1	RQ2	RQ3	RQ4
“Sound of silence” – Changing from oral to a computer-mediated handover	Dark grey	Light grey	Dark grey	White
Standardization – the iron cage of nurses’ work	Dark grey	White	Dark grey	White
The Pendulum of Standardization	Dark grey	White	Dark grey	Dark grey
Standardization in Nursing – Cross-contextual Information Sharing	Dark grey	Dark grey	Dark grey	White
Lost in Translation – The challenges of seamless integration in nursing documentation	Dark grey	Light grey	Dark grey	Dark grey
Electronic medication management: a socio-technical change process in clinical practice	Light grey	White	Dark grey	Dark grey

Table 1. Correspondence between articles and research questions: Dark grey indicates full match, grey indicates partial match and white indicates no match.

As shown in the table, the papers contribute to different aspects of standardization, where the intensity of the gray scale indicates the degree to which the various papers answer the research questions. The various papers also indicate the movement of empirical and analytical focus of nursing documentation as a standalone system towards an interrelated information infrastructure. Paper one, two and three emphasize adoption and use of nursing terminologies and electronic care plan, and contributes to an expanded understanding of the co-constructive perspective on standardization. In line with an increased understanding of the collaborative infrastructure, the last three papers focus on the boundary between nursing-specific documentation and information sharing across organizational and domain-specific boundaries. Overall, these papers contribute to an expanded understanding of the evolving and changing nature of information infrastructures, and of interdependencies between work practice and technologies.

1.5 Thesis structure

The remainder of the thesis is organized as follows: Section 2 provides an in-depth description of the theoretical framework and perspectives that were adopted during this research. Section 3 elaborates on methodological approaches as well as an outline of the research design and specific procedures used in conducting the study. Section 4 provides an overview of empirical data presented as four different cases from the nursing environment. This is followed by a summary of each paper and findings in section 5. Section 6 outlines the contribution of this research where theoretical and practical implications are elaborated and discussed. Finally, section 7 provides a summary as well as considerations and recommendations for future research.

2 Theory

2.1 Standardization – The cornerstone of a shareable EPR

Standardization is a powerful movement that is embedded in all daily activities in our globalized world; “standards specify how we work, how our technologies interact; they hold our sociotechnical societies together (S. Timmermans & Berg, 2003, p. 8). Standards are ubiquitous in our networked society and are not just one “thing”. Standards and standardization has come to mean different things to scholars focusing on different issues. The International Standardization organization (ISO), Technical Report, Health Informatics have defined a standards as “ *a document, established by consensus and approved by a recognized body, that provide, for common and repeated use, rules, guidelines or their results, aimed at the achievement of the optimum degree of order in a given context*” (ISO, 2005, p. 6). This definition is quite broad and covers all types of standards used in EPR systems. Traditionally, standards have been considered as technological artifacts that are part of programming languages, communication protocols, and exchange formats; they ensure that systems fit together (S. Schmidt & Werle, 1998, p. 3). From a technical perspective, efforts have been aimed at developing information models and architecture arrangements for EPR systems to ensure interoperability, data consistency and data quality (Kalra, 2006). However, there have been increased attention on the role of human, social and organizational context in which information systems operate, i.e. socio-technical approach towards health information systems (Ash, 2010). Similar studies have emphasized standards as coordinating mechanisms (K. Schmidt & Simone, 1996), ordering devices (C. Bossen & Markussen, 2010) as well as the transforming power of standardization (G. Ellingsen et al., 2007; S. Timmermans & Berg, 2003). A common feature of these studies is that they focus on what standards *do* and how they are shaped and shapes practice. Accordingly, standardization in health care covers more than plugs and sockets, but also includes rules, guidelines and the process of rendering things uniform (S. Timmermans & Berg, 2003). In addition to these overall definitions of standards, I have been inspired by the work of Bowker and Star (2000) who have outlined several dimensions of standards such as:

- A standard is any set of agreed-upon rules for the production of (textual or material) objects.
- A standard spans more than one communities of practice (or site of activity). It has temporal reach as well in that it persists over time.
- Standards are deployed in making things work together over distance and heterogeneous metrics. (Ibid. p. 13 – 14)

The degree of agreement and / or consensus may be more or less formal, and a distinction is usually made between formal, de facto and de jure standards (Hanseth, Monteiro, & Hatling, 1996; S. Schmidt & Werle, 1998). In health care, formal standards are most common in which guidelines and recommendation are prepared by organizations or professional communities such as the International Standardization Organisation (ISO) or International Council of Nursing (ICN). In addition, market dominance (de facto standards) as well as legal governance (de jure standards) affects and impose standardization.

Timmermans and Berg (2003) distinguish between four standards used in health care; design standards, performance standards, terminological standards, and procedure standards. Design standards are more or less specification of social and technical systems ensuring uniformity and compatibility. Performance standards represent outcome specification used to regulate professional work and outcome measurements. An example is the adoption of quality indicators in Norway that offers transparency that is essential for securing accountability for health systems performance⁴. The third kind of standard are terminologies that have a long history in various levels of the health care, such as professional organizations and the World Health Organization. North American Nursing Diagnosis Association (NANDA)⁵ and International Classification of Diseases (ICD)⁶ are examples of such standards that have evolved over a long time in order to share and compare clinical information and to ensure stability of meaning over different sites and times. Finally, procedural standards are specifications of processes such as clinical guidelines, protocols, procedures or care plans. These standards demarcate a number of actions to be performed when specified situation and conditions occurs, for example, what step a nurse should follow in preventing decubitus ulcers. All of the above standards may overlap each other and be a part of the same standard. For example, terminologies can be embedded in care plans, and clinical guidelines may also include outcome specifications.

Although all the mentioned types of standards have a key role in health care, I have mainly focused on terminology and procedural standards. These standards represent the highest level of standardization as an integral part of EPR systems. All terminologies and standardized schemes are a mixture of physical entities, such as paper forms, plugs, or software instructions encoded in silicon, and conventional arrangements such as speed rhythms, dimensions, and how conventions are implemented (Bowker & Star, 2000, p. 39), i.e. they are socio-technical.

In the following paragraphs I will elaborate on the content, context and process of standardization in nursing. In the first section I illustrate the historical and professional development of standards in nursing as well as the efforts, negotiations and cooperation that has characterized the design and development of terminologies. A large part of this work has been going on within the nursing and nursing informatics community where attention has been on the progress of a shared language in nursing. My purpose is to demonstrate that nursing terminologies are not developed from scratch, but are built on an extension and improvement of what already existed, i.e. the installed base (Ciborra, 2001). Moreover, I argue that standardization is a negotiation process between professional conventions of practice and progress in technological capabilities (Bowker & Star, 2000). Accordingly, multiple interests and actors have taken part in the development of standards and involved cooperation between various national and international organizations. In the next section I go to the interplay between standards and practice and how standards are inscribed in other arrangements in nursing. I highlight the correlation between

⁴ <http://www.helsedirektoratet.no/publikasjoner/nasjonale-kvalitetsindikatorer/Sider/default.aspx>

⁵ <http://www.nanda.org/>

⁶ <http://www.who.int/classifications/icd/en/>

terminologies and procedure standards (care plans) in nursing, the coordinating role of standards as well as the enabling and constraining capability of standards. Finally, I conceptualize nursing standards as part of a coordinating infrastructure and elaborate on some of the dynamic mechanisms that characterize information infrastructures. I emphasize the relational aspect of infrastructures and how they are maintained and changed.

2.1.1 Design and development of standardized terminologies in nursing

Standardization is rooted in strategies as a means to increase the quality and effectiveness in health care. The International Organization for Standardization (ISO) Technical report highlights the ability to share information as one of the greatest potential benefits of the EPR and emphasizes interoperability across systems as a major challenge. In spite of high expectations and visions of seamless integration, the EPR is still characterized as “island of information” with little or no ability to share information beyond the immediate boundary of a single health organization, between different applications or between different disciplines (ISO, 2005, p. 9). Similar challenges are echoed in the Norwegian strategy for coordination in the health care sector in which lack of standards hampers coordination within and between different organizations (HOD, 2008).

Terminologies and clinical classification are a *sine qua non* to sharing information between systems and ensure a common meaning of the information and has been a key topic in the field of medical informatics and in the nursing community (E. J. S. Hovenga & Garde, 2010; Kalra, 2006; Kim, Coenen, & Hardiker, 2011; Lenz, Beyer, & Kuhn, 2007). However, classifications and coding of patient information have been carried out long before the advent of computers. Ever since 1893, the International Classification of Diseases (ICD) has been used for assessment of information about morbidity and mortality and has become a global classification system. This kind of classification system has been directed at simplifying information, converting it to a general form which is easier to manipulate and have mainly been used for statistical purposes (Cimino, 1996).

The history of classification systems of nursing also goes back to last century. In a way, Florence Nightingale was the first to use clinical information systematically to improve the health of people. In addition to being the founder of modern nursing, she was also an acknowledged statistician and developed new methods to demonstrate the need for reforms in health care (Nightingale, 1992). However, evolvement of classification systems in nursing started formally in the 1970s and was motivated by the need to develop a way of recording nursing practices that provide a more comprehensive and accurate picture of what nurses do on behalf of the patient (Clark, 1998). The North American Nursing Diagnosis Association (NANDA) has been a driving force in efforts to develop diagnostics classifications in nursing as a means to support clinical judgement and knowledge development (Clark, 1998). Similarly as ICD is a classification system for medical diagnose, NANDA is developed to represent nursing diagnoses; i.e. patient’s problems and needs. Diagnoses are concepts that are given a word- label; it is a conceptual model for interpreting a set of observations and therefor provides a way of understanding and thinking about the set (Gordon, 1998, p. 3). The origin of the development of nursing diagnosis was grounded in

theory and knowledge development in nursing at the time and was influenced by the problem-solving nursing process. In the following year, a group of nursing researchers at the University of Iowa initiated efforts to develop nursing intervention classification (NIC) and nursing outcome classification (NOC). NANDA, NIC and NOC complete the diagnosis- intervention – outcome linkage relationship in which a nursing diagnosis provides the basis for selection of nursing interventions to achieve outcomes for which the nurse has a accountability (NANDA-International, 2012).

Development and implementation of computer-based systems has increased attention on the use of a standardized language to share information within and between care teams. For example, NANDA and NIC have been implemented in EPR systems worldwide and translated into several languages, including Norwegian. In the meantime, there has been a trend towards development of a number of different terminologies⁷ such as Clinical Care Classification (CCC), Omaha system, Nursing Minimum data set (NMDS), PeriOperative Nursing Data Set (PNDS) and International Classification for Nursing Practice (ICNP). Some of these terminologies supplement each other (NANDA, NIC, NOC) while other cover specific purposes to meet the needs of particular uses and new demands for use in EPR systems. Thus, studies in the nursing informatics community has been focused on efforts to enable the applicability, comparability, consistency and interoperability of clinical information (S.. Bakken, Warren, Lange, & Button, 1998; Chute, 2000; Müller-Staub, Lavin, Needham, & van Achterberg, 2007). However, current diversity on nursing terminologies is a major impediment to achieve these goals and is unable to fulfil the multipurpose goals that the profession expect from them (Goossen, 2006). Despite extensive efforts, challenges remain in assessing and improving the quality of terminologies because of variation in development, maintenance, auditing and governance (Kim et al., 2010, p. 1041). Similar studies have evaluated domain completeness and illustrated limitation of some terminologies (Ruland, 2001; Thoroddsen & Thorsteinsson, 2002) and support the earlier study of Bakken et al. (1998) that found that none of existing systems met all the criteria for complete, comprehensive, clear and non-redundant representations of concepts.

2.1.2 Standardization as a negation process among stakeholders

There is now widely agreement about the need to standardize the content of the EPR to facilitate sharing and comparing of health data within and across the healthcare team. It is also recognized that there is a need for a number of different terminologies to enable safe and secure exchange of information across organizational and professional boundaries. This implies to visualize nursing documentation across the continuity of patient care and it has lately been initiated international cooperation to coordinate and support mapping between classification systems as well as development of reference terminologies like SNOMED CT and International Classification of Nursing Practice (ICNP). A number of standard organizations such as CEN, ISO, and the U.S. Nursing Vocabulary Summit have cooperated to facilitate greater coherence between nursing terminologies as well as between terminologies used in other areas of health care (N. R. Hardiker, Hoy, & Casey, 2000). The majority of nursing terminologies currently in use is

⁷ <http://nursingworld.org/npai/terminologies.htm>

based on old technologies and is known as interface terminologies such as NANDA, NIC, and HHCC. These are typically a restricted set of phrases, generally enumerated in a list and arranged into a hierarchy. The advantage of interface terminologies is that concepts and terms are predefined in a list and thus easy to implement and use. However, it is a challenge compared to granularity and completeness with the use of such a system. On the one hand, a large number of phrases would be necessary to cover all the clinical information used in nursing practice. On the other hand, to be useful in practice the number of phrases need to be limited. Accordingly, interface terminologies have been criticized for insufficient granularity or aimed at specific areas of nursing. Moreover, “differences between individual nursing terminologies prevent direct comparison and exchange of nursing documentation” (N. R. Hardiker et al., 2000, p. 525).

In order to meet some of these challenges, nursing terminologies have evolved from simple lists of words or phrases to large, complex ontologies, i.e. descriptions of entities within a domain and the relationship between them (N. Hardiker, 2011, p. 116). ICNP is an example of so-called ontologies and is part of the program of the International Council of Nurses (ICN), a federation of national nurses associations that currently has more than 120 country members (Coenen, Marin, Park, & Bakken, 2001). The international cooperative efforts of developing a unified framework for nursing started in 1989 and have resulted in several releases of ICNP where the last version, ICNP 20, was released in 2008. ICNP may be used as an interface terminology as well as a uniform nursing language system. The structure of ICNP is more complex but also more flexible and dynamic than traditional interface terminologies. For instance, while NANDA and NIC are represented in pre-defined lists, ICNP is comprised of 7 axes (Focus, Judgment, Means, Actions, Time, Location, Client) that facilitate the composition of nursing diagnose, interventions and outcome statement (Park, Lundberg et al 2010). A key feature of ICNP is the use of Web Ontology Language (OWL) and thereby enabled automated reasoning and cross-mapping between terminologies (N. Hardiker, 2011).

Another international effort initiated by the nursing informatics community has been the development of a reference terminology model for nursing (ISO, 2003). The main objective is to facilitate the development, harmonization and evaluation of terminologies with the ability to enhance the body of nursing knowledge, as well as harmonization with evolving terminology and information model outside the domain of nursing. Several studies have demonstrated the usefulness of the ISO Reference Terminology Model to cross-mapping between different terminologies in order to enhance further development of terminologies and bridging the gap from one terminology to another (Goossen, 2006; N. R. Hardiker, Casey, Coenen, & Konicek, 2006; Kim et al., 2011). Nursing practice is also characterized by interdisciplinary collaboration and documentation thus needs to be available and integrated with a shared EPR to ensure continuity of care and treatment. Accordingly, several studies have emphasized cross-mapping between nursing terminologies and multidisciplinary terminologies such as International Classification of Functioning, Disability and Health (ICF)⁸ and SNOMED CT⁹ (S Bakken et al., 2001; Park,

⁸ <http://www.who.int/classifications/icf/en/>

⁹ <http://www.ihtsdo.org/snomed-ct/>

Lundberg, Coenen, & Konicek, 2010). Despite the fact that several of these studies demonstrated promising results, they showed, however, that semantic interoperability is still a challenge. SNOMED CT and ICNP may be used in different contexts and the same term can thus have different meanings. For example, “depression” in medical domain means “depressive disorder”, while “depression” in nursing means “sadness” (Park et al., 2010). This is not only a challenge in the nursing community, but also generally in health care environment.

Despite of the mentioned achievements and efforts, a number of challenges and issues still remain. Although there are high expectations for the use of reference terminologies and its ability to cross-mapping between diverse terminologies, it is also reluctance to adopt comprehensive reference terminologies as it might simply be too complex and too difficult to maintain (E. Hovenga, Garde, & Heard, 2005). There is also increasing attention to more flexible models for standardization and an archetype approach is recently considered as an appropriate information model for the representation of the clinical content in EPR (Knaup, Bott, Kohl, Lovis, & Garde, 2007). A key feature of the archetype approach is that it separates the definition of clinical content from any technical concerns. The first level is a stable information model, while the second level consist of archetypes that are agreed models of clinical or domain specific concepts (E. Hovenga et al., 2005). For example, a blood pressure archetype represents a description of all the information a clinician might need or has to report about a blood pressure measurement. Standardized terminologies and / or agreed upon local terms may be used as specification of the clinical content of archetypes and thus enables dynamic and flexible use of standards. Archetypes have received increased attention as a framework that facilitates semantic interoperability, evidence-based practice and the generation of local knowledge (E. Hovenga et al., 2005; Kalra, 2006)

2.1.3 Challenges and tensions between formal and informal documentation

Despite international and national efforts to the development and design of nursing terminologies, it has been challenging to adopt standards in everyday practice and a large part of nursing documentation is still captured in narrative text (S Bakken, Hyun, Friedman, & Johnson, 2005). Health care data must serve multiple purposes such as supporting day-to-day documentation of care processes, facilitating management of care, identifying best practices, triggering clinical guidelines and facilitating communication within the health care team (Moen, Henry, & Warren, 1999). A recent European survey showed that the nursing process is the model most used to structure nursing documentation in Europe. Although many standardized nursing terminologies are in use in Europe, the study showed that general use in nursing is still lacking which makes access to nursing data an obstacle (Thoroddsen et al., 2009). The need for a standardized language in nursing is also expressed in the often quoted statement from Dr. Norma Lang: “*If we cannot name it, we cannot control it, finance it, teach it, research it, or put it into public policy...*” (Clark & Lang, 1992, p. 109). On the one hand, the quote illustrates the need to standardize nursing language and challenge the expectations of the use of EPR and its ability to streamline and improve the quality of documentation. On the other hand, the statement also illustrates the tension between informal and formal communication and how clinical judgement is made visible by means of terminologies. As mentions earlier, terminologies are abstract simplification of reality, i.e. objectification.

Scholars in the nursing field as well as in the interdisciplinary field of Information System (IS) have questioned this simplification and are sceptical to the oversimplified reduction of knowledge embedded in nursing practice, which are typically used in the formal classification schemes (Patricia Benner, 2004). Patricia Benner questions the flattening of nursing care, and suggests that we must find alternative ways of valuing the unclassified:

“The classifications of nursing intervention can make nursing more visible and traceable in the medical record. However, categories belie the logic of caring practices, nursing knowledge, and skill that cannot be reduced to techniques or discrete interventions. Nurses are required to trade one form of visibility to another.” (Patricia Benner, 2004, p. 427)

Bowker and Star (2000) express the same scepticism to make the invisible work visible by using classifications:

“As the layers of complexity involved in its architecture reveal, however, a light shining in the dark illuminates certain areas of nursing work but may cast shadows elsewhere.” (Ibid. p. 254)

These scholars highlight the trade-off between pre-defined categories and the cases that do not fit into formal classification systems. For example, the latest edition of NANDA contains 216 nursing diagnoses (NANDA-International, 2012). Whether these classifications cover all potential nursing diagnoses is also determined by the representation of the list itself and how it is managed. Similar studies have illustrated the tension between formal and informal information (Berg, 1996; Bjørn et al., 2009; G. Ellingsen et al., 2007) or standardization and flexibility (Hanseth, Jacucci, Grisot, & Aanestad, 2006). A common feature of these studies is that they consider standardization as a process interrelated to social (work practice, routines) and technological (material) actors in the EPR system that may lead to unexpected consequences in the process of alignment and stabilization. Some scholars have emphasized both the enabling and constraining characteristics of classifications (W.J. Orlikowski, 1994), as well as the tension between interoperability and local usability (Ure et al., 2009). On the one hand, formal terminologies enable shared meaning and comparability across different contexts. On the other hand, their use restricts activity that does not conform to the types recognized in the category systems. The enabling factor is dependent on the degree to which it facilitates their actions outweighs the difficulties created by its restrictions (W.J. Orlikowski, 1994). Accordingly, the use of international classifications in nursing is not only a translation of concepts to local practice, but a process of negotiation and transformation (Carlile, 2004).

By considering these challenges, it is not my intention to question the use of classifications or standards per se. On the contrary, I consider classifications as an inherent part of the professional vision of nursing. Goodwin (1994) illustrated how the professional vision are shaped and contested by using classification schemes, in which the shaping process entails of socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group (ibid. p. 606). Similarly, Suchman (1994) notes that categorization is “a fundamental device by which all members of any society constitute their social order” (ibid. p. 181). Accordingly, classification can only be assessed empirically by examining the content of the category system in the context in which it is being used, and the actors using

or affected by it (W.J. Orlikowski, 1994, p. 76). Thus, the challenge is how the professional vision is inscribed in formal standards and aligned with other material artifacts in the EPR system. Insights from these studies move my attention from the content of standards (terminologies) to the context of standardization, i.e. how standards are inscribed in technological objects and social arrangements.

2. 2 Standardization in action

I consider the design and adaption of nursing standards as a process of stabilization, alignment and negotiation in the EPR system. As stated by Akrich (1992), “ it is in the confrontation between technical objects and their users that the latter are rendered real or unreal..... technical objects define a framework of action together with the actors and the space in which they are supposed to act” (ibid. p. 208). Accordingly, I will highlight some of the performative capabilities of standards as technological objects inscribed in socio-material practice.

2. 2. 1 Standards embedded in electronic care plans

As mentioned, the development of standards in nursing has been an ongoing process for many years and was motivated by the professionalization of nursing as an independent profession. The development of nursing theories in the mid-nineteenth century promoted the nurse’s unique contribution to health care and moved away from the role as physician’s assistant. In particular, the development of the nursing process has had major impacts on nursing practice as well as on education and documentation of nursing. The nursing process is an interpersonal process and problem-solving approach, with an emphasis on patients’ responses to diseases rather than medical diagnoses. The nursing process model involves accessing, planning, implementation and evaluating patient situation, with the ultimate goal of preventing or resolving problematic situations (K. Häyrynen, Lammintakanen, & Saranto, 2010).

Written care plans structured by the phases of the nursing process have been an acknowledged method for the documentation of nursing over the past decades. However, studies have revealed barriers and obstacles such as lack of time to document, lack of consistent record systems and routines, inappropriate forms and so on (Björvell, Wredling, & Thorell-Ekstrand, 2003). Implementation of new technology has yet provided capabilities and expectations in order to facilitate the use of care plans as an integral part of the EPR. The ISO standard also points out that the EPR should have “ a standardized or common agreed logical information model which is independent of EPR systems” and that “its primary purpose is the support of continuing, efficient and quality integrated health care and it contains information which is *retrospective, concurrent, and prospective*” (ISO, 2005, p. 2). Moreover, a standard is defined as “a document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context” (ISO, 2005, p. 5). Accordingly, use of care plans has gained renewed attention since adoption of computer based systems as a means to facilitate accuracy and completeness of nursing documentation.

Similarly, the use of clinical guidelines, evidence-based practice and clinical pathways has also gained increased significantly. Accordingly, care plan can be standardized in various ways, either by the use of terminologies and / or the use of procedural standards. First, terminologies may be used for documenting the different phases of the care plan. For example, NANDA can be used for assessment and diagnosis, and NIC for the planning and implementation of nursing. Second, clinical guidelines may be integrated into the care plan and thus ensure use of knowledge-based practice (E. Hovenga et al., 2005). The move towards integrated care, evidence-based practice and guidelines all have led to increased interest in process-oriented ICT (Berg & Toussaint, 2003). Documentation and standardization is thus not just a passive information repository, but have impact of the very nature of care (Fitzpatrick, 2004) and turns us towards the interactive and unfolding nature of health care work which is constantly adapted to local needs and changing circumstances (Garrod, 1998).

2. 2. 2 Standards as coordinating mechanisms

Nursing is characterized by a high degree of cooperation and interdependence between actors and artefacts used in the clinical process. This implies dependency between resources used in the work as well as interdependence between the tasks and activities in the course of carry out work. The work is also characterized by a dynamic environment where events and efforts are constantly changing according to the patient's condition, unpredictable arrival of new patients, distribution and adjustment of work tasks and so on. The use of standardized care plans in this environment is more than sharing information between nurses, but is also an embedded part of the cooperation within and across the care team.

When we move our attention from the “drawing board” and toward work practices, standardization thus gains a new dimension and significance. The research field of Computer Supported Cooperative Work (CSCW) has long been interested in health care including collaborative technologies, standardization and collaborative practice of patient care teams. CSCW is defined as “an endeavour to understand the nature and requirements of cooperative work with the objective of designing computer-based technologies for cooperative work settings (K Schmidt & Bannon, 1992, p. 9). Researchers in this field stresses that the effects of technology is always mediated by social processes and emphasize the difficulties to discuss more generic “effects” of any technology, without an understanding of the particular context of use (Bannon, 1992 p. 5)

A main focus of the CSCW research has been on managing the complexities of collaborative work and some key issues have been coordination and articulation. The interdisciplinary study of coordination focus, in part, on how people work together now and how they might do so differently with new information technologies (Malone & Crowston, 1990). Malone and Crowston have defined coordination “as the act of managing interdependencies between activities performed to achieve a goal” (ibid. p. 361). Examples of interdependency is when outcome of one activity which is required by the next activity. A key issue is thus to manage interdependence because if there is no interdependence there is nothing to coordinate. Thus attention has been aimed at developing a computational notation to facilitate the construction of computer-based coordination mechanisms and exploring how these systems can enhance the ability of coordinating actors in articulating their activities (K. Schmidt & Simone, 1996). Articulation

work has a pivotal role in CSCW research and is the work that “ gets thing back on track on the face of the unexpected, and modifies action to accommodate unanticipated contingencies” (S. Star & Strauss, 1999, p. 10). Schmidt and Simone make a distinction between coordination and articulation and emphasize this distinction as recursive. This implies that coordination and articulation often go hand in hand in which management of an established arrangement of articulating a cooperated effort may itself be conducted as a cooperative effort which, in turn, may also need to be articulated (K. Schmidt & Simone, 1996, p. 159).

Coordination and articulation is highly interesting in nursing in which the distributed nature of the work involves complex articulation across time and place. In order to reduce the complexity of articulation work, the use of coordinating mechanisms such as standardized terminologies and care plans have capability to stipulate articulation of coordinative work (K. Schmidt & Simone, 1996). Articulation work is richly found in nursing and nurses have a key role in coordinating patient care and are the “glue” that holds complex health care practice together (Goorman & Berg, 2000). However, this kind of work is usually invisible and taken for granted, but is often made visible by breakdown. Bowker and Star (2000) gives a vivid description of articulation work in their study of classification work. They illustrate the tension between informal and formal representation of work as well as the invisible work, structures and negotiations involved in the classification and standardization in nursing. Similar studies have also elucidated that plans are resources for situated actions and the articulation work involved in managing the contingencies between plans and situated action (L. A. Suchman, 2007). Moreover, coordinating tools such as standardized care plans also has a transformative power; it will transform both the organization and the cognitive aspects of work (Berg, 1999, p. 392).

2. 2. 3 Sharing and coordinating knowledge

“Learning by doing” is a slogan in nursing and express the evolving, contextual clinical knowledge that characterize nursing practice. Patricia Benner using the Dreyfus 'novice to expert' model to illustrate the learning needs and styles of learning at different levels of skill acquisition. She has been engaged in making the hidden work of nursing visible through articulation research and emphasizes the importance of clinical “know-how” that enables the competent nurse to move from rule- governed thinking to an intuitive grasp of the situation (P Benner, 2004). According to Brown and Duguid (1998), “know-how” enhances the ability to put “know-what” into practice and is thus pivotal in making knowledge actionable and operational . Groups in which such know-how and sense-making is shared, is called “communities of practice”:

“In the course of their ongoing practice, the member of such a group will develop into de facto community Through practice, a community of practice develops a shared understanding of what it does, of how to do it, and how it relates to other communities and their perspectives, in all – a “world view”. This changing understanding comprises the community’s collective knowledge base..... In this context, knowledge and practice are intricately involved” (ibid. p. 96).

Nursing practice is a typical example of a “community of practice” where mutual understanding and knowledge is developed in the local practice. However, a health care organization comprises hybrid groups with specialized and interdependent nursing practices and represents another level in the

complex process of knowledge creation and distribution. This implies that information and knowledge must be shared both within and across domain-specific boundaries. Boland and Tenkasi (1995) highlights the process of perspective taking as our capacity to adopt the perspectives of different others as a necessary component for coordinated action to take place. Overall, it illustrates the complex process of creating, sharing and distributing knowledge across domain-specific and organizational boundaries.

The distinction between “know-how” and “know-what” or between tacit and explicit knowledge can be useful for studying the complexity of knowledge. However, such a distinction may be inappropriate since it mystify practical knowledge (K. Schmidt, 2012) and resulting in objectivist reification on the one hand or subjectivist reduction on the other (WJ Orlikowski, 2002, p. 250). Instead it is proposed to uncover the logics of mutual learning in cooperative work and a perspective on knowing as an ongoing social accomplishment enacted through people’s everyday activity (WJ Orlikowski, 2002; K. Schmidt, 2012).

“A view of organizational knowing as an enacted capability suggests that core competencies or capabilities of the organization are not fixed or given properties, embodied in human resources, financial assets, technological artifacts, or infrastructural capital. Rather they are constituted every day in the ongoing and situated practices of the organization’s member” (WJ Orlikowski, 2002, p. 270)

Thus, there is a mutual relationship between knowledge and practice – it does not make sense to talk about either knowledge or practice without the other (WJ Orlikowski, 2002). In accordance with this, Marc Berg has in several studies demonstrated the tension between formal and informal representation of health care work, the generative power of information technology and the interrelationship between the staff members’ embodied expertise and the tool’s accumulating and coordinating activity (Berg, 1999).

“The most promising route toward understanding medical (or other) work practices lies not in opposing the formal to the informal or the complexity of medical work to the record’s impoverished representation of it, but in seeing how the two emerge and interlock” (Berg, 1996, p. 515).

I agree with these views and consider standardized care plans as coordinating artifacts constituted in clinical practice as well as the capability to mutual learning. A challenge is thus how the standardized care plan as a coordinative tool has the capability to maintain both formal and situated knowledge. As stated by Schmidt and Bannon (1992), there is a risk by just being concerned about “information- flow” in the design and development of computer systems and neglecting the articulation work needed to make the “flow” possible. Verghese (2008) vividly illustrates this risk, where he warning only to see the patient as an icon on a computer screens.

“The iPatient’s blood counts and emanations are traced and trended like Dow Jones Index, and pop-up flags remind caregivers to feed or bleed. iPatiens are handily discussed (or “card-flipped”) in the bunker, while the real patients keeps the beds warm and ensure that the folders bearing their names stay alive on the computer” (Verghese, 2008, p. 2742)

The point of this article is that although he appreciates new technologies enabling capabilities of seeing the body, he stresses the importance of clinical skills and learning from the real patient’s body examined by the bedside.

To sum up, standardization can be seen as the interrelationship between “the map” (standardized care plan) and “the terrain” (situated action and context). As discussed so far, this is not a static relationship, but a dynamic, evolving process including multiple actors, i.e. a socio-technical network. It is in this interrelation that I’m interested and that has led to the fundamental framework for my research that is coordinating information infrastructures.

2.3 From singular artifacts toward collaborative infrastructures

So far I have been concerned with the diversity of content, context and processes in accordance with standardization in nursing. This leads me back to what an EPR really is and the ISO definition of an EPR system. Accordingly, today’s EPR systems are more than just a computerized blueprint of the traditional paper- based record. Contemporary EPR system includes a range of technical applications, international standards, procedures, professions and so on. Thus, we need a framework to describe the interplay between the various actors in the EPR system and how these are interconnected. In recent years the notion of information infrastructure, cyber infrastructures or e-Infrastructures has received increased attention as a way to describe the complexity and heterogeneity that characterizes large-scale information systems. The notion of Information Infrastructures captures several major changes of the last two decades. In many areas, information sharing has shifted from individual computers and local networks to more distributed communication and the dependency of global networks such as World Wide Web. In our “network society”, it has thus been a shift from “systems” towards “networks” in the organization of societies, including healthcare. Information Infrastructures are typically formed when various systems merge, in a process of consolidation characterized by mechanisms that allow dissimilar systems to be linked into networks (Edwards, Jackson, Bowker, & Knobel, 2007). I have used Information Infrastructure as an overall framework and used the concept of Coordinating Infrastructure to zooming in on the part of the infrastructure interrelated to a particular practice, i.e. nursing. In addition, I have used an ANT-influenced perspective on Information Infrastructures because it provides a vocabulary to describe the dynamics of heterogeneous actors in the socio-technical network (E Monteiro, 2001).

2.3.1 Conceptualizing nursing documentation as an information infrastructure

Standardisation plays a key role in studies of information infrastructures and has been explored in various organizational contexts such as health care, oil industry, business management and so on. Bowker and Star (2000) studied the creation and maintenance of complex classifications and used NIC to illustrate some key properties of information infrastructures such as; (1) Embeddedness; (2) Transparency; (3) Having reach or scope; (4) It is learned as part of membership; (5) It is linked with conventions of practice; (6) Multifunctionality (Bowker & Star, 2000, p. 238). These properties are precisely what characterize standardized nursing terminologies as described previously. Moreover, they emphasize the historical cultural development of classifications and how classifications are linked with work practices. The book "Sorting things out" illustrates some of the efforts and invisible work required to make classifications usable in practice as well as those cases that do not fit into the predefined standard. As mentioned, the motivation for the creation of nursing terminology was a means to support clinical

judgement and knowledge development. There has been considerable amount of effort to develop nursing terminologies representing nursing practice and knowledge across geographic and domain-specific boundaries. However, no terminology or knowledge systems exist in a vacuum, “it must be rendered compatible with other systems. The tricky, behind the scenes work of ensuring backward and sideways compatibility is not only technical work, it challenges the very integrity of any unifying scheme” (Bowker & Star, 2000, p. 108). It is this tension between the need for a universal language and the diversity in practice that the notion of information infrastructure provides theoretical insight to bridging this gap.

Similarly, Hanseth (2001) highlighted the supportive or enabling aspect of infrastructure that is shared by a larger community. This implies that infrastructures is more than “pure” technology, but are heterogeneous socio-technical networks that include technological components, humans, organizations, institutions and so on. This approach to Information Infrastructure is deeply influenced by the ANT and do not distinguish between human and non- human actors. I find this approach as an illuminating vocabulary to describe the dynamics between social and technical actors that neither favouring the technocratic determinism or the social construction of technology. ANT has often been criticized for juxtaposing human and- nonhuman actors. As pointed out by Law, “to say that there is no fundamental difference between people and objects is an analytical stance, not an ethical position..... analytically, what counts as a person is an effect generated by a network of heterogeneous, interacting materials (Law, 1992, p. 383). It is, however, actions or translations or transformations that define the ANT, not actors or the network per se. A technical object may be treated as a program of action coordinating a network of roles played by humans and non-humans (Callon, 1991). In addition there are several mechanisms used to describe the inner dynamics of the network. For example, Callon (1991) distinguish between actors and intermediaries. He describes intermediaries as a collection of human and non-human entities that are defined by their roles, their identities and their program – which all depend on the relationship into which they enter actors define one another by means of the intermediaries which they put into circulation (ibid. p. 141–142). Thus intermediary is what transport meanings or force without transformation (B. Latour, 2007, p. 39), however, changes may transform intermediaries into actors, or actors back to intermediaries (Callon, 1991).

A key feature of both Information Infrastructure and ANT is the interrelation between actors. Alignment, or interconnection, enables maintenance and extension of the socio-technical network. The layered construction where larger components are based on existing smaller independent components allowing to zoom in and out of the network depending on the circumstances. For example, nursing classifications such as NANDA and NIC is one information infrastructure that comprises a large international nursing community and organizations such as ISO. When NANDA and NIC are adopted to local practice, they become part of the local infrastructure as part of the EPR system. This implies that NANDA and NIC have to be stabilized and aligned to the local working infrastructure. Star and Ruhleder (1996) have also described information infrastructures as a fundamentally relational concepts that occurs in relation to organized practices:

“An infrastructure occurs when the tension between local and global is resolved. That is when local practice are afforded by large-scale technology, which can be used in a natural, ready-to-hand fashion” (ibid 114).

When new infrastructure evolve, they need to be built through extension and improvement of what exist, the installed base, never from scratch (Ciborra, 2001, p. 23). Hence, it is a slow, evolving, bottom-up negotiation to achieve stability and order.

As briefly illustrated, information infrastructures are quite complex, dynamic and comprehensive. Normally, they are often invisible, but become visualized by breakdown. Take for instance the electricity system that is a complex infrastructure that surrounds us in everyday life and that we take for granted. Yet, when we are abroad and use a hair dryer, we must deal with volts, adapters and so on. This leads us to the necessity of alignment or integration through standardized interfaces. "If an infrastructure is built on bilateral arrangement only, this is not an infrastructure, but just a collection of independent connections" (O Hanseth, 2001, p. 57). This makes standardized nursing terminologies and care plans particularly interesting because they are both a means and effects of standardization.

2. 3. 2 Standardization revisited: From semantic interoperability towards material semiotic

The historical "journey" from the creation of terminologies within the nursing environment towards inscriptions of standards in technological artifacts as a program of action, has been an attempt to open Pandora's black box of standardization. When I move my attention from systems to socio-technical networks, interoperability and integration are not at all less important, but involve different mechanisms. Semantic interoperability is often considered as a technological capability used in the exchange of data such that the original semantics of data (shared meaning) are retained irrespective of its point of access (E. J. S. Hovenga & Garde, 2010). Yet, semantic interoperability also refers to the meaning of a structure that is unambiguously exchanged between humans (Mead, 2006). From a socio-technical perspective, interoperability or integration is not just a technical issue but rather a process of translations that leads to alignment (Callon, 1991).

ANT is rooted in semiotics which considers that all entities achieve their significance and meaning by being in relation to other entities as well as performed in, by, and through those relation (Law & Hassard, 1999). Translation is a key notion in ANT and defines relations, inscriptions and program of actions embodied in intermediaries. It involves a translator, something that is translated, and a medium in which that translation is inscribed (Callon, 1991). It is not a literal, word-for-word translation but emphasizes the continuity of the displacements and transformations of goals, interests, devices, human and non-human beings and inscriptions. Translation in this sense is not a single act once and for all, but a product of compromise and mutual adjustment negotiated through a series of iterations. There is a chain of interest embodied in texts, machines, bodily skills and so on that articulate roles, links and feedback loops between actors.

Strong or weak alignment depends on the degree of successful translation:

Thus the higher the degree of alignment and co-ordination of a network, the more its actors work together, and the less their very status as actors is in doubt..... It also points to the way in which each actors in a convergent network are able to identify and mobilise the skills within the network without having to get involved in costly adoptions, translation or decoding (ibid., p. 148).

As illustrated with standards in nursing, there has been a negotiation that involved heterogeneous actors from the international nursing community, national and professional guidelines, scientific articles and so on. When terminologies are displaced from textbooks, strategies, scientific articles and to computer systems, then technical objects define a framework of action together with the actors and the space in which they are supposed to act (Akrich, 1992). Depending on the degree of alignment, it may reach a level where it is impossible to go back to the point where that translation was only one among others and decisions become more and more dependent on past translations, i.e. irreversibility. When an actor-network is stabilized and aligned, it becomes a “black box”, that means everything you need to know is its input and output (B Latour, 1987).

What is interesting about actor-network in terms of information infrastructure is how they grow and evolve. Mutual interrelation among actors in the network leads to path dependency, which means that past decisions limit future options (Edwards et al., 2007). By considering standards as actors means that standards shape and is shaped by the dynamics of the network. From this point of view there is no distinction on micro and macro systems and standardization is thus a bottom-up, dynamic process. As stated by Callon and Latour (1981); “macro-actors are micro-actors seated on top of many (leaky) black boxes” (ibid. p. 286).

More recent studies have expanded our understanding of the dynamics of the actor network and emphasized the multiplicity of health care.

Medicine is not a coherent whole. It is not a unity. It is rather, an amalgam of thoughts, a mixture of habits, an assemblage of techniques..... There is multiplicity. (Berg & Mol, 1998, p. 3)

As illustrated by Berg and Bowker (1997), the medical record constitutes multiple histories, a series of parallel trajectories, constantly rewritten, and constantly emergent (ibid.). Moreover, representation of multiple trajectories is a distributed collection of complexly interrelated forms, papers, and documents. On this view, capacities for action are seen to be enacted in practice through the skilful construction, integration, interpretation and communication of information in everyday practices, i.e. sociomaterial practices’ (Fitzpatrick, 2004; WJ Orlikowski, 2007). Similar, Annemarie Mol (2002) has in her studies illustrated the different practices and realities of arteriosclerosis. She argues that it goes beyond different perspectives on the same object, but many objects where each of them produced in their own practice. However, there are more or less mutual dependencies among different practices or social worlds. The challenge is thus to facilitate links and interconnections in spite of the difference. To share information is thus more than maintaining a shared meaning of information, but requires some costs, efforts and transformations (Carlile, 2004; Rolland & Monteiro, 2002). To use a slogan from the ANT: It is no information, only trans-formation (B. Latour, 2004, p. 69).

Star and Griesemer (1989) used the notion boundary object as a sort of arrangements in developing and maintaining coherence across intersecting social worlds.

“Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across site. They are weakly structured in common use, and become strongly structured in individual use.....They have different meaning in different social

worlds but their structure is common enough to more than one world to make them recognizable, a means of translation” (ibid. p. 393).

The origins of the concept boundary object derived from analysis of the development of a natural history museum and the tension between coherence and coordination when multiple social world are involved in cooperation. The starting point of their analysis was actor network theory, but they have extended the theory by considering multiple translations where for instance the viewpoint of amateurs is not inherently better or worse than that of the professionals (S. Star & Griesemer, 1989). Bowker and Star (2000) have further elaborated the concept and used nursing classifications as an example of how boundary objects evolve over time serving both hospital administrators, nursing researchers and practitioners. Boundary object has since been used to explore standardization in healthcare (Fujimura, 1992) as well as a way to support knowledge management across boundaries by focusing on fostering the emergence of a joint field (Levina & Vaast, 2005).

Boundary object may also be considered as gateways to enable interconnection between different networks (O Hanseth, 2001). As mentioned, standards are an important prerequisite for development of sustainable information infrastructures. However, it is not always agreement on the choice of standards and, consequently, a range of diverse and competing standards are currently in use covering various needs, interests and purposes. Thus, agreement on a unified standard based on backward compatibility (installed base) is rarely the case and may be costly and not in line with changing capabilities and circumstances in the environment. A more common mechanism for merging and consolidation of systems is characterized by gateways that allow dissimilar systems to be linked to networks. Traditionally, the notion “gateways” have been used in a technical context to denote an artefact that is able to translate back and forth between two different communication networks. The most well-known example is the “battle” between alternating/direct current (AC/DC). There were strong proponents and interest behind both and the introduction of the converter made it possible to interconnect the two networks. Gateways are often wrongly understood as hardware or software alone. Yet a more appropriate approach conceives them as combining a technical solution with a social choice, i.e. a standard, both of which must be integrated into existing users’ communities of practice (Edwards et al., 2007, p. 16). Hanseth (2001) argued that gateways are just as important as standards and are key tools to enable the change of an infrastructure and (some of) its standards from one version to another and accordingly avoid being trapped in lock-in situation (ibid. p. 87).

A key challenge with information infrastructures is how they evolve and change. The dynamic capabilities as described above involve both enabling and constraining implications (W.J Orlikowski & Baroudi, 1991). By conceptualizing standards as part of a cooperative infrastructure provides an analytical attention on the interaction between standards and practice. First, it provides insight into the construction and co-construction of standards. Second, it highlights the mutual dependency between standards, practices and material objects used in nursing. Thirdly, it provides the opportunity to study the changes that affect and are affected by the dynamics of information infrastructures, i.e. EPR systems.

3 Method

”Behind every method lies a belief. Researchers must have a theory of reality and how reality might surrender itself to their knowledge-seeking efforts. These epistemological fundamentals are a subject to debate but not to ultimate proof.” (Zuboff, 1988, p. 423)

The quotation of Zuboff illustrates that methodological approaches are more than practical use of method, but also basic assumptions of the nature of reality and how to obtain knowledge of it. Thus, the methodological approach has been a process that has been in line with the planning of the study and emerged based on my approach to the use of nursing documentation as an integrated part of the EPR. The methodological approach has thus been the foundation of my thesis and formed the research design as well as the performance of the study.

As described in the previous sections, my main focus is not on technological solutions, but on the interplay between technology and organization. Thus, I have applied interpretive methods of research, “aimed at producing an understanding of the context of the information system, and the process whereby the information systems influences and is influenced by its context (G. Walsham, 1992, p. 5).

Interpretive field research originates from the phenomenological and hermeneutical perspective (Klein & Myers, 1999; G. Walsham, 1992). Phenomenology emphasizes how we classify, describe, interpret and analyze structures of experiences from the subjective or first- person point of view¹⁰. Similarly, the hermeneutic circle, the movement back and forth between the parts and the whole, is a fundamental principle in interpretive research as described by Klein and Myers (Klein & Myers, 1999). Interpretative research has slowly emerged as an important strand in information systems over the past decades. It has the potential to produce deep insight into information systems phenomena and the ongoing relation among information technology, individuals, and organizations (Geoff Walsham, 1995). Research studies are usually categorized based on the underlying epistemological assumptions and classified into positivist, interpretive, and critical studies (W.J Orlikowski & Baroudi, 1991). Although positivistic research still is the most common research paradigm in Information Systems, the amount of interpretive research has increased slowly over the past decade (M. Myers & Liu, 2009).

Interpretive and positivist perspectives have quite different “world views” and it has not only significance for the choice of method, but also to development of theory and our understanding of information systems phenomena. The positivist paradigm has its roots in the natural science in which the “world view” is characterized as objective, pre-defined truths about knowledge that can be measured, tested and validated. From an interpretive perspective, the social world is not given, but is produced and reinforced through human actions and interactions. Interpretations of reality change with time, circumstances, objectives and constituencies (W.J Orlikowski & Baroudi, 1991, p. 14). In contrast to the objective and deterministic explanation of phenomena, the interpretive perspective emphasizes that reality as well as

¹⁰ <http://plato.stanford.edu/entries/phenomenology/>

our knowledge of reality, are social products and hence incapable of being understood independent of the social actors that construct and make sense of that reality (W.J Orlikowski & Baroudi, 1991, p. 14).

The distinction between positivist and interpretive paradigm is not to justify the usability of the one above the other, but to be aware of the implications of the choice of perspectives. Another issue is whether the two different perspectives can be used in combination. Some say yes, while others consider the essential different philosophical assumptions makes it difficult to reconcile. As mentioned above, I have applied an interpretative approach in this thesis because the main focus is to explore the interaction between standardization and local contexts. I do not consider standards as objective, static properties, but as dynamic processes in a socio-technical network, and considers the interpretive approach in accordance with my research interests and assumptions. However, I have used some objective data such as frequency analysis from the EPR system as a supplement to field data from observations and interviews.

Another issue I will elaborate on is the use of the concept “social construction” and my approach to technology in health care settings. As quoted by Walsham (1992):

Interpretive methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers..... Interpretivisms is thus an epistemological position, concerned with approaches to the understanding of reality and asserting that all such knowledge is necessary social construction and thus subjective.(G. Walsham, 1992, p. 5)

I follow this approach, however, it is necessary to clarify my assumptions on “actors” because my theoretical framework is based on information Infrastructures, inspired by the Actor-Network Theory. Bruno Latour (1987) defines actors as both human and non-human and this has caused controversy in research communities. Some of the disputes have been whether non-human actors may have agency in the same way as human actors. Yet ANT has been widely used as a theory as well as a method across different research communities. “Follow the actors” have become a slogan in ANT communities and is a powerful way of rephrasing basic dynamics in socio-technical networks. In later work Latour has pointed out some misunderstandings to the concepts of actors and network and argues that an actor have to make a difference (translation, transformation). The slogan “Follow the actors” becomes “Follow the actors in their weaving through things they have added to social skills so as to render more durable and constantly shifting interactions”(B. Latour, 2007, p. 68).

One of the perspectives that I find interesting about this theory is that it also highlights the role of technology in the study of information systems. Recently there has also been called for a stronger focus on IT artifact in the IS field (Hanseth, Aanestad, & Berg, 2004; W.J. Orlikowski & Iacono, 2001). For example, as proposed by Lee (2001):

“Research in the information systems field examines more than just the technological system, or just the social system, or even the two systems side by side; in addition, it investigates the phenomena that emerge when the two interact.”(ibid.iii)

The discourse about the role of technology leads us once again back to the distinction between determinism and voluntarism. However, recent studies in the IS and CSCW communities have recognized that it is possible to talk about a technology’s materiality without also being a determinist. Rather than

consider technology as a “black box”, they recognize that technological artifacts have “material properties” that provide opportunities to or constraints on action (C Bossen, 2002; Leonardi & Barley, 2008; WJ Orlikowski, 2007; K. Schmidt & Simone, 1996).

3.1 Research design

As mention in the introduction, the subject and scope of my research study has been electronic documentation in nursing. The research was part of Tromsø Telemedicine Laboratory's (TTL) project portfolio in which the vendor DIPS was one of the partners. The strategy of TTL is research-based innovation in close collaboration with business partners to support research and innovation of sustainable ICT solutions for health care. The project proposal emphasized close collaboration between the vendor, researcher and user environment in order to inform future redesign of the nursing module in the EPR. The purpose of the research project was to bridge the gap between academic findings and real-world issues. Thus, the topic of the project was given, but *how* and *where* should it be carried out? My supervisor and a former PhD student had previously conducted similar research, and my work was a further development of this research. On the one hand, this was an advantage because I had access to the research context that gave access to my first case study. On the other hand, it was a challenge continuing previous work while adding my own perspective. Yet, I had the opportunity to choose my own approach to the field and scope of the study, such as relevant social groups, organizations and geographical areas (Yin, 2009). My starting point was *how* and why electronic nursing documentation was used and performed in real world settings and case studies are an appropriate research method to answer these questions. Case studies may be either quantitative or qualitative depending on the phenomenon being investigated as well as philosophical assumptions about the phenomenon (Yin, 2009). According to my methodological approach that is explained above, my research was founded in an interpretive method that has guided the planning and performance of the case study.

The study was exploratory in nature aimed at; i) improved understanding of the standardization process in nursing; ii) increased knowledge of the standards used to share information and knowledge in nursing, and; iii) further inform the design of a nursing module in EPR. Qualitative case studies are aimed at an understanding of the context of the information system and the process over time of mutual influence between the system and its context (G. Walsham, 1992, p. 14). The most appropriate method for conducting empirical research in the interpretive tradition is the in-depth case study carried out over a reasonable long period of time (longitudinally) with the opportunity to directly observe the unfolding of event over time. In addition, it is often supplemented by detailed historical reconstruction of earlier periods and frequently involves the use of two or more case studies for comparison purposes (G. Walsham, 1992, p. 14). While qualitative methods often have pre-defined guidelines for planning and conducting the study, interpretive research are more characterized by an iterative process which means that data collection and research questions are adjusted according to what is learned. Yet it does not imply that there are no structures in interpretive research, but it places greater demands on the researcher to focus and adjust based on changing conditions in the environment. That does not mean that I started from nowhere. I started with some research questions that have been adjusted as conditions and prerequisites

have changed along the way. In particular, I have used the principles of interpretive fieldwork and case studies as well as general guidelines for qualitative methods and ethnographic fieldwork (Klein & Myers, 1999; Randall, Harper, & Rouncefield, 2007; G. Walsham, 1992; Yin, 2009).

Nursing practice is complex and diverse and I decided to apply a multiple case study to gain a broad contextual understanding of the use of electronic nursing documentation, as well as to compare across different care settings. Getting access to do field work in a busy hospital environment may be difficult. However, because my supervisor had a prolonged history of involvement at the University hospital of North Norway, it was easy to get access and legitimacy at the first care setting. In addition, I had access to the historical development of the implementation and use of electronic nursing documentation at the department. The next case was selected from another organization and specialty to gain a broader contextual understanding of the field. While the first case was a psychiatric ward, the next was a surgical ward that involves different competencies, skills and procedures, and thus different needs for the documentation of nursing. Thus, I gained a more comprehensive understanding of the context across settings.

The plan at the start of the study was close cooperation with the vendor, and participation in the development team for the redesign of the nursing module in EPR. I have participated in meetings and workshops with the vendor, but it was early recognized to postpone the redesign of the module indefinitely.

However, my collaboration with the vendor continued with participation in another project. Development and implementation of an electronic medication management system and a clinical chart was an ongoing project in cooperation between the vendor and Akershus University hospital. Thus, along with my supervisor and the vendor, it was decided to involve this work in my study because it encompasses an important part of nursing practice.

Another issue that I want to elaborate on is the role of theory in my research. The use of theory in interpretive research is different from the positivist tradition that suggests theoretical propositions, sufficient blueprint of the study, whether the purpose of the study is to develop or to test theories (Yin, 2009). In the interpretive research tradition, the role of theory is more as a "sensitizing device" to view the world in a certain way (Klein & Myers, 1999, p. 75). Walsham (1995) has outlined three distinct usages of theory in IS research: as an initial guide to design and data collection; as part of an iterative process of data collection and analysis; and as a final product of research (Geoff Walsham, 1995, p. 76). However, there are different points of view on the role of theory in the initial guide to data collection. Scholars in the "Grounded Theory" tradition highlighting the interaction between researcher and data and does not recommend using prior theory as a guide in the data collection.

"A researcher does not begin a project with a preconceived theory in mind.... Rather the researcher begins with an area of study and allows the theory to emerge from the data" (Strauss & Corbin, 1998, p. 12).

I see the point of allowing the data to "speak for itself" and the risk of narrowing the scope of the analysis with the use of literature review. However, I agree with Walsham that it is possible to assess existing knowledge and theory while also being able to consider the different perspectives and insights from field

data (Geoff Walsham, 1995). Moreover, I consider theoretical insights as an essential and important guide for not risking to “reinvent the wheel”. Particularly in a complex environment such as health care, I consider it an advantage to have a theoretical foundation before starting fieldwork. I consider doing fieldwork as a craft that grows with experience, in which each new situation brings new knowledge, skills and ability to navigate in “real-world” settings.

3.2 Data collection

This thesis is based on the interpretive field study of standardization in nursing practice and includes in-depth case studies and ethnographies (Klein & Myers, 1999; G. Walsham, 1992). Data gathering methods used the principle of data triangulation, which involves collection of data from interviews, participatory observation and documentary archival (G. Walsham, 1992; Yin, 2009). As I was inspired by the work of Bruno Latour (1987), I started the fieldwork by “follow the actors”. I started to follow nurses, the electronic care plan, classifications, paper documents and so on. I soon recognized that this strategy was quite confusing because there were so many actors involved and it was difficult to get an overview of key actors. Thus I changed my focus and followed the actions, i.e. the actors that made a difference. Moreover, I have focused on content, context and processes of documentation of nursing which then formed the basis for collecting empirical data as shown in Table 2.

Data sources	Numbers	Context
Observation	435 hours	<ul style="list-style-type: none"> • 200 psychiatric ward (2008 – 2010) • 140 hours in a surgical department (2010) • 65 hours in a medical department (2010 – 2011) • 2 workshops with the vendor and users (15 hours) • 4 workshop with the vendor (15 hours)
Semi-structured interviews	35	<ul style="list-style-type: none"> • 32 nurses and assistant nurses • 1 occupational therapist • 1 physician • 1 vendor
Document archive		<ul style="list-style-type: none"> • Project plans, user manuals, frequency analysis of the use of classifications and care plans, local procedures, guidelines, official reports and newsletters

Table 2. Overview of data sources

In the following paragraphs I will present the different forms of data collection according to the methodological principles and practical performance.

3.2.1 Interviews

The qualitative interview is one of the most important data gathering tools in qualitative research and permitting us “to see that which is not ordinarily on view and examine that which is looked at but seldom seen” (Rubin & Rubin, 2004, p. xv). The qualitative interview may be considered as a craft and not just a straightforward activity as talking to some people. It's a performance that requires experience and skills

as well as guidelines and models of good interview practice (M. D. Myers & Newman, 2007). I have mainly used semi-structured interviews, however, I have also used some informal interviews as part of my observation studies. Moreover, some of the interviews were conducted in collaboration with colleagues, while in other cases I was responsible for the performance alone. For example, when I started my first fieldwork I participated in a local project. Two nurses at the ward were in the process of scheduling interviews with the staff, and because the topic was the use of nursing classifications, I was invited to participate in the project. Thus, I had easy access and legitimacy to the interviewees. Meanwhile it was regarded as an advantage that I was an outsider who could provide input to the interviews. These interviews were conducted in a conference room at the ward in a quiet environment. The interviews were conducted by one of the project nurse while I had a role as an observer and an opportunity to make supplementary questions. First, this was a good opportunity for me to become familiar in the field and tell about my role and purpose of the fieldwork. Secondly, it was an advantage that we were two interviewers that could supplement and complement each other during the interviews. Selection of interviewees was aimed at a mixed group (nurses and social worker), both in terms of age and experience, to gain insight into several aspects and user stories (M. D. Myers & Newman, 2007). Although the interviews were semi-structured, the interview guide was just used as a support to ensure that important issues were discussed. The questions were open-ended and encouraged to interaction, improvisation as well as encouraging the interviewees to explain their world in their own words (Klein & Myers, 1999; M. D. Myers & Newman, 2007). In total we made 6 interviews together in this project, which were all tape-recorded, anonymized and transcribed subsequently. I consider this as an efficient way to perform the interviews in a challenging situation that is often the case when interacting with interviewees and ensuring a good performance. It increases the ability to perform interviews in a professional manner and to make the interviewee feel comfortable. Moreover, we had the opportunity to reflect on key issues and adjust the interview guide in line with emerging subjects during the interviews. Since then, I also had the opportunity to collaborate in the performance of interviews together with a PhD research fellow, working with the same topic as me, as well as with my supervisor.

All semi-structured interview, either with one or two interviewers, more or less followed the same procedure. There was agreement with the interviewees in advance with information about the role and purpose of the interviews. In addition, I also used unstructured interviews. An unpredictable and busy environment characterizes hospitals and as an outsider, I had to be aware of and adjust to daily activities in the wards. Thus, I was always prepared and aware if there was an opportunity to make an ad hoc agreement for an interview. The content and duration of these interviews varied according to circumstances. Sometimes they followed more or less the same procedure as semi-structured interviews, while other times they were more informal conversations after an observation session.

3.2.2 Participant observations and ethnographies

In all field studies, ethnographic techniques such as participant observation and document analysis were used in addition to the interview. Ethnographic methods such as participant observation, document archive is well-recognized techniques for data collection, often used in combination with interviews and

informal conversations. With its roots in anthropology, ethnographic methods have increasingly been used in multidisciplinary communities for designing, evaluation and exploration of technology in use (Forsythe, 1999; W.J Orlikowski & Baroudi, 1991; S. L. Star, 1999). Particularly in the CSCW community, methods like participant observation and fieldwork in general has been applied to explore cooperation by using workplace studies (K. Schmidt & Wagner, 2004; L. A. Suchman, 2007). At the same time, there has been some debate about whether, and in what senses, this applied research is ethnographic. With respect to professional ethnographers who have training and skills in ethnographic research, I am aware that ethnographic research is more than looking and listening to what people do. However, I have used some ethnographic methods such as participant observation and documentary sources as shown in Table 2.

By applying these methods, I have gained an in-depth historical understanding of the use of standards in nursing as well as detailed insight into real-world processes where electronic nursing documentation are integrated to local practice (Klein & Myers, 1999). Participant observation and documentary sources used in combination with the interview, enable the fieldworker to detect consistent patterns of thought and practice and to investigate the relationship between them – an important comparison, since what people do is not always the same as what they say they do (Forsythe, 1999, p. 128).

Participant observation has played a key role during the fieldwork in all cases from the different care settings. Yet, my level of participation has varied from different situations and contexts. It is often drawn a distinction between participant and non-participant observation on the basis of whether the researcher plays an established participant role or not. However, these differences are blurred and some have argued that in a way all social research is a form of participant observation, because we cannot study the social world without being part of it (Atkinson & Hammersley, 1994, p. 249). Thus, participant observation is a mode of interacting with the research field in which the fieldworker herself is the research instrument (Forsythe, 1999).

The focus on the fieldwork in clinical care settings has been on nurses' documentation work, such as how they used the electronic care plan and classifications in their daily work. Thus, the purpose was not to measure gains and losses with the use of care plans and classifications. It was rather to gain insight into how information and knowledge was translated, coordinated and articulated between nurses as well as the artifacts, competencies and skills that were used in this process. Most of the fieldwork was carried out in the nursing office and conference room where the documentation work and handover conference took place. By shadowing nurses while they used the EPR and electronic care plan, I had the opportunity to gain insight into how they made sense of the various artefacts used in daily practice for sharing information within the care team. I shadowed many different nurses to visualize various perspectives and attitudes towards documentation practices. In addition, I used the opportunity for informal conversations during the fieldwork to elaborate on specific issues or situations. Particularly in a busy hospital environment, I consider this flexibility as a useful strategy in combination with the formal interviews.

The fieldwork has been carried out in different periods of time using various techniques and ways of representation. Fieldwork and observations have mainly been documented as a diary of situations and actions in practice and varied based on situations and environment where I have used different types of

field notes (Tjora, 2006). For example, detailed descriptions of ongoing activities, social and material actors, events and collaboration processes. Field notes also have reflected the progress in the fieldwork where I have narrowed the focus on specific collaboration and coordination processes such as, for example, how the nurses share information and knowledge during the handover meetings. In these situations, I have endeavored to make notes of actions and interactions between nurses and how they understand the formal and informal information. Usually, I transcribed the field notes after the observation session and added my own reflections, assumptions, or issues that required elaborations. However, it is not straightforward to “grasp” and unfold the complexity of sociotechnical interactions. As stated by Geertz and quoted by Walsham (1992): *“What we call our data are really our own constructions of other people’s constructions of what they are up to”* (G. Walsham, 1992, p. 320) Thus it has been helpful with informal conversations with experienced nurses, in which I frequently used a tape recorder, and thus supported the reconstruction of events.

The fieldwork has also been an iterative process back and forth between research questions, data collection and analysis. I started with a broad approach to the research field to gain an understanding of situational issues in the context. As I have developed philosophical and theoretical assumptions, I gradually narrowed my focus based on assumptions related to translation, coordination, and change of work-oriented infrastructures. For example, at the University Hospital of North Norway, I have focused on how nurses share information in the handover conference. Thus, I have participated in a number of handover meetings as an observer where I have focused on the artifacts, competencies and skills used in the handover, and aimed to uncover some of the invisible players in this process. Participation in various projects has also played an important role in the course of my fieldwork. First and foremost, it has enabled access to informal conversations with key people in the projects as well as historical and contextual understanding of events and processes. Second, it provided useful information according to different perspectives on issues such as adoption of nursing classifications, changes in the handover process, or implementation of a new medication management system and so on. Thirdly, I gained access to various documents, project plans, strategies, and frequency analysis of the use of standards.

The collection of documents and reports has also played a key role during the fieldwork, on both a macro, meso and micro level. Documents and reports have provided historical insight, and used along with other forms of data, special perspectives have been explored and compared. Thus, I have contextualized the various cases in specific historical moments and traced actions and processes over time. For instance, on a macro level, I have traced public guidelines, visions, plans and standards. On an organizational level, I have collected projects plans, evaluations, newsletters, manuals and email. Strategies, beliefs, and ideas are important for action and practices and this kind of data is used to explore different perspectives and intentions in different contexts. On a micro level, I have collected local procedures, guidelines, forms, evaluations and reports. From the vendor I have had access to user manual and a test version of the EPR system that provided an opportunity to become familiar with functionalities and user interfaces of the computer system. In the local care setting, I have not only aimed attention on the use of the electronic care plan and classifications, but also other materials traces used in documentation such as forms and paper documents. Along with data from interviews and observations, this kind of documentary archive has

become an important part of data collection to construct and reconstructing events, intentions and processes across time and place.

3.3 Analysis of data

Data collection and analysis have been regarded as an iterative process, moving “from a precursory understanding of the parts to the whole and from the global understanding of the whole process back to an improved understanding of each part” (Klein & Myers, 1999, p. 71). This process, the hermeneutic circle, has been a fundamental principle during the entire research process. Accordingly, data collection and analysis has not been distinctive activities, but an iterative process back and forth between the field of research, representation and categorization of field data, and analysis. By reading the interviews and fieldnotes repeatedly, categories and thematic areas have emerged and formed the foundation for further fieldwork, which has become a coherent case description.

Throughout the research process, I have attended seminars, conferences and workshops where I have presented my work in different stages. Accordingly, the research has not been performed in separate stages isolated from the outside world, but been a continuous process of feedback from an interdisciplinary research community. Firstly, it has forced me to start the analysis at an early stage as well as arguing and defending analysis and progress of the research. Secondly, I have been confronted with my interpretations and preconceptions that have guided the research design. Thus, I have been challenged to defend my preconceptions and been able to modify these based on the philosophical foundation of my research. Particular because I have several years of experience as a nurse as well as experience with implementation and management of EPR systems, I have entered the research field with assumptions based on past experience and knowledge that has been significant for interpretation and understanding of the field. Yet, prejudice is not considered as a source of bias in interpretive research, but recognized as the necessary starting point of our understanding (Klein & Myers, 1999, p. 76). Similar, it is argued that ethnography is usually most productive when conducted by an outsider with considerable insider experience (Forsythe, 1999). Still, my previous experience as an “insider” is no guarantee that I am a qualified observer. As a nurse, there may be events and processes from the research field that I take for granted and may have ignored with my insiders knowledge. Presentations of my field work during the research process has challenged me to analyze and elicit field data through systematic comparison between inside and outside views of particular event and processes (Forsythe, 1999, p. 130).

One of the key tasks in interpretive method is seeking meaning in the social and historical context (Klein & Myers, 1999) and has been a consistent approach throughout the research process. As mentioned previously, I have explored various contexts ranging from local use, national policy and global intentions. Accordingly, I have collected a large amount of data to be able to understand the adoption of standards across time and place. As a systematic way to “opening up” field data, I have used analytic maps of situation and social worlds (Clarke, 2005). Situational maps are rooted in the grounded theory approach and are visual representation of social worlds used as devices for handling multiplicity, heterogeneity, and messiness in the situation. Moreover, situational maps are based on actions, actors (human and non-human) and their relation (Clarke, 2005, p. 29). I have used situational maps as an analytical exercise to

moving into and around in the field data in different stages of the analysis. Thus, it has enabled navigation in the field data, guided me to see the “big picture” or “new picture” and provided new insight into the situation. Using this method has enabled me to focusing on situations, interactions and “following the actions”.

As mentioned, I started early in the study with writing up the case where I used the empirical material for the reconstruction of standardization in local practice. In doing this I was forced to analyze and interpret situations in practice and it was a process back and forth between the empirical data, data collection and case description. In this process, I made markups and comments in the transcribed interviews and field data, and organized it according to emerging topics and categories. Similar has the use of theory in this process been more as a “sensitizing device”, both as a way to view the world in a certain way and as an analytical device to the generation of theory as well as contribution of rich insight (Klein & Myers, 1999; Geoff Walsham, 1995).

“Scientific theories begin with situations Theories are responses to the contingencies of these situations - courses of actions articulated with yet more courses of actions. The theories that scientists form about nature are the actions that both meet specific contingencies and frame future solutions (S. L. Star, 1989, p. 15 - 16).

I find the quote by Susan L. Star as a great illustration of the iterative process between empirical data and theory in which theoretical insights arising out of situated practice. “Situation” viewed from this point is not just a single action or a simple representation of a validation or falsification of a true worldview. It is rather an organization of perspectives that “stratifies nature” and takes into account different perspectives and multiple interpretations (S. L. Star, 1989). Moreover, it enables expansion of our understanding and deems some of the invisible aspects of the situation. In my study, I have considered standardization from different intentions and applications and the analysis has moved back and forth between professional intentions, historical development and practical usability. Moreover, the fieldwork has been characterized by interaction with participants in the field to understand how and why standardization is constructed and reconstructed in everyday practice. The social world is not given where the data is ready to be collected. “Rather, the social world is produced and reinforced by humans through their action and interactions” (W.J Orlikowski & Baroudi, 1991, p. 14). To be able to dig into the interpretation process, I have participated in professional meetings and projects to understand standardization in different situations. However, it is a balance between being open minded and avoids exposing externally defined categories of a phenomenon and still has the ability to interact with participants and use myself as a research instrument in the interpretive process. Accordingly, I have received rich insights into situations and have been challenged to revise or reconsider my own assumptions during the analysis.

Although I did not have aimed to discover one “true” objective understanding of standardization in nursing, there is always a risk of false preconceptions when field data is filtered through my interpretation (Klein & Myers, 1999). One strategy that I have used to avoid this kind of bias is triangulation of data sources. Using multiple data sources, I have had the ability to go beyond what the participants say they do, but also considered what they actually did. By analyzing and comparing interview data, field notes and documents from different setting, I have been able to get a comprehensive understanding of the situation

and thus revealed possible distortions in the narratives collected from the participants (Klein & Myers, 1999, p. 72). Furthermore, as I pointed out at the beginning of this chapter, the research process has not occurred in isolation from the outside world. First and foremost, my data has been discussed with my supervisor who has prolonged experience in the field of research. Throughout the research I have also collaborated with colleagues who work with similar PhD projects. We have had regular meetings where I presented my data and thus provided opportunities for critical thinking, elaboration and reflection on specific issues.

4 Case

This chapter provides an overview of empirical data that elucidate different aspects of standardization and user contexts. The research includes four settings that illustrate both the local use of standards as well as national efforts for standardization. The various research settings are presented chronologically and are as follows: First, I present the national work on design and development of standardized terminologies. Then I present two case studies of practical use of standards, and finally a case study of the development and adoption of an electronic medication management system and medical chart.

4.1 Case 1. Cooperative efforts to the use of standardized terminologies in Norway

When I started my PhD project, the aim was to participate in the re-design of a nursing module used in the Norwegian hospital environment. An important part of the nursing module is the use of the nursing terminologies and along with a colleague who is also involved in the same PhD project, I have traced the history and current state of nursing terminologies in the Norwegian hospital environment. This research setting has involved multiple stakeholders and provided a historical background for the research sites of practical use of standards.

As mentioned in the introduction, the Norwegian Directorate of Health is responsible for validation and approval of standards. The Norwegian Center for Informatics in health and social Care (KITH) has played a major role in assessment of relevant standards and maintaining recommended classification systems and codes. This implies that when classification systems and terminologies, such as ICD-10 and ICF, have been approved by the Directorate of Health, further updating and translations is attended by KITH. Assessments and investigations of new terminologies is also an important task performed by KITH who cooperate with the professional communities and other stakeholders. It has recently been initiated investigation on the use of standards in the medical chart where SNOMED CT and archetypes are considered. However, it has not yet been approved a national terminology for nursing practice.

Despite the fact that there is no national approval for the use of standardized terminologies in nursing, there has been a significant diffusion of classification systems in nursing practice during the last decade. The evolving use of classification systems has been collaboration efforts between the Norwegian Nurses Organization (NNO), user groups and vendors.

The Norwegian Nursing Organization (NNO) has played a key role in the development of strategies and guidelines for electronic nursing documentation and e-Health. NNO also has a department for ICT and documentation (NNSID) that participate in national and international cooperation to promote nursing's contribution to the development of a standardized language in the EPR. In addition NSFID has prepared guidelines for the introduction of electronic nursing documentation, participation in projects, organizing conferences and consultation to the user communities.

As one of the largest suppliers of EPR systems to Norwegian hospitals, DIPS ASA has also played a key role in the use and diffusion of nursing terminologies in Norway. In collaboration with users at a hospital

department and the NNO, design and development of a nursing module started in 2001 as a pilot project. First and foremost, it was important to the Norwegian Nursing Organisation that provided nursing care was reflected in the nursing module, and that it was in accordance with professional and political requirements for documentation in the EPR. For the vendor, the nursing module was a continuation of the EPR portfolio, since nurses constitute a major user group and produce and use a large amount of information and documentation in everyday work. Users at a pilot ward also participated in the design period, which lasted from 2001 to 2003. Within the group, there was agreement to use process-based documentation, and to facilitate the use of international terminologies. After reviewing the research and experiences of different classifications, a decision was made to adopt the North American Nursing Diagnosis Association (NANDA) and the Nursing Intervention Classification (NIC). Thus, efforts to translate NANDA and the NIC into Norwegian were initiated as a joint project between the vendor and the NNO. Simultaneously, design and development of a nursing module began and was ready for piloting in 2001.

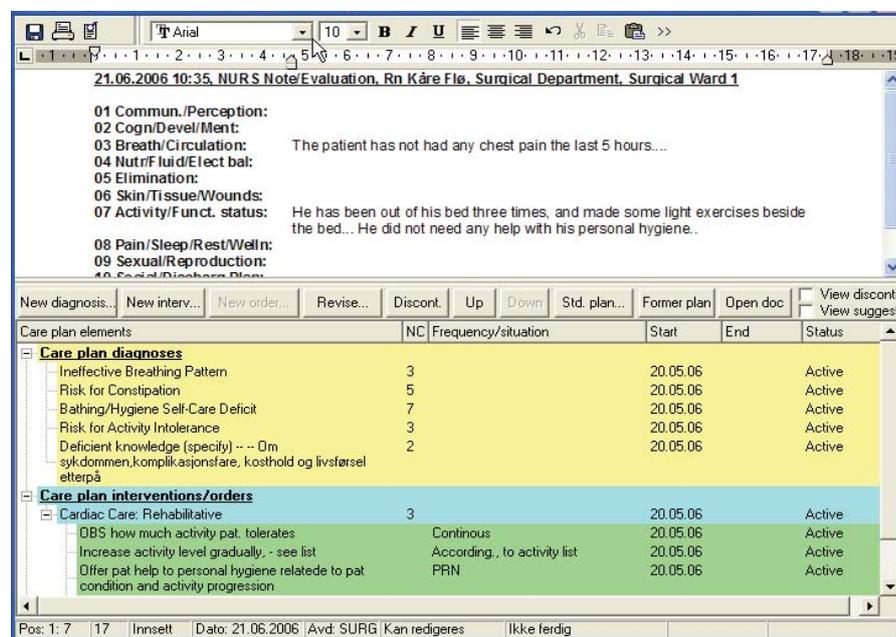


Figure 1. Screenshot of the nursing module in the EPR.

The nursing module contains two separate parts that are interdependent (Figure 1). The lower part of the screen contains the care plan, which provides an overview of patient problems (nursing diagnoses) and planned interventions, as well as the opportunity to audit the plan according to the progress of the nursing process. The NANDA and NIC classifications are available from the toolbar, and are thus an integrated part of the care plan. While the care plan represents the planning and implementation of nursing care, the upper part of the document represents an evaluation of the nursing care provided in relation to the care plan. When a care plan has been created according to the patient's needs for nursing care, it is attached to the following nursing notes as part of the daily report.

After piloting the system for over a year, the NNO concluded that the trials with NIC and NANDA showed promising results and that future use should be monitored in order to gain knowledge about usability for

nationwide implementation. Similarly, the vendor regarded the pilot as successful, and a nursing module that included NIC and NANDA was offered to hospitals on a commercial basis. Accordingly, the nursing module has been widely implemented in Norwegian hospitals and become an important part of the EPR portfolio of DIPS ASA. Because approx. 78% of Norwegian hospitals are using DIPS EPR system, the nursing module, as well as NANDA and NIC, are in widespread use.

Following the first pilot period in 2001 – 2003, the further responsibility for translation of NANDA and NIC has been left to the Akribe publishing house. So far there has been one Norwegian release of NANDA in 2003 and NIC in 2006, both in book editions as well as electronic versions for use in EPR systems. Moreover, the use and updating of classifications in the EPR system is governed by licence agreements that are organized by the vendor and paid for by each user hospital.

Meanwhile, the NNO has followed the diffusion and use of terminologies in the Norwegian environment as well as ongoing international cooperation and development of terminologies. In addition, other classification systems have been translated into Norwegian, such as ICT, CCC and the beta version of ICNP. Based on the evolving use and progress in development of terminologies, it was established a terminology council in 2008 with the aim of reviewing appropriate terminology for nursing practice. Representatives from health regions, universities, municipalities and hospitals participated in the work that came up with a recommendation on the use of ICNP as an integrated part of EPR. However, this recommendation is quite new and there is no hospital yet that has adopted ICNP.

Finally, the various user groups have had a significant role to the widespread use of standards in nursing practice. It has been established internal hospital user groups as well as regional groups. For example, the Hospital of Southern Norway has established a network of super users in each department that participated in the implementation and training as well as regular meetings to coordinate activities internally. Similarly, it has been established a group in the South-Eastern region to coordinating needs and demands on documentation of nursing in the EPR. The motivation to establish the group was to share knowledge, experiences, and as key spokespersons between users and the vendor. Group members are mainly nurses with special interest and/or skills for ICT in health care and often have had a role in the implementation of the nursing module in practice. Thus, they have acquired specialized competency in the use and adoption of EPR in general, and nursing classification in particular. Accordingly, the EDS group has gained knowledge and experience that is also used in collaboration with the vendor and NNO.

4.2 Case 2. Long term use of electronic nursing care plan and classifications

My first fieldwork in a clinical setting was carried out at the University Hospital of North Norway in the period April 2008 - 2010. My supervisor and a former PhD student had previously done fieldwork in the same department and my study was therefore a continuation of their research.

The University hospital of North Norway has hospitals in Tromsø, Harstad, Narvik and Longyearbyen (on Svalbard) and distributes highly specialized care and treatment in a range of specialist areas. As a leading employer in the region, with around 5900 employees spread across 70 departments, UNN strives to develop education arenas designed to meet the challenges for the future. Large geographic distances in

the region make distribution and access to health services to a special challenge. This is one of the reasons why the Norwegian Centre for Integrated Care (NST) has evolved from the research community in Tromsø, and has today become one department organized at UNN.

The psychogeriatric ward where I have carried out fieldwork is organized in the Department of Special Psychiatry (SPA), and located in the countryside outside Tromsø. The aim of the ward is to provide specialist services with evaluation and treatment of mental disorders, including assessment of level of care. The psychogeriatric ward is an inpatient ward with 14 beds and provides treatment and care to patients who suffer from psychiatric disorders, including depression, psychosis, dementia, and anxiety disorders. Patients who are admitted to the ward are 65 years or older and the hospitalization typically lasted 6-8 weeks. The problem facing patients are complex, since most of the patients suffer from somatic illness in addition to the psychiatric disease. The patients are subjected to various types of tests (blood work, imaging, physical examination, psychological testing, etc.) and are diagnosed, and appropriate treatment is subsequently initiated. The work at the ward is highly inter-disciplinarily, and the clinical staff comprises psychiatrists, physicians, psychologists, nurses, assistant nurses, social workers, occupational therapists, physiotherapists, and some unskilled staff. The number of staff on duty at the ward varies. Normally, there are 8 on the day shifts, 6 on the evening shift, and 3 on the night shift. Nursing is organized as primary nursing, which means that a team of typically two nurses is responsible for the patient during hospitalization. In this environment, nurses play a key role in observing and monitoring patients' needs, as well as assessing the patient's cognitive ability for self-care. Moreover, the coordination of patients' trajectories is a key task to ensure continuity within and across the care team.

In 2003, the psycho-geriatric ward participated in a hospital-wide project at UNN for the implementation of a new EPR system. The ambition of the project was an integrated, shared EPR infrastructure at the hospital. This implies integration between the four principal classes of hospital-based systems such as the EPR, the laboratory systems (LIS), the radiology systems (RIS/PACS) and patient administrative systems (PAS). Furthermore, it was desired to have a common ICT-infrastructure across the health region with a common EPR solution. As part of this plan, it was also decided to adopt the nursing module and it was established a sub-project for organizing the implementation during a period of one year. As mentioned earlier, a key part of the nursing module is the electronic care plan (Figure 1) that facilitates the use of nursing classifications (NANDA and NIC). However, this is only one option. It is also possible to use a free-text language instead of NANDA and NIC in order to describe the various steps in the care plan. To use or not to use classifications were discussed in the project. Yet, given the short timeframe for implementation of the electronic care plan in addition to other modules in the EPR, the use of NANDA and NIC was not part of the overall strategy.

Meanwhile, a group of nurses at the psycho-geriatric ward initiated a local project on the use of care plans and classifications at the Department of Special Psychiatry. Information and documentation work had long been on the professional agenda and they considered use of the care plans and standards as a means to improve the nursing documentation. The management at the department supported the local project, and later on, the psycho-geriatric ward became a pilot ward in the overall project at UNN.

When I started my fieldwork at the psycho-geriatric ward in spring 2008 they had used the electronic care plan including NANDA and NIC for 3 years. At this point, two nurses at the ward had just started an evaluation of the use of classifications. I was invited to participate in the project, which enabled me to focus on long-term use of classifications. Shortly after this evaluation project, another documentation project was initiated. I also participated in this project where the aim was to change the handover practice. Over long time there had been requested to change the traditional practice of reporting between shifts. The traditional, oral handover have been practiced in the same way for years. The main objective of the oral handover has been to share information between the nursing team. It is typically performed three times a day (between morning, evening and night shift) in which an off-going nurse gives an oral report to the oncoming nurses. The main motivation for changing the handover was a requirement to make time for professional discussion and reflection of particular patient problems. It was claimed that the oral handover reports was more or less a recitation of patient problems and the written documentation. The successful implementation of electronic documentation provided an opportunity for considering new ways of carrying out the handover. Accordingly, a new report was introduced fall 2008. Instead of presenting all information orally, staff now needed only to read the documentation on the patients they were responsible for during the shift. In addition, every morning, there was a 30-minute meeting for professional discussion, usually covering 2-3 patients, but also including discussions not related to specific patients. During the meeting, the electronic care plan was visualized on the wall screen by a projector to provide an opportunity for collective reading and participation.

The case study at the psycho-geriatric ward provided insight in local use of standardized terminologies and care plans, and are discussed and analyzed in paper 1. Yet, standards were not used across organizational boundaries. As mentioned, the use of NANDA and NIC was not part of the overall project at UNN and it was just the psycho-geriatric ward that consistently used nursing classifications. Thus I continued my fieldwork at a hospital that had a general plan for the use of standards.

4.3 Case 3. Cross-contextual use of standardized care plan at a surgical department

The Hospital of Southern Norway (SSHF) has used the same EPR system since 1999 and has since gradually digitized the EPR infrastructure in line with development of new modules from the vendor. At the same time the hospital has undergone major organizational changes during the last decade. After reorganization in 2003 with a merger of three local hospitals, SSHF has become a large enterprise with approximately 5,600 employees and provides specialist health care to the population of Agder counties. SSHF is responsible for 3 hospitals located in Arendal, Flekkefjord and Kristiansand and is part of the Southern and Eastern Norway Regional Health Authority.

A major EPR project was carried out in 2006 where the EPR systems at the three hospitals localization were integrated to a joint EPR infrastructure. As part of this project, it was also decided to adopt the nursing module and a pilot project was carried out in 2007. The purpose of the pilot project was to gain experience with the use of the electronic care plan and use of classifications, as well as to facilitate further implementation strategy. Accordingly, a project plan was drawn up and approved by the hospital management and subsequently, the core elements of the nursing module was introduced at the hospital

during the period 2008-2011. Similar as the hospital in North Norway, the implementation of a nursing module at SSHF was organized as a hospital-wide project. Yet there were strategic differences to the use of standards. While the hospital in Northern Norway had no general plan for the use of nursing classifications, the hospital of Southern Norway had a more strategic management-oriented approach. Based on evaluation and experiences from other hospitals in the region, it was approved by the hospital management to use classifications available in the system (NANDA and NIC) as well as standardized care plans. As shown in the figure 1, the care plan has a dynamic user interface with several options from the tool bar. One option is the “Standard care plan” with the ability using templates prepared by each hospital.

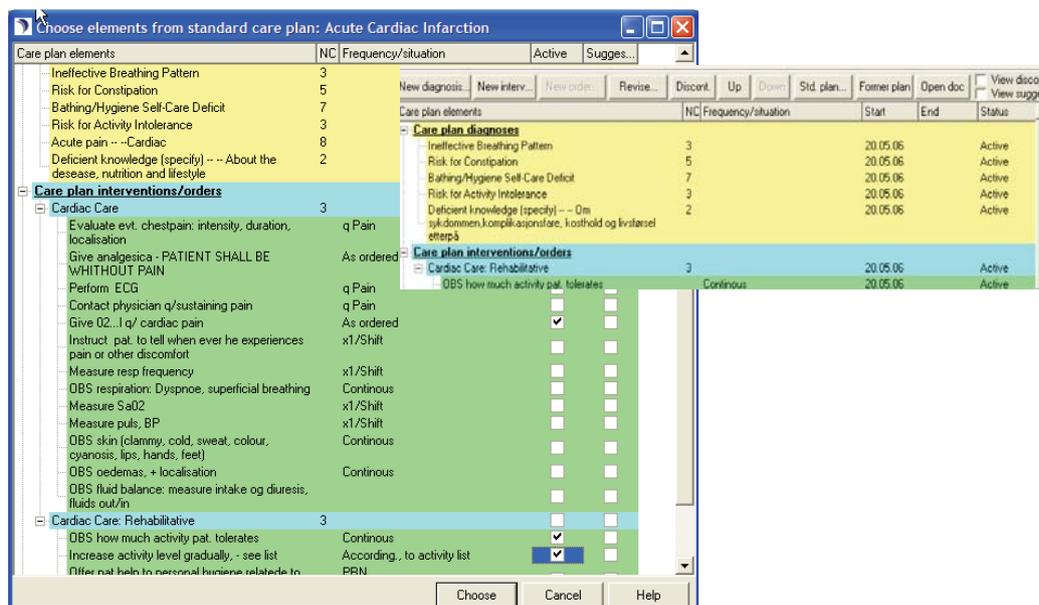


Figure 2. Standard care plan

Like many other hospitals in the region, the hospital of Southern Norway decided to use this opportunity and developed several standardized plans that have been made available in the system. This implies that the implementation of the nursing module was not just a change from paper-based to computer-based documentation. It was also a major change process and was also highly embedded in the professional development of nursing. Accordingly, collaborative efforts were initiated across departments to develop templates for different patient pathways. An internal super-user network was established at the hospital where key users within the different disciplines developed standardized care plans within their area of expertise. A total of 153 standardized plans were prepared, which was approved by the professional leadership and made available in the electronic nursing module. Use of these templates implies standardization on two different levels. First, the key users aimed to use classifications (NANDA and NIC) in the preparation of the plans. Second, it stipulated a guide with pre-defined suggestions on nursing diagnoses and interventions prepared in accordance with guidelines from the local practice. Thus it was interesting to explore how these core elements of the nursing module were used in practice and how it was used to facilitate the coordination of nursing care within and across the nursing team.

My fieldwork started approximately two years after implementation of the nursing module at the surgical department where I have mainly been at gastro-surgical ward and intensive care unit. The surgical department is organized in terms of specialties and patients are admitted to either elective or emergency surgery. The gastro-surgical ward has 24 beds where nurses and some nursing assistants have responsibility for the care of patients. A chief physician and a head nurse are in charge of daily management of the ward as well as the professional responsibility for care and treatment. In addition, an inter-disciplinary team of surgeons, anesthesiologists and physiotherapists visiting the ward regularly during the day. Nursing service at the ward is organized as team nursing and divided into two teams, which means that a group of nurses and nursing assistants are responsible for the care of several patients. Observing, assessing and monitoring of patients' needs before and after surgery characterize nursing at the ward. Planning and coordination of procedures and interventions are also an important part of efforts to ensure the continuity of the patient trajectories. During this process, the patient is moved between the surgical ward, operating room and post anesthesia care unit (PACU) in which coordination and communication plays a key role in seamless care across specialized boundaries in nursing. The stay at the PACU varies from a half hour to one day depending on the type of surgery or anesthesia, complications and so on. Nurses employed at the PACU are specially trained and the main task is to monitoring vital signs, stabilize and support vital functions. As mentioned previously, the nursing module was introduced to all wards at the hospital. An exception was the intensive care unit that only uses the nursing note, and not the care plan and classifications. So far, they have not yet decided how a shared electronic care plan has the capability to support care and monitoring of patients in the initial postoperative phase. In this environment, they are dependent on a number of computerized systems and a specially designed electronic chart has been in use since 2002. This clinical information system is an integrated part of the monitoring system used to continuously collect and store vital signs such as ECGs, blood pressure, respiration rate and so on. In addition, the system enables documentation of medication, fluid balance, clinical assessment and free-text documentation. However, the electronic clinical chart is not integrated with the EPR system and a paper printout needs to be taken when the patient moves back to the ward.

The information that are used and shared in the clinical chart is particularly interesting since it plays a pivotal role in nursing practice. It is also an interdisciplinary information system that recently has received much attention in Norway. The medical chart, or clinical chart, is used across professional and organizational boundaries and has been used at all times. Everyone knows the clinical chart that in the old days was attached at the bedside of each patient. Although EPR has been introduced at all Norwegian hospitals, the clinical chart is still paper-based in most hospitals, except for some specialized departments such as the PACU. Yet, most health regions have initiated efforts for the development and use of electronic chart. Similarly, the vendor DIPS ASA has also developed a clinical chart that has recently been adopted by the University Hospital in Akershus. This has triggered my curiosity since the clinical chart is an important part of nursing documentation and plays a key role in coordination within and across the care team.

4.4 Case 4. Adoption of an electronic clinical chart in nursing

During my PhD project, I also have been involved in projects and workshops together with DIPS ASA that is a partner to the TTL. One such project was the design and development of Panorama Clinical Chart, which was done in collaboration with Akershus University Hospital (AHUS). With this starting point, I tracked the process from design and development of a medication module, and up to the implementation and use of a clinical chart. Akershus University Hospital is one of two university hospitals in the South-East region, which is affiliated to the University of Oslo and has approximately 6,000 employees. The hospital has for years been at the forefront of adopting new ICT solutions. EPR (DIPS) was introduced in 2004 and the hospital had a superior strategy for the introduction of core elements of the nursing module with the use of electronic care plans, classifications, and standardized care plans. Moreover, the hospital was also the first in Norway to apply Practical Procedures in Nursing (PPN) as an integrated part of the electronic care plan. In 2008 the hospital moved to new facilities and is today one of Europe's most modern university hospitals. The use of new technology was a key issue during planning and construction of the new hospital, where the main objective was to use technology to promote organizational development and support work processes. The hospital has undertaken major efforts to standardize the hospital infrastructure for computer technology, such as IP-enabled telephony, automated drug management systems and automated transportation systems (robot technology). DIPS ASA was one of the main partners in this effort by developing a medication module as an integrated part of the automated drug management system. The new ICT infrastructure was introduced when the new digital hospital was opened in autumn 2008. However, challenges and contingencies led to redesign of the system (Paper 6). One outcome of this redesign process was a new application called Panorama Clinical Chart.

As part of my fieldwork I followed the training and use of the medication module and Panorama at the neurological ward, which was the first ward to adopt the system in February 2010. The 28-bed neurological ward provides care and treatment to patients with acute and chronic neurological diseases. The organization of work in the department is divided into four-bed units, and a group of three or four nurses is responsible for each bed-unit during the day. Further, the bed units are designed to support collaboration, and they are provided with modern technology to increase efficiency in daily practice. A workstation is located centrally in the bed unit and provides an overview of patient rooms as well as access to the EPR system and nearby facilities such as local medication storage and a locking system for pneumatic dispatch for medication, laboratory samples, requisitions and so on.

Medication management is a complex workflow involving various tasks such as prescribing, storage, distribution and administration of medications. Each step in the workflow is interdependent, which means that the outcome of one work task provides input to the next and so on. Furthermore, many different professions are involved with different legal and professional responsibilities. In this fieldwork, I have focused on how nurses are using the new medication management system and the clinical chart as an integrated part of the EPR system. The medication management system in the EPR includes different modules and user interfaces. The administration interface is mostly used by nurses and provides information about the timing, amount and name of the medication to be given and so on (Figure 3). The administration interface also provides the option to show the medications on one or more patients, time

interval and history of given drugs, etc. Moreover, the system offers decision support such as access to Pharmacopoeia, which is the national consolidated catalogue of pharmaceutical compounds marketed in Norway. In addition, information in the medication module is also linked to the clinical chart (DIPS Panorama) that has the ability to provide a graphical representation of the medications.

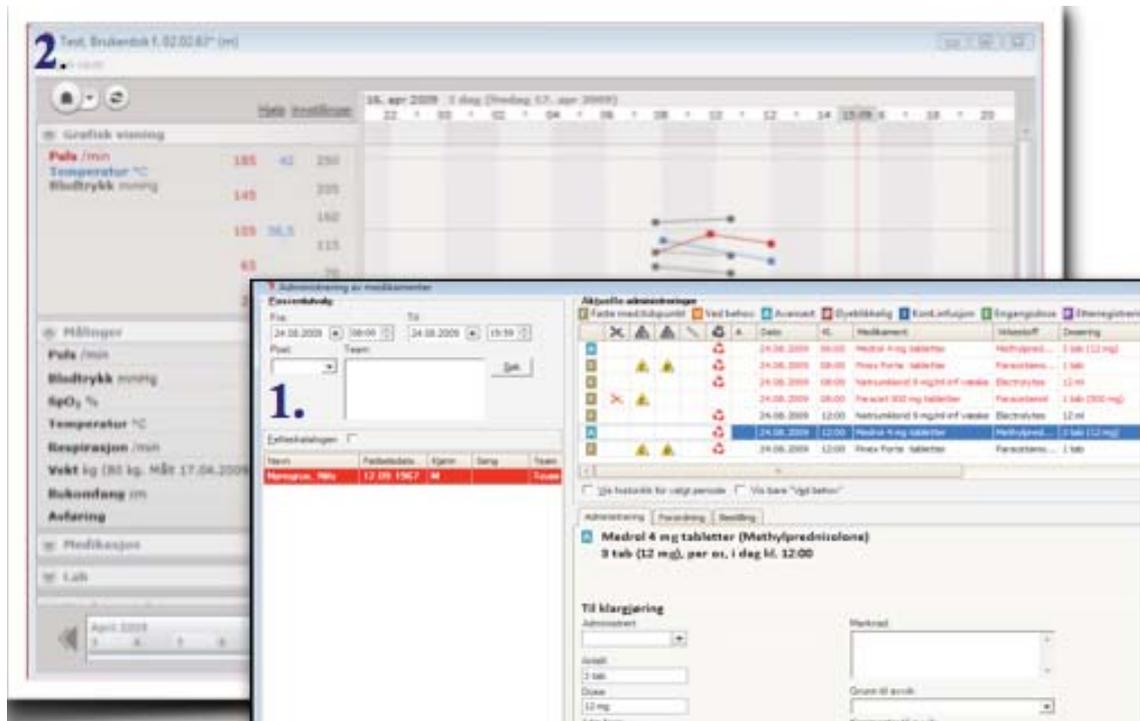


Figure 3. Administration interface in the medication module (1) and the the clinical chart (2)

DIPS Panorama affords an overview of clinical information and event along a time axis. A flexible screen view enables graphical or tabular display of measurements (blood pressure, heart rate, body temperature) or zooming in on specific trended data on the time axis. Display of medication and laboratory information is also available and integrated into the system.

As mentioned, the use of electronic medication module and clinical chart is quite new in Norway and the neurological ward were the first to use the system. Experience from the pilot period led to gradual implementation at all departments and ongoing cooperation between the hospital and DIPS for further development. Thus it was particularly interesting to explore these process-oriented technologies in use since representation of symbols and information in the these applications are highly standardized as well as tightly embedded in nursing practice.

5 Findings

This thesis includes six papers published, or accepted for publication in conference proceedings or peer-reviewed journals and are arranged as follows:

1. Meum, T. and G. Ellingsen (2010): ""Sound of silence" - Changing from oral to a computer-mediated handover." *Behaviour & Information Technology*
2. Meum, T. Wangensteen, G., Igesund, H., Ellingsen, G., Monteiro, E (2010) Standardization – the iron cage of nurses’ work. *Information Technology in Health Care: Socio-technical approaches 2010*. ISO Press
3. Meum, T., E. Monteiro, Ellingsen. G (2011): The Pendulum of Standardization, European Conference of Computer Supported Cooperative Work (ECSCW2011), Springer.
4. Meum, T. and G. Ellingsen (2011): Standardization in Nursing: Cross- contextual Information sharing. ECIS Proceeding, AIS
5. Meum, T. (2012): "Lost in Translation - The challenges of seamless integration in nursing documentation." Accepted for publication in *International Journal of medical Informatics*.
6. Meum, T. (2012): Electronic medication management: a socio-technical change process in clinical practice, ACM 2012 conference on ComputerSupported Cooperative Work (CSCW).

The papers are more or less presented in a chronological order and thus illustrate how my PhD project has evolved. Several papers appeared from the same fieldwork, but differ in scope and scale (paper 1,2 and 3). Other papers emerged from increased empirical and theoretical insights and are a prolongation of earlier work.

Before presenting a summary of the individual papers, I want to emphasize that they all signify long-standing processes where previous versions have appeared in other settings and/or undergone prolonged review processes. An earlier draft of paper 1 has been submitted and presented at the EASST (The European Association for the Study of Science and Technology) conference in Trento 2010. In addition, this paper originated from a project in collaboration with Margunn Aanestad and Irene Olaussen and is published as a chapter in a Norwegian book edition. Similar, paper 2 was motivated by a joint project between two nurses and published at the ITHC (Information Technology in Health Care: Socio-technical approaches) conference in 2010. This is a rather short paper, however, I have chosen to include it in the thesis because it has been the origin of further work and papers. For example, paper 2 was an extension of this work, although with a different scope. Since then I have also been invited by the editors of the conference proceedings to submit a revised and expanded version of the short paper for a special issue of the *International Journal of Medical Informatics*. The theme of the special issue is patient safety and I am currently in the final review process. Paper 5 is also the outcome of a similar process. At this stage of my work, I have moved toward the interrelation between nurse-specific and interdisciplinary documentation. Accordingly, a short paper was submitted, presented and published at the conference

"Infrastructures for Healthcare 2011" and has since been revised and accepted for publication in a special issue of the International Journal of Medical Informatics.

The collection of papers in this thesis has been selected to depict the learning process that I have gone through as well as the theoretical evolution of my work. All papers have been a collective achievement where discussions with the supervisor, co-authors and peer reviews have accompanied my study. The remainder of this chapter provides a summary of each paper and an overview of the main findings.

5.1 Article 1. Changing form an oral to a computer-mediated handover.

In this article, we studied the transition from oral to computer-mediated handover among nurses in a particular nursing practice. The motivation for this study emerged gradually in the course of my first fieldwork. The main focus was on the use of standardized terminologies and care plan paying particular attention on how new technologies affected collaboration among nurses. Yet I found that the transition to new technology enabled the change of the traditional oral report and I followed this process by participating in a local project at the department.

The traditional oral handover has been an integral procedure in the health care in general and nursing in particular. The main objective of handover practices is the transfer of information, responsibility, and/or authority from one set of caregivers to another. This procedure is performed several times a day, for example, between shifts or when the patient moves between departments and treatment facilities. In recent years, the handover practice has been under scrutiny and several countries have introduced guidelines as a means to prevent misunderstandings and improve patient safety and continuity of care (See for instance, Nadzam, 2009).

In this study I focused on the nursing shift handover that usually takes place three times a day where off-going nurses provide information about the patient to on-coming nurses. In particular, I have emphasized the transition from oral to written handover and asked the following research questions: What issues are at stake when introducing written hand-over to a nursing practice? How can it be accomplished and what are the consequences? The analytical focus is on the multifunctional capacity of handover practice and the interrelation of heterogeneous practices and sociomaterial agency (Berg, 1996; Kerr, 2002; Moser & Law, 2006; WJ Orlikowski, 2007). In addition, the study illustrate well the mutual relationship between knowledge and practice as well as the coordinating capacity of care plans as described in section 2 in this thesis.

The transition from unstructured paper-based documentation to the use of computer-based care plans based on standardized classifications facilitated more accuracy and reliability in nursing documentation. Thus it was possible to replace the traditional verbal handover with computer-mediated handover. Although the electronic care plan plays a key role in this change process, the study also illustrates the socio-material assemblage of information sources used in the handover procedure. The various actors (non-human and human) played different roles in order to maintain the multi-functional capability of the handover process. Overall, it shows that the handover practice implies communication, coordination and interaction that affects decision- making in nursing. Reconfiguration of the handover process also affected

collaboration among nurses. The new practice led to increased accountability to the individual nurse to document and collect information using the electronic care plan. At the same time, because the electronic care plan was displayed on a wall-screen during professional meetings, the new technology led to new opportunities to share and enhance clinical knowledge. Generally the paper illustrates the socio-material dynamics of handover practice, negotiations between formal and informal communication as well as the enabling and constraining power of new technology.

5.2 Paper 2. Standardization – the iron cage of nurses' work

This paper explores how nursing classifications have been adopted and used in nursing practice and have been performed in close collaboration with two project nurses from clinical practice. As a researcher, I was involved in a local project aimed to explore the use of classifications and the empirical data was based on frequency analysis, participant observation and interviews.

First, the paper gives a detailed description of implementation and adoption of NANDA and NIC to the local practice over a period of two years. Although the standardized terminologies were in widespread use, frequency analysis showed a decrease when they moved from mandatory to voluntary use. Yet there was a high degree of similarity and correlation between NANDA and free text classifications. Second, the study illustrates how nurses adjusted, changed and added situated knowledge to classifications as a way for bridging the gap between formal classifications and local practice. Thirdly, the study shows how local classifications emerged as a collective process among the nursing team. It also shows how local improvisation enabled the representation of local classifications in the electronic nursing module.

I argue that the evolving process with the use of local classifications were more than just local adjustments and modifications. Rather, I argue that this standardization was a mutual process between formal standards and situated knowledge, i.e. co-construction. As a continuation of this work, the co-constructive perspective is explored in more depth in the next paper.

5.3 Paper 3. The Pendulum of Standardization

As a prolongation of previous paper, this paper highlights the collective re-construction of classifications that emerge over time. The study is carried out in collaboration with the Eric Monteiro and Gunnar Ellingsen who both have extensive experience with empirical studies of standardization in general and in health care in particular. We have emphasized the temporal process of standardization and traced initiation, implementation, adoption and use of standardized classifications in a nursing practice over a period of five years. Specifically, we study how the negotiation between global classifications and local practice takes place with long-term use, and depict this dynamic interaction as a pendulum movement.

Inspired by previous studies that have emphasized the interplay between standards and local practice (Bowker & Star, 2000; G. Ellingsen et al., 2007; S Timmermans & Berg, 1997), we have analysed the mutual dynamics of the socio-technical network; i.e. the skills, knowledge and material capacity involved in the translation and transformation of standards. In particular, we emphasize the mutual dependence between international standards and situated practices and the co-constructive perspective on

standardization. Furthermore, we characterize this standardization as a transformation, i.e. an ongoing process of change, and highlighted the emergent and opportunity-based changes (W.J. Orlikowski, 1996).

First and foremost, the study illustrates how skills, domain-specific knowledge and situated practice resolved the gap between international classifications and local categories. Despite some sceptics and reluctance at the start, experiences during the first year showed that the care plans were used in daily practice and that classifications were used extensively. After some time, a gradual decline in the use of NANDA and NIC occurred while the use of free text to describe nursing diagnoses and interventions (local classifications) increased. Of special interest in this case are the similarities between NANDA and local classifications. This illustrates the mutual dependency between the standards and practices and expanding the insights of the co-constructed perspective of standardization. Secondly, the gradually co-construction was a collective achievement in which articulation and coordination of domain-specific knowledge and clinical judgment led to a shared understanding. Finally, we have highlighted local innovation and improvisation in the standardization process. A cascade pattern of changes entailed new opportunities for interconnecting local knowledge in the computer-based system. There was a gradual development in which increased knowledge of NANDA resulted in increased awareness of using the language to describe nursing, which in turn led to increased development of local nursing diagnoses. In this way, NANDA contributed to sound clinical judgement and knowledge development, and we have characterized this change process as a pendulum movement. Moreover, we have compared the evolving process of local classification with social tagging (folksonomies) and suggest that this kind of bottom-up, user-driven approach to classification as a useful supplement to formal, expert-created classifications.

5.4 Paper 4. Standardization in nursing practice: Crosscontextual information sharing

The previous papers have mainly dealt with the use of standards in a singular practice and the political negotiation process of standardization in nursing. Standardization is also considered as coordinating mechanisms that have the ability to articulate activities and event over time and space. In this paper we have highlighted the coordinating capabilities of standardized terminologies as an embedded part of the care plans used within and across domain-specific boundaries. We build further on the co-constructive perspective of standardization, but explore further on what issues are at stake when standard plans are used across organizational boundaries, the tension between different standard and the use of standard plans as a bridge to share information and knowledge across various contexts.

Our empirical data is based on fieldwork in a surgical department at a regional hospital in Norway. The work in this environment is characterized by close cooperation and coordination in which multiple actors (humans and non-humans) are mutually dependent on each other to ensure continuity and quality of the care process. The dynamic environment in which patients move back and forth between bed-units, operating rooms and post anaesthesia care unit (PACU) requires a high degree of articulation work that is distributed across time and space. Particularly interesting in this case is the capability of standardized plans to be a shared asset across domain-specific boundaries.

Based on a theoretical perspective on standardization-in- action (S. Timmermans & Berg, 2003) this paper analyse efforts of standardization in nursing through the use of nursing plans. The study

supplement paper 2 and 3, however, attention is more aimed at standardized applications and its capabilities to regularize movement of information from one context to another. (Bowker & Star, 2000). The concept of boundary object is used to analyse how standards span the boundaries between the diversity of specialities (Levina & Vaast, 2005; S. Star & Griesemer, 1989).

In the analysis, we discuss the role of standardized care plans as a boundary object and using the framework transferring, translating and transformation to illustrate the standardization process within and across care settings (Carlile, 2004). The empirical examples illustrate how standardized classifications have been translated into local practice as an integrated part of care plans. The local investment in the adoption of the standardized care plans show how local knowledge are integrated into the new technology and goes beyond an “information processing” ability for transferring information. A common terminology in this case is not sufficient to create a shared meaning between actors. Nevertheless, the standardized plans have been made “do-able” in a process of “naturalization” (adaptation to local knowledge) and maintaining coherence across intersecting social worlds (Bowker & Star, 2000; S. Star & Griesemer, 1989). Thus, care plans enabled a shared language and common understanding of the use of nursing documentation in the EPR system. Despite the successful introduction of standardized plans, the study shows the challenges of maintaining coherence across domain-specific boundaries. The heterogeneity in nursing practice challenges the standardization and a “shared meaning” when the circumstances at a boundary grow more complex. We use the concepts of perspective-making and perspective-taking to illustrate the trade-offs and efforts required to share information and knowledge across pragmatic boundaries (Boland & Tenkasi, 1995; Carlile, 2004). First, different knowledge is grounded in different specialties within nursing that requires transformation from domain-specific to common nursing knowledge. Second, multiple technologies and standards are used with supplementary or additional functions in various practices. This is not just a technical challenge, but involves sorting and transforming in order to obtain a common understanding.

5.5 Paper 5. Lost in Translation: The challenges of Seamless Integration in Nursing Practice

One of the main objectives of standardization is seamless integration, continuity of care and reuse of data across knowledge-intensive care settings. As demonstrated in previous papers, standardization and integration is not just a technical issue, but also a negotiation process in a socio-technical network. In this paper, I moved one step further and explored the dependency between multiple artifacts used in the care process and mechanisms used to navigate the multiplicity of information used across contexts.

This paper builds on the same empirical data and theoretical framework such as paper 4. In addition, I have highlighted the role of redundant information and build on studies from the CSCW field and the mutual interrelations between various artifacts used in practice. Researchers in this community have distinguished between different kinds redundancy and its cognitive and coordinative role in health care (F Cabitza, Sarini, Simone, & Telaro, 2005; F. Cabitza & Simone, 2008; G Ellingsen & Monteiro, 2003). More specifically, I focused on the coherence and intersection between artefacts commonly used in nursing, i.e., the care plan, medical sheet and medical chart.

A pragmatic approach is used to analyse the standardization process and builds on the discussion in paper 4. Furthermore, a distinction is made between positive (i.e., useful) and negative (i.e., cumbersome) redundancy, in order to illustrate some of the “cost” and “efforts” to maintain seamless integration within and across domain-specific boundaries. Supplementary and correlated information is emphasized in order to illuminate their importance in translating and transforming information (pragmatic redundancy), as well as to support coordination across distributed health care providers (coordinative redundancy). Finally, I highlight the importance of taking into account the mutual relationship and the degree of coherence between the various artefacts and activities in nursing, not only the care plan per se. Particularly considering ongoing design and implementation of computerized physician order entry (CPOE) and electronic medical charts. Insight into these interrelations, as well as the role of coordinative and pragmatic redundancy, can inform the design process to enhance process-based EPR systems.

5. 6 Paper 6. Electronic Medication Management – A socio-technical change process in clinical practice

As shown in the previous papers, the focus has moved from the use of care plan as a standalone artefact towards the diversity of nursing and artifacts used in the coordination of the work. Standardization has been the main focus, but from a network perspective, where the coherence between activities and representation of the care process has been stressed. My interest in developing and maintaining coherence and coordination across intersecting social world has led me to the subject of this paper that is management of a particular work process; medication management.

The empirical material draws on a case study of the implementation and use of an electronic medication management system at a university hospital in Norway. The hospital moved into new facilities in 2008, and a priority in the planning and construction of the new “digital hospital” was to use leading-edge technology to improve patient care and hospital efficiency, including an automated medication management system. Implementation of this highly standardized electronic system was quite ambiguous and revealed a gap between pre-defined plans and challenges in daily practice. Therefore, the system was withdrawn after a short period of use and changes were made, including a redesign and development of a new electronic chart. I have traced this process and questioned what kind of mechanisms enabled this change process (transformation) and how the interplay (interrelation) among technical, social, and material artifacts involved reconfiguration of the system.

Conceptually, I have drawn on studies in the field of CSCW and highlighted coordinative artefacts, ordering systems and the coordinative capabilities of procedural standards (C. Bossen & Markussen, 2010; K. Schmidt & Wagner, 2004; S. Timmermans & Berg, 2003). Medication management is a particularly interesting process because of the complexity of the medication process; it involves core activities in clinical practice, collaboration between different professions, is distributed across time and space, and is an interplay between multiple task and supportive artifacts. As in previous papers, I have characterized medication management as part of an infrastructure arrangement and highlighted the socio-material affordance and constraints as well as the relational aspects of the socio-technical network (Leonardi & Barley, 2008; WJ Orlikowski, 2007; S. Star & Ruhleder, 1996). Finally, I have considered the

transformative power of infrastructure arrangements and the emergent, unanticipated changes that evolve over time (W Orlikowski & Hoffman, 1997; S. Timmermans & Berg, 2003).

In the analysis section I discuss the adaptations of the new technologies and how changes and workarounds evolved to maintain alignment of the new network. I characterize this dynamic interaction as an ongoing cycle of design, use and modification, with special focus on three main issues. First, I discussed the power of the installed base, i.e. existing portfolio of information systems and practices. Furthermore, I argue that standardization involved technical applications, standardized procedures and local practices. New standardized technologies required new standardized procedures, which had to be adapted to local procedures. The complexity of this infrastructure cannot be changed instantly, but co-evolves slowly over time. As illustrated in the case, misalignment of the new infrastructure caused a breakdown, which in turn resulted in delays and a redesign of the whole system. Second, I discussed the unanticipated and emerging needs that occurred during the redesign process. In particular, I emphasized the interrelation between the medication process and clinical information and how emerging needs and opportunities led to development of a new application. Finally, I discussed the socio-material reconfiguration that emerged in the interplay between new technologies and local practices. Moreover, I have highlighted material affordance and constraints and how workarounds evolved to address socio-material constraints.

6 Implications

My contribution in this thesis is increased theoretical and empirical insight into the content, context and process of standardization and has both theoretical and practical implications.

6.1 Theoretical implications

When I return to the beginning of my research journey, I started with a curiosity of what standards *do* in practice, coherence between standards and practices, and the mechanisms that make standards “do-able”. Accordingly, my intention was not to argue for or against the use of standards. As previously mentioned, the use of standards has been highlighted as a key measure in order to achieve improved quality and efficiency of health care in numerous visions and strategies. However, the quality and efficiency of care processes are difficult to measure and goes beyond the scope of this study. Rather I look at standardization from “both sides”: “the politics of standards does not lie in the debate whether standards bring quality of care or dehumanization, professional autonomy or deprofessionalization. Rather the politics of standards lies in elucidating the specificities of the socio-material networks that emerges” (S. Timmermans & Berg, 2003, p. 200).

6.1.1 The dynamics of the coordinating infrastructure

The main focus when I started this research was on development, management and adoption of nursing terminologies. However, I realized that there was a mutual dependency between terminologies and the use of care plans in the EPR and that these often are intertwined. My initial considerations of a EPR as a computerized archive system towards a process oriented working record has moved my attention from a stand-alone technical artefact to a socio-technical system, i.e. information infrastructure. Accordingly, all of the papers included in this thesis are about, more or less, how information infrastructures are maintained and modified, i.e. the dynamics of the socio-technical network.

The notion of information infrastructures has in recent years emerged as a research field in the health care environment from an interdisciplinary community such as medical informatics, CSCW and Information System. As mentioned earlier in section 2, the notion of information infrastructures is particular fruitful for conceptualizing EPR in general and nursing documentation specifically. It changed the perspective from organizations to network and from systems to infrastructures, providing an analytical capability to explore the interaction between technology and organization (work practice) from a local / global perspective. A key characteristic of infrastructures is that the different elements are integrated through standardized interfaces (O Hanseth, 2001). Accordingly, numerous studies in the health care domain have focused on the development and adoption of standards. A large part of these studies have mainly focused on organizational and political issues on a national or international level (See e.g., Bowker & Star, 2000; Hanseth et al., 2006; S. Timmermans & Berg, 2003). Taking into consideration the slow evolving nature of information infrastructures that is expressed by the notion of embeddedness, installed base and how it is linked to conventions of practice, makes work practice studies highly suitable

for exploring the challenges of changing and maintaining information infrastructures. Although it has gradually been increasing focus on workplace studies from research communities such as medical informatics (Aarts, Ash, & Berg, 2007) and information systems (Vikkelsø, 2005), scholars from the CSCW field has contributed most to our understanding of the interconnection between work practice and technologies (Fitzpatrick & Ellingsen, 2012; Leonardi & Barley, 2008). Yet, workplace studies typically focus on single settings (Randell, Wilson, & Woodward, 2011) or groupware application (Grudin, 1994), and less attention on standardization across organizational and domain-specific boundaries. Moreover, only a few studies have focused on the standardization of nursing from a socio-technical perspective (G. Ellingsen et al., 2007) and the interplay between standards and practice as evolving over time. The findings from my study of the socio-technical dynamics that evolve around standardization in nursing is based on the aforementioned studies and contribute to a broader understanding of standardization across domain specific boundaries and transformation that evolves over time. In this section I will further elaborate on the following aspects of the standardization process; i) the socio-material reconfiguration, ii) the pragmatic aspect of interdependency between work practice and technology; iii) the co-constructive perspective of standardization.

6. 1. 2 Socio-material reconfiguration: Expanded understanding of collaborative infrastructures

One of the key issue in my study have been changing or growing of information infrastructures, i.e. standardization as a process of transformation. By introducing the concept of sociomateriality, this thesis seeks to contribute to the theoretical discussion on the interrelation between social and material agency. The notions of socio-technical and socio- materials are often used interchangeably, which is also the case in the various papers in this thesis. Leonardi (2012) distinguish between socio-technical system and socio-material practices and argue that the term materiality simply refers to the properties of a technology that are used in various ways to support various task in the technical subsystem (ibid. p.41). Moreover, a socio-technical system refers to the entire organization of work as opposed to socio-material practices that refers to a group's localized experiences around a particular or various technologies. From my point of view, this is an analytical distinction that provides insight into the dynamics of the socio-technical network. In accordance with the actor network theory (ANT), the socio-material perspective emphasizes the role of the technology that has been called for in the Information System (IS) field (Hanseth et al., 2004; W.J. Orlikowski & Iacono, 2001).

Various studies have either explained the challenges of standardization based on a purely technical perspective (N. Hardiker, 2011; Kalra, 2006; Lenz et al., 2007), or the social processes related to the adoption and use of standards (G. Ellingsen & Monteiro, 2006; G. Ellingsen et al., 2007; S Timmermans & Berg, 1997). These studies do not address the role of the social or the role of technology in a proper way. By applying ANT and a sociomaterial perspective, neither the role of technology or the social aspect is ignored. Instead, according to Orlikowski (2007), "the social and material are considered to be inextricable related – there is no social that is not also material, and no material that is not also social (ibid.p. 1437). By applying a sosio - material perspective on collaborative infrastructures, provides a language to talk about affordance and constraints, or enabling and constraining factors, without favouring

either the technology per se or the social aspect. Based on my theoretical framework, agency (affordance and constraints) is a capacity realized through the associations of social and material actors, and thus relational, emergent and changing. I have previously argued that the implementation and adoption of standards is a transformation, i.e., an ongoing process of change. Making technologies (standardization) is a practice of configuring and re-configuring new alignment between the social and material that are constituted in situated practice (L. A. Suchman, 2007).

Several of the papers in this thesis demonstrate how the implementation and adoption of standards in nursing configured and reconfigured practices in various contexts. In the first paper, I unfolded the socio-material practices that constituted the handover routine in nursing. Although the focus of this paper was on sharing information by using standardized terminologies and electronic care plans, it also illustrates the coordinating infrastructure that constituted the handover practice. Accordingly, the analytical focus was on the complexity of different social and material sources of information that constituted the handover process, not only on standards per se or the organization of the handover routine. First and foremost, the study illustrated the socio-material negotiations between formal and informal information in everyday practice. Moreover, the study revealed a cascading pattern of changes that emerged after adoption of the new technology. Some of these changes were planned, while other changes were improvised and enacted by nurses using the new electronic care plan over time. To move the theoretical analysis a step further, I characterize these changes as socio-material affordance and constraints. The notion of “affordance” in this context is not simply a pre-fixed characteristics of the new electronic care plan, but the material capabilities that allow people to do things that they did not do before, and thus transformed work practices (Leonardi & Barley, 2008), i.e., the handover process. Increased accessibility and accountability of the information in the electronic care plan facilitated the new handover practice and enabled a new cooperative space (i.e. the morning meeting, the care plan projected on the wall screen). Similar, by highlighting the various social and material actors in the local infrastructure illustrate the interrelation between knowledge, practices, formal and informal information to facilitate information sharing in everyday practice. This dynamic stresses not only the affordance of the new socio-material practice, but also the limitations of the new electronic care plan. The sociomaterial agencies of paper-based routines revealed constraints of the electronic system and the workaround used to link different layers of the infrastructure together (Pollock, 2005).

Another example of socio-material reconfiguration is demonstrated in Article 6. In this study, I move from standardized terminologies and electronic care plans toward interdisciplinary computerized systems, i.e., electronic medication management systems (EMMS). Although this paper focused on a different kind of standard, the analytical attention was still on coordinating infrastructures in nursing care. A key issue in this study was the socio-material dynamics of the new practice of medication management and I characterized this process as an ongoing cycle of design, use, improvisation, innovation and reconfiguration. Most of the study of sociomateriality derives from research fields such as organizational studies (Leonardi, 2012; Leonardi & Barley, 2008; WJ Orlikowski, 2007) and Science and technology Studies in general (B Latour, 1987; Law, 2008; L. A. Suchman, 2007). However, there is less focus on these issues from workplace studies in health care. Thus, this study expands the understanding for changing

collaborative infrastructures by emphasizing the sociomaterial affordance and constraints as well as the capability for innovation and improvisation emerging from local configuration and reconfiguration in daily use of new technologies.

6. 1. 3 The pragmatic aspect of interdependency between work practice and technology

Based on a sociomaterial approach to standardization as derived above, there is no independently existing entities with inherent characteristics but that human and artifacts relationally entail or enact each other in practice (WJ Orlikowski, 2007, p. 1438). The relational aspect of information infrastructures has more or less been a recurring theme in the various articles in this thesis, although with different analytical focus. Although I have used different expressions to describe the relational mechanisms in the socio-technical network such as interrelation, interdependence, interaction, and so on, my ontological approach has been grounded in a socio-material perspective, i.e., the constitutive entanglement of social and material in everyday organizational life (ibid.p. 1438). Yet, for analytical purposes, I find it appropriate to emphasize interdependency between technology and work practices in order to expand the understanding of relational mechanisms that are essential for the coordination, integration and interoperability.

The notion of interdependency has attracted attention from various research fields such as computer supported cooperative work, medical informatics and from the field Information system generally. Scholars from the CSCW society in particular has highlighted the notion of interdependency as a key characteristic for the coordination and articulation of work tasks, that is, about how actors can work together harmoniously (Malone & Crowston, 1990). As elaborated in section 2, coordination is defined as the act of managing interdependency between activities performed to accomplish work (ibid.). Yet while many studies have focused on the interdependency between work tasks, there has been less consideration of interdependency among technologies. Bailey, Leonardi and Chong (2010) distinguish between work interdependency and technology interdependency and define the latter as “technologies’ interaction with and dependence on one another in the course of carrying out work”(ibid. p. 714). In their study, they identified various technological gaps and found that the decision to tightly or loosely couple coordination and technology interdependency was influenced by a mix of work characteristics, occupational structures, and industry constraints (ibid. p. 715). Accordingly, their study suggests that high levels of task interdependency may call for high coordination, but high levels of technology interdependency may not necessarily do so, and illustrated how managers designed policies around technology interdependency in a manner consistent with their occupational environment (ibid. p. 715).

Managing “technological gaps” typically focuses on standardizing input and output as the case of standardized terminologies, care plans, and procedures. Thus, standardization is considered as coordinating mechanisms to reduce complexity of articulating cooperative work (K. Schmidt & Simone, 1996), or interconnect the multiple layers of the socio-technical network (Ciborra, 2001) and stresses the interrelated aspect of information infrastructures (S. Star & Ruhleder, 1996). In nursing, coordination and articulation is a key part of work practices where the outcome of one activity is required by the next

activity. Adoption and use of technology implies thus more or less interdependence between technologies and/or artifacts used in nursing. Seamless integration is the overall objective to ensure continuity of care across time and place and is promoted in national and international vision to enhance quality and efficiency of health care. However, as demonstrated in this study, there are different kinds of technological gaps and various mechanisms to interconnect artifacts and work practices in nursing.

By unfolding the complexity and diversity of artifacts and practices and thus opening “the black box” of standardization in nursing, I have analyzed correlation between standards and practices within and across domain-specific boundaries. I have used a pragmatic approach to interdependency, that is the increased effort required to share information and knowledge when a pragmatic boundary occurs (Carlile, 2004). Mechanisms such as sorting, bridging, transforming and bypassing are used for expanding the notion of boundary object, redundancy and workaround.

By considering the care process as part of the socio-technical network, provides an analytical lens to zoom in on local practices as well as scaling up to incorporate information sharing across domain-specific and/or organizational boundaries. As shown in this study, the use of standardized terminologies and care plans facilitated information sharing and thus increased the capabilities for communication and coordination of knowledge within and across domain-specific boundaries. In particular, paper 4 demonstrates how local knowledge was made available in the standard care plans and made these plans resources for situated actions in everyday work. The correlation between coordination and technology were tightly connected in this case and illustrates tightly couple coordination and technology interdependency (Bailey et al., 2010) and how standards emerged as a boundary object within the communities of practice (Bowker & Star, 2000). Yet when these standards were used across different contexts, the interdependency between coordination and technology became more loosely coupled. Moreover, this demonstrates the multiplicity of the nursing and the efforts and trade-offs by translating information and knowledge across contexts. The gap between coordination and technology across domains can be characterized as a pragmatic gap and this notion has been taken further in paper 5 where the focus moved from the nursing-specific information sharing to encompass the range of material artefacts used during the care process. The paper demonstrates how mechanisms like sorting, navigating and bridging were used to manage technological gaps in the care process. I further argued that redundancy and workaround might play a coordinating role as well as valuable purposes of communication, translation and transformation of knowledge across domain-specific boundaries.

6. 1. 4 Expanded understanding of the co-constructive perspective on standardization

A key part of this thesis has been on “standardization in action” in which adoption and use of terminologies has been a prominent issue in several of the papers. After focusing on what standards *do* in practice, I move back to how standards emerge and evolve over time. My ontological and epistemological foundation is, as previously stated, based on a socio-technical approach and this in-depth study enriches our understanding of the co-constructive perspective on standardization. Thus, my study is inspired by the work of Timmermans and Berg (2003) and Bowker and Star (2000) who have emphasized the political, historical and transformative construction of standards in health care. Furthermore, this thesis is

based upon similar studies of standardization in general (Rolland & Monteiro, 2002), as well as adoption and use of standards in health care especially (G. Ellingsen et al., 2007; Hanseth & Monteiro, 1997). These studies have either emphasized standardization as a socially constructed negotiation process in which standardization and work practice mutually shape and constitute each other, or socio-technical negotiations involved in establishing large-scale information infrastructures. In order to contribute to an expanded understanding of the co-constructive perspective, I have stressed the socio-material aspect of standardization and argue that standards are constitutively entangled in daily nursing practice.

In the theory section, I pointed out some of the challenges of standardization in nursing such as the tension between formal and informal information, semantic interoperability as well as the tension between interoperability and local usability (Berg, 1996; Häyrynen, K. et al., 2008; Ure et al., 2009). Several of the papers in this thesis have pointed out the difficulties of achieving consensus on a universal language in nursing, and a shared understanding of standardized terminologies. Design and development of terminologies is founded in professional and political ambitions and is basically socially constructed. However, the representation of standardized terminologies is also enabled by systems, forms and documents, that is, they are socio-material. Thus, I have suggested that interoperability is not just a technological issue, but also a socio-material challenge. For example, it is difficult to imagine the widespread use of nursing terminologies in Norway without the use of technological solutions such as EPRs. Similar, international and national efforts in nursing communities are of paramount importance and are founded in professional conventions and guidelines for nursing practice. Although the use of new technology such as electronic health records enabling the representation of a common language, I have demonstrated that interoperability entails more than a shared understanding (semantics) of pre-defined terms. I have suggested that it also implies *pragmatically interoperability*. Representation and re-representation of clinical information is always entangled with the context of its production and, as I have demonstrated, it requires additional work, effort and tradeoffs to translate and transform information across domain-specific boundaries.

In my study, I have identified several so-called pragmatic gaps and/or contextual contingencies. Based on the dynamics of the socio-technical network, there are several mechanisms that have the capability to interconnect heterogeneous elements of the socio-material practices (standards, boundary objects, gateways, workarounds). In particular, I have emphasized the co-construction of nursing terminologies as a mechanism for bridging the pragmatic gap between formal standards, local practice and local innovation. I argue that the co-construction of terminologies is an ongoing transformation constituted in the dynamic interrelation between new technology, formal terminologies, situated practice and local knowledge. In particular, I have emphasized the temporal aspect as well as localized improvisations and innovation.

Formal terminologies such as NANDA and NIC are founded within the international nursing community and is regularly revised and updated based on feedback from the international user community. However, these review processes are dependent on organizational negotiations, for example, between national and local management bodies, and may be long lasting. Unlike this rather static and bureaucratic process, nursing, like other modern organizations are characterized by rapid changes. In the theory section, I have

described the evolving, contextual knowledge that characterizes nursing practice and the entanglement between practice and knowledge (WJ Orlikowski, 2007). The analysis of the empirical data illustrating how user-generated information is added to formal classifications to maintain local knowledge. On the basis that classification is an integral part of the professional vision (Goodwin, 1994), I argue that this “tinkering” with classifications is more than local adaptation. Rather, I suggest that the co-constructive perspective promotes local innovation and adds a new dimension to the design and development of nursing terminologies

6.2 Practical implications

The findings reported in the previous sections as well as the theoretical implications on standardization-in-use ought to have implications for various user groups, such as vendors, managers and end-users. In particular, I will highlight some practical suggestions on user involvement as well as perspectives for the design and adoption of standards.

6.2.1 The long now of standardization; the tricky issue of user involvement

Myths of user involvement have been ongoing for ages and have almost become a cliché in the system development literature. User involvement is often defined by pre-planned processes (requirement, design, implementation and use), or as single-site implementation studies (Johannessen & Ellingsen, 2008). Design and development of standards in nursing is often a “chicken and egg” problem. On the one hand, standards can only be assessed in the context in which it will be used. On the other hand, it is challenging to convince vendors to adopt or implement a new system that may or may not become a standard sometime in the future (Knaup et al., 2007). However, more recent research suggests new methods of user involvement that moves beyond standalone systems and is based on more dynamic approach to the design and development of large-scale information infrastructures (Bjørn et al., 2009; Fitzpatrick & Ellingsen, 2012; Johannessen & Ellingsen, 2008; E. Monteiro, Pollock, Hanseth, & Williams, 2012). Based on the evolving nature of information infrastructures, I suggest that developers and vendors consider workarounds and improvisations as input to the design process of standards in nursing in particular, as well as standardization in general.

Workarounds are typically ad-hoc strategies deployed by users to overcome difficulties or constraints imposed by a technology (Gasser, 1986; Pollock, 2005). Traditionally, workarounds are regarded as a way to compensate for the shortcomings or constraints of the technology. However, several studies have pointed out how workarounds enables integration and alignment of information infrastructures. Accordingly, I argue that workarounds are more than just a measure of design failure, but may also be regarded as mechanisms for adaptation of technology to the “installed base” or “network in place” (Pollock, 2005). Taking into account the slow evolving nature of information infrastructures, I consider that these mechanisms of adaptation particularly useful for the design of technology because workarounds have the ability to bridge the gap between users and producers of technology.

What I have stressed in my study is that “growing” and design of infrastructures is not a static activity confined in time and place, but rather distributed activities that involves a large number of actors and artefacts (E. Monteiro et al., 2012). In particular, paper 6 demonstrates how improvisation and articulation was involved in the design and re-design of the new technology. Some of these changes were not part of the strategic plan or procurement process, but enacted through socio-material practices in line with emerging needs and opportunities. I consider these socio-material affordance and constraints as valuable input to inform the design process and thus contribute to user involvement. Accordingly, I recommend a prospective approach to the design process that takes into account both the “network in place” (i.e. the installed base) as well as emerging development in work and technology.

6. 2. 2 Co-construction - creating a space of user involvement

A prospective approach to standardization is also demonstrated by the co-construction of nursing terminologies. As previously mentioned, the co-constructive perspective promotes local innovation and adds a new dimension to the design and development of nursing terminologies. As highlighted in numerous studies, including this study, the balancing between standardization and flexibility is a challenge to the increasing use of computerized communication in general as well as in health care. Rather than consider the co-construction of standards as cumbersome workaround or just local adaptation, I

argue to take this perspective a step further as a capability for incorporating local knowledge to formal standards. Paper 3, in particular, demonstrates how global and local classifications used in combination both constitute each other and support professional development. Moreover, I recommend looking at new technologies such as social media and Web 2.0 to develop methods that recognize local knowledge and agency rather than ways to overcome or suppress it (Ure et al., 2009). As an emerging approach to standardization, i.e. the use of core terminologies in combination with user-generated content, emphasizing local agency and social capital in system design (ibid.). This view of standardization changes the user's role from passive recipients of new technologies to enhance user involvement in generating, managing and sustaining the content of nursing documentation in computerized systems.

As mentioned in the theoretical section, a “one world” view of standardized terminologies in nursing is increasingly challenged. Much work has been done to address these challenges within the international nursing community, such as development of a reference terminology model for nursing as well as a structural framework for archetype development (E. Hovenga et al., 2005). Although my study supports this development, I emphasize more capacity for user involvement that maintains the dynamic, evolving, co-constructive nature of socio-material practices. A co-constructive perspective to the standardization of nursing recognizes efforts such as translation and transformation performed by end-users in local practices and expands the understanding of user involvement in the design process. Thus I recommend various stakeholders to look for new ways to integrate the co-construction perspective in design and development of standards and repeats the statement of Bruno Latour; “The fate of facts and machines is in the hand of later users”.

7 Conclusion

This thesis has presented an interpretive case study of the adoption and use of standards in nursing practice. As I have pointed out, standardization is a powerful movement and has different intentions and interpretations depending on the stakeholders' "worldview". "We live in a world of standards but not in a standard world" (S. Timmermans & Epstein, 2010). I have, however, emphasized the importance of standards and elucidated how standardization is embedded in visions and strategies to facilitate communication and coordination through the use of information technology in health care. Thus, I consider standards as embedded in nursing practice in which knowledge is constituted through a variety of social and political processes. Consequently, I do not perceive standards just as static objects but as a dynamic interplay of socio-material practices. Although there are many kinds of standards in health care, I have in this thesis emphasized the use of terminology and procedural standards as these types of standards represent the highest level of standardization as an integral part of the EPR systems. Moreover, I have focused on the content, context and process of standardization in nursing and the mechanisms that makes standards "do-able".

Firstly, this thesis provides insight into the transformative capabilities of standardization. By drawing upon the notion of information infrastructure, several of the papers illustrate the effort and trade-offs that emerge in the interplay between formal standards and situated practice. I have also pointed out the socio-material affordance and constraints based on standardization and thus provided insight into how information infrastructure grows and evolves, i.e. change of socio-technical networks. Second, I described standardization a part of a coordinating infrastructure and highlighted the coordinating mechanisms to standards. By characterizing the interdependency that characterizes nursing practice, I have analysed correlation between standards and practices within and across domain-specific boundaries. The interrelation aspects of information infrastructures illustrated how standards emerged as boundary objects within and across care settings. However, it also demonstrated how redundancy and workarounds evolved as mechanisms to bridging of the technological gaps in practice. Thirdly, this thesis adds to the co-constructive perspective of standardization. In particular, I focused on the co-construction of standardized terminologies and stressed the socio-material aspects of standardization and argued that standards are constitutively entangled in daily nursing practice. Moreover, I have emphasized the temporal aspect as well as localized improvisations and innovation and suggest that the co-constructive perspective adds a new dimension to design and development of nursing terminologies.

Finally, I would add a few considerations and recommendations for further work. When I started this PhD journey, my motivation was to make a difference and to have an impact to the further development of standards in nursing. However, my ambitions have been adjusted along as I have realized the complexity of information systems in healthcare. Yet, I hope that my contribution can have an impact on others, both within the nursing community and to the theoretical understanding of standardization in general. Although this thesis is both lengthy and detailed, it has several limitations. A PhD project has a specific time frame, which means that many decisions have to be taken for research field and focus area. Standardization in nursing includes many aspects and perspectives, and by selecting a focus area means

that others must be excluded. For example, I could have focused on the design and development of standards. At this time, the vendor was planning further development of the nursing module. Because of postponement in the development process, I decided to focus on the use of standards due to uncertainty of further design. Taking into account the time frame, I had to focus on standards and technologies that were currently in use. Meanwhile, there has been a lot of work in the nursing community as well as attention from vendors on the development of archetypes and process oriented EPR systems. However, much of this work is still at the planning stage and the findings of my study may inform further development of standards and decision support in the EPR. In particular, I emphasize the interrelation aspect of information infrastructures. I suggest that ongoing efforts with computerization of medication management and medical chart not only must be regarded as stand-alone artifacts, but considered in correlation of domain-specific documentation and context of use.

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ARTICLE 1

ARTICLE 2

ARTICLE 3

ARTICLE 4

ARTICLE 5

ARTICLE 6

DECLARATIONS



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

Declaration describing the independent research contribution of the candidate

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

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

Article no: 1

Authors: Torbjørn Meum and Gunnar Ellingsen

Title: "Sound of silence" – Changing from oral to a computer-mediated handover

The independent contribution of the candidate:

In this article the candidate carried out data collection and did most of the writing. Formulation of problem, theory, methods, analysis and interpretation were done in collaboration with the second author. Both authors read and approved the final version of the paper

..... Signature of the candidate Signature of co-author 1
Name (bold letters): Torbjørn MEUM	GUNNAR ELLINGSEN Name (bold letters):
Any Comments: Signature of co-author 2
	Name (bold letters):
 Signature of co-author 3
	Name (bold letters):
 Signature of co-author 4
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For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 2

Authors: Torbjørg Meum, Gro Wangensteen, Harald Igesund, Gunnar Ellingsen and Eric Monteiro

Title: Standardization – the iron cage of nurses' work?

The independent contribution of the candidate:

In this article, the candidate participated in the data collection and did most of the writing. The second and third author participated in the design of the study as well as collecting and analysis of data. Formulation of problem, theory, analysis and interpretation were done in collaboration with the two last authors. All authors read and approved the final version of the paper.

<p><i>Torbjorg Meum</i> Signature of the candidate</p> <p>Name (bold letters): TORBJØRG MEUM</p> <p>Any Comments:</p>	<p><i>Gro Wangensteen</i> Signature of co-author 1</p> <p>Name (bold letters): GRO WANGENSTEEN</p> <p><i>Harald Igesund</i> Signature of co-author 2</p> <p>Name (bold letters): HARALD IGESUND</p> <p><i>Gunnar Ellingsen</i> Signature of co-author 3</p> <p>Name (bold letters): GUNNAR ELLINGSEN</p> <p><i>Eric Monteiro</i> Signature of co-author 4</p> <p>Name (bold letters): ERIC MONTEIRO</p> <p>..... Signature of co-author 5</p> <p>Name (bold letters):</p>
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For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 3

Authors: Torbjørn Meum, Eric Monteiro and Gunnar Ellingsen

Title: The Pendulum of Standardization

The independent contribution of the candidate:

In this article the candidate carried out data collection and did most of the writing. Formulation of problem, theory, methods, analysis and interpretation were done in collaboration with the second and third author. All authors read and approved the final version of the paper

..... Signature of the candidate Signature of co-author 1
Name (bold letters):	Name (bold letters):
Any Comments: Signature of co-author 2
	Name (bold letters):
 Signature of co-author 3
	Name (bold letters):
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For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 4

Authors: Torbjørn Meum and Gunnar Ellingsen

Title: Standardization in Nursing – Cross-contextual Information sharing

The independent contribution of the candidate:

In this article the candidate carried out data collection and did most of the writing. Formulation of problem, theory, methods, analysis and interpretation were done in collaboration with the second author. Both authors read and approved the final version of the paper

<p>..... Signature of the candidate</p> <p>Name (bold letters): Torbjørn MEUM</p> <p>Any Comments:</p>	<p>..... Signature of co-author 1</p> <p>Name (bold letters): GUNNAR ELLINGSEN</p> <hr/> <p>..... Signature of co-author 2</p> <p>Name (bold letters):</p> <hr/> <p>..... Signature of co-author 3</p> <p>Name (bold letters):</p> <hr/> <p>..... Signature of co-author 4</p> <p>Name (bold letters):</p>
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For each article the declaration should be filled in and signed by the candidate, then circulated to the other co-authors for signatures.

Article no: 5

Authors: Torbjørg Meum

Title: Lost in Translation – The challenges of seamless integration in nursing documentation

The independent contribution of the candidate:

In this article, the candidate performed the entire process from problem formulation, data collection, analysis and interpretation of data. The candidate also carried out the writing process.

<p>..... <i>Torbjørg Meum</i>..... Signature of the candidate</p>	<p>..... Signature of co-author 1</p>
<p>Name (bold letters): <i>TORBJØRG MEUM</i></p>	<p>Name (bold letters):</p>
<p>Any Comments:</p>	<p>..... Signature of co-author 2</p>
	<p>Name (bold letters):</p>
	<p>..... Signature of co-author 3</p>
	<p>Name (bold letters):</p>
	<p>..... Signature of co-author 4</p>
	<p>Name (bold letters):</p>



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Declaration describing the independent research contribution of the candidate

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

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

Article no: 6

Authors: Torbjørn Meum

Title: Electronic medication management: a socio-technical change process in clinical practice.

The independent contribution of the candidate:

In this article, the candidate performed the entire process from problem formulation, data collection, analysis and interpretation of data. The candidate also carried out the writing process.

..... Signature of the candidate Signature of co-author 1
Name (bold letters):	Name (bold letters):
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