Participation and Evaluation in the Design of Healthcare Work Systems

A participatory design approach to organisational implementation

Maren Sander Granlien

APRIL 2010 ROSKILDE UNIVERSITY COMPUTER SCIENCE RESEARCH REPORT #129

Maren Sander Granlien

Computer Science
Department of Communication,
Business and Information Technologies
Roskilde University
P. O. Box 260
DK–4000 Roskilde
Denmark

Telephone: +45 4674 3839
Telefax: +45 4674 3072
Internet: http://www.ruc.dk/dat_en/
E-mail: datalogi@ruc.dk

ISSN 0109–9779

Research reports are available electronically from:

http://www.ruc.dk/dat_en/research/reports/

Participation and Evaluation in the Design of Healthcare Work Systems

– a participatory design approach to organisational implementation

Maren Sander Granlien

PhD thesis

Roskilde University, 2010
Department of Communication, Business and Information Technologies

Acknowledgements

> It seems, in fact, that you do not truly begin to think until you attempt to lay out your ideas and information … you are never truly inside a topic – or on top of it – until you face the hard task of explaining it to someone else.
>
> Lofland and Lofland

Being an engaged scholar, I truly acknowledge that research is not a solitary affair. Thus, I would like to take the opportunity to thank a number of people – both the people who have been part of or supported my PhD work system, and the people who have lent me their ears in my attempt to lay out my ideas and explain them.

The work presented here was conducted under the PhD programme Design and Management of Information Technology, which is associated with the Department of Communication, Business, and Information Technologies at Roskilde University. The PhD scholarship making this work possible has been funded in collaboration by Region Zealand and Roskilde University. I would like to thank the people in former Roskilde County who have made this cooperation possible, especially Ivan Lund Pedersen and Rikke Kragh Iversen for initiating this cooperation. I would also like to thank the people in the region with whom I have worked, especially the true expert in HIS implementation, Jette Gudmundsen, who introduced me to the practical reality of HIS implementation and who taught me the limitation of theory. Also, thank you to all of the hospital wards, clinicians, general practitioners, patients, and others who, one way or another, have participated in the empirical studies.

I appreciate all of my colleagues in Computer Science at Roskilde University, who have made my time there enjoyable by creating a good work and research environment. To the User-Driven IT innovation research group, which I have been part of, thank you for your interest in and contribution to my research career. I would also like to thank my co-authors, Keld Bødker, Jesper Simonsen, Jan Pris-Heje, Richard Baskerville, and Morten Hertzum, for collaboration and guidance in the art of writing scholarly papers, thereby improving my skills as a researcher. I owe a special thanks to Morten Hertzum who has also been my supervisor. Thank you for your patience and lenience in guiding me through this PhD and for not only believing in but also being supportive of me and my projects.

I would like to acknowledge former as well as current members of the HIT research group, who have constituted an invaluable audience in my attempt to lay out my ideas. These are: Erling Havn, Jørgen Bansler, Finn Kensing, Morten Hertzum, Jesper Simonsen, Peter Carstensen, Keld Bødker, Kjeld Schmidt, Pernille Bjorn, Brit Ross Winthereik, Magnus Nilsson, Peter Danholt, Nis Johannesen, Karen Marie Lyng, Hrönn Kold Sigurðardóttir, Martin Scheil Corneliussen and Anders Barlach. Thank you for listening and for giving constructive comments and advice.

Also I am truly grateful to the DOIT group at the ITU for taking me in as one of their own. I wish to extend an especially warm thank to Pernille Bjorn, for taking time to discuss my work with me.

I have enjoyed my way-too-short stay at the Centre for Health Informatics at the University of New South Wales, and I would like to take the opportunity to thank them for their courtesy and kindness, especially to Farah Magrabi and Enrico Coiera.

Also, a warm thank to the Health Informatics Research & Evaluation Unit, University of Sydney, for lending me their ears.

Thanks to Anders Barlach for an Effects-Driven road trip that lead us to many fine and fruitful discussions and nice beaches.
Thanks also to Britt Gadegaard and Steven Alter for commenting on vital parts of my work.

I wish to express my gratitude to my co- researchers in the Shared Care study, Sine Marie Øelund and Louise Baunsgaard Koch, for learning the basic research skills with me and for taking the first steps towards becoming a researcher with me – 7 years…then you know something.

Thanks to Stine Ejsing-Duun, my virtual colleague and friend, for amusement and lamenting life as a PhD student.

I truly recognize the value of the interest and support afforded by my dear friends and family – the ones bringing me cake at the office, the ones taking care of my family, the ones providing me with entertainment and experiences, and those of you very familiar with the healthcare sector who shared your experiences and helped me understand this distinct world. Thank you to all of you!

Last, thanks to my son, Aslak, for being an effective distraction from the thesis work; but above all, I wish to thank Margit, for being there with all your love, care, and priceless support.

Maren Sander Granlien
Copenhagen, February 2010

Abstract

The work in this thesis originates from a desire to contribute to improving the use of healthcare information systems to support the work of the clinicians working in the healthcare sector. One way of doing this is to understand and overcome some of the challenges related to designing and implementing healthcare information systems (HIS). Both participation and evaluation are highlighted as key elements for improving the implementation of healthcare information systems. Thus, this thesis investigates h**ow participation in evaluation can be understood and approached in the design of healthcare work systems.**

The research question is investigated both empirically – through three different studies in the Danish healthcare sector – and theoretically – by suggesting a mainly analytically developed approach to design and implementation of HIS. The theoretical background for this thesis is found at the intersection of four theoretical elements: participatory design, evaluation, HIS implementation, and a work system perspective. A synthesis of the theoretical elements and the empirical work results in an approach where the design and implementation of HIS is conceptualised as an ongoing participatory design process of healthcare work systems, a process in which formative evaluation of the changes in the work system is part of design. The participatory design approach has been applied in one of the empirical studies, and it provides a basis for understanding and approaching participation in evaluation as part of an iterative, ongoing design process.

The thesis comprises a summary report and six research papers. The summary report provides an introduction to the empirical research context, the research approach applied, the theoretical field of research, and a synthesis of the theoretical and empirical findings. The empirical findings are presented in the six research papers included in the thesis following the summary report. The papers are concerned with challenges for implementing HIS to support shared care, including how to involve and represent different groups of participants in design processes, how to manage participatory prototyping of HIS, barriers for using an HIS that supports the medication process, how to design and evaluate interventions aimed at obtaining specified effects, and how to facilitate participation and approach formative evaluation.

The theoretical and empirical synthesis results in five main contributions that concern 1) changing the focus from healthcare information systems to a focus on healthcare work systems, 2) seeing HIS implementation as an ongoing design process of healthcare work systems, 3) supporting participation in evaluation because evaluation is part of design, 4) using effects specification to inform the evaluation and thus also the design process, as well as to facilitate participation in evaluation, and 5) how to facilitate participation in terms of what is required to fulfil the role of a facilitator facilitating participation in evaluation.

Sammendrag

Denne PhD afhandling omhandler organisatorisk implementering af sundheds-it systemer i sundhedssektoren. Implementeringsprojekter hvor komplekse it systemer med mange brugergrupper implementeres som et led i en forandringsproces.

Arbejdet i denne afhandling er drevet ud fra et ønske om at medvirke til at forbedre brugen af it den danske sundheds sektor. Udgangspunktet er, at it skal understøtte brugerne, i de fleste tilfælde klinikerne, i at udføre deres arbejde.

En måde at medvirke til at forbedre brugen af it, er ved at forstå og overkomme nogle af de mange udfordringer, der ligger i at designe og implementere sundheds-it. En af de grundliggende udfordringer består i at opnå det rette match mellem it og det arbejde og den organisation, der skal understøttes. Det kræver, at der ikke kun fokuseres på de tekniske aspekter, men også på organisatoriske og menneskelige aspekter. Brugerdeltagelse og evaluering er blevet fremhævet som nogle af nøgleelementerne til at imødegå nogle af udfordringerne. Deltagelse og evaluering ses derfor som centrale elementer i arbejdet med at forbedre design og implementering af sundheds-it. På den baggrund sigter jeg i denne afhandling efter at undersøge, **hvordan deltagelse i evaluering kan forstås og udføres i relation til design af arbejdssystemer.**

Forskningsspørgsmålet bliver undersøgt både empirisk, via tre forskellige studier i den danske sundhedssektor, og teoretisk ved at udvikle en tilgang til at designe og implementere sundheds-it, der bygger på brugerdeltagelse og evaluering.

Det empiriske grundlag for afhandlingen består af tre forskellige studier.

1. Det første studie er en sammenlignende analyse af implementering af to forskellige systemer til samarbejde mellem praktiserende læger og læger på hospitalerne omkring diabetes. De to systemer var under implementering i to forskellige af de tidligere amter.
2. Det andet studie fulgte et projekt, hvor man udviklede og pilottestede en prototype applikation til monitorering af forskellige patientgrupper. I projektet blev der eksperimenteret med prototyping som metode, brugerdeltagelse og brug af effekter til at styre udvikling i stedet for en kravspecifikation. Mit fokus var primært på udfordringerne ved brugerdeltagelse i effektspecificering og ledelsen af iterative prototyping projekter med høj grad af deltagelse.
3. Tredje studie tager udgangspunkt i et elektronisk medicin system, der har været i brug to til fire 4 år. Studiet er mere aktions præget, og der eksperimenteres med, hvordan man kan inddrage klinikerne i evaluering i forbindelse med design og udførelse af interventioner, der skal skabe forandringer i it understøttet arbejdspraksis. Til brug i studiet har jeg anvendt en tilgang til organisatorisk implementering, der sigter mod at optimere IT understøttede arbejdsprocesser, bl.a. via effektkort og formativ effektevaluering.

Den teoretiske baggrund for afhandlingen skal findes i overlappet mellem fire teoretiske felter eller elementer: implementering af sundheds-it, teori om arbejdssystemer, brugerdrevet design og evaluering. Overlappet mellem de fire elementer skaber et teoretisk grundlag, og et ordforråd til at kunne diskutere deltagelse i evaluering i forbindelse med implementering og design af sundheds-it.

Implementering af sundheds-it anskues ud fra en socio-teknisk tilgang, der indebærer at implementering ses som en kompleks og uforudsigelig proces. Uforudsigeligheden indebærer, at implementering bør være en iterativ proces med sigte på at opnå et passende match mellem sundheds-it systemet og de organisatoriske og menneskelige faktorer. Arbejdssystem perspektivet ligger i forlængelse af det socio-tekniske perspektiv og bidrager med at placere it systemet i forhold til det arbejdssystem, det understøtter. Udgangspunktet er, at effektiviteten af it systemer ikke er interessant i sig selv, men det væsentlige er, hvordan de understøtter det arbejde og de mennesker, der udfører arbejdet i at levere de resultater eller ydelser, som it systemet er tiltænkt til at understøtte. Derfor plæderer arbejdssystem perspektivet for, at man bør fokusere på det it understøttede arbejdssystem og ikke se isoleret på it systemet.

Brugerdrevet design gennemgås ud fra dets hovedprincip om deltagelse. Udfordringer for brugerdrevet design peger i retning af at udvide forståelsen af, at design ikke blot er noget softwaredesignere gør i starten af et udviklingsprojekt, men derimod noget der foregår løbende og udføres af både designere og brugere. Der præsenteres en iterativ brugerdrevet design proces, som består af en design ide/vision, et iterativt design forløb, anvendelse af design og en evaluering af det anvendte design.

Formativ evaluering er en iterative form for evaluering, der kan understøtte en iterativ design proces. Formativ evaluering har til formål at understøtte læring og forbedring i modsætning til summativ evaluering, der fokuserer mere på kontrol. Formativ evaluering har potentiale til at imødekomme nogle af de negative implikationer, der er af (primært summative) evalueringer, der bygger på prædefinerede evalueringskriterier. Af negative implikationer kan nævnes: *indikatorfiksering* hvor der fokuseres udelukkende på evalueringskriteriet på bekostning af større målsætninger. Dette medfører såkaldt *tunnelsyn*, der giver blindhed for afledte effekter, hvilket igen medfører *nærsynethed* og *suboptimering*, hvor man fokuserer på kortsigtede og lokale effekter i stedet for mere langsigtede og bredere målsætninger. Man kan også risikere *ossification*, der betyder, at man satser på nutidens kriterier, som ofte også er fortidens kriterier, og dermed bliver man dårligere til innovation.

En syntese af de teoretiske fund og empiriske erfaringer resulterer i en konceptualisering af design og implementering af sundheds-it som en fortløbende brugerdrevet design proces af sundheds-it understøttede arbejdssystemer. En designproces hvor formativ evaluering af de forandringer, der fremkommer i arbejdssystemet, er en del af designprocessen. Denne brugerdrevne tilgang til design danner grundlag for at forstå og iværksætte deltagelse i evaluering som del af processen med at designe arbejdssystemer. En vekselvirkning mellem teorien og erfaringerne i primært de to første studier har ledt til udviklingen af denne tilgang, som bliver afprøvet i det tredje empiriske studie.

Afhandlingens empiriske resultater er præsenteret i seks artikler. Artiklerne berører forskellige emner med forskellig fokuser, men alle tager de udgangspunkt i studier, hvor det har været intentionen at inddrage centrale aktører i design af sundheds-it, og hvor evaluering har spillet en central rolle.

I. I den første artikel identificeres tre udfordringer for implementering af it til understøttelse af shared care mellem diabetes ambulatorier og almen praksis. Udfordringerne kan for en stor del forklares ud fra et iboende problem med at repræsentere praktiserende læger i design af sundheds-it systemer.

II. Den anden artikel påpeger på baggrund af en analyse af et it understøttet shared care initiativ, udfordringer for brugerdrevet design som felt i at adressere deltagelse og repræsentation af mange forskellige grupper af deltagere i sundheds-it projekter.

III. Den tredje artikel rapporterer fra et prototyping projekt med fokus på brugerdeltagelse. Baseret på en analyse af projektet opstilles, med udgangspunkt i projektledelsestrekanten (tid, ressourcer, omfang), en 3 gang 3 matrix af strategier til at håndtere prototype projekter, der er på gal kurs. Artiklen identificerer desuden en række udfordringer for at administrere deltagelse i evaluering.

IV. Baseret på en spørgeskemaundersøgelse om implementeringen af et elektronisk medicin system, påpeger den fjerde artikel behovet for et øget fokus på organisatoriske implementerings aktiviteter, såsom undervisning, tilpasning af arbejdsgange og tiltag, der kan nedbryde barrierer for bedre anvendelse af systemet. Artiklen dokumenterer, at flere års tilvænning og obligatorisk brug ikke er nok til at sikre konsistent anvendelse. Derfor er der behov for en systematisk tilgang til organisatorisk implementering.

Den femte artikel pointerer nødvendigheden af at kombinere interventionerne med evalueringer af, hvorvidt effekterne rent faktisk opnås i forbindelse med implementering af sundheds-it. Dertil peger artiklen på at for at implementere nye arbejdsgange, er det sandsynligvis nødvendigt med en fortløbende organisatorisk implementerings proces, der inkluderer iterative interventioner og systematisk evaluering.

Den sidste artikel rapporterer ligeledes fra anvendelsen af den brugerdrevne tilgang til implementering. Studiet viser, at arbejdssystem perspektivet sammen med effekt-begrebet er med til at skabe et bredere og mindre teknologi fokuseret omdrejningspunkt, og kan derfor være med til at facilitere deltagelse og forbedre arbejdssystemet.

På baggrund af den teoretiske og empiriske syntese fremdrages fem hovedbidrag som tjener til at uddybe svaret på forskningsspørgsmålet.

Det første bidrag er at erstatte fokus på sundheds-it systemet med et bredere fokus på it understøttede arbejdssystemer. Arbejdssystem perspektivet adresserer og omfatter mange af de bekymringer og problematikker, som er blevet fremlagt i forbindelse med design og implementering af informationssystemer, så som problematikker omkring den rolle som henholdsvis sundheds-it systemet og organisationen spiller i design og implementeringsprojekter. Idet arbejdssystem perspektivet giver et grundlag for at fastlægge og eksplicitere et passende analyseniveau med fokus på, hvordan arbejdssystemet fungerer og bliver understøttet af sundheds-it systemerne.

Arbejdssystem perspektivet danner sammen med et bredere syn på implementering, grundlaget for det andet bidrag, som er konceptualisering af implementering som en løbende iterativ designproces. En udvidet designproces der informeres af formativ evaluering. Den løbende designproces af arbejdssystemet imødekommer behovet for iterativt at skabe overensstemmelse mellem sundheds-it systemet og de organisatoriske aspekter som store dele af den socio-tekniske litteratur påpeger. Det at se implementering som en løbende designproces af arbejdssystemer, har betydning for anvendelsesområdet for brugerdrevet design. Brugerdrevet design udvides til og-

så at beskæftige sig med implementering og evaluering, da deltagelse i evaluering er en del af design og implementering er design.

Bidrag nummer tre vedrører den rolle formativ evaluering spiller som bestanddel i designprocessen. Resultatet af den formative evaluering er med til at korrigere og informere designprocessen. Derved kan formativ evaluering forstås som en integreret del af designprocessen. Så, hvis vi værdsætter deltagelse i design, må deltagelse i evaluering også være en del heraf. Deltagelse i evalueringen har potentiale til at øge engagementet i at opnå de specificerede effekter. Dertil kommer, at deltagelse i evalueringen også adresserer behovet for at inddrage deltageren på et tidspunkt, hvor de mærker forandringerne, og de derfor er motiverede til at engagere sig i design/evalueringsprocessen.

Det fjerde bidrag stammer hovedsagelig fra den tredje empiriske undersøgelse, hvor deltagelse i evalueringen faciliteres af effektspecifikationer understøttet af effektkort. Effektspecifikation er anvendt som en teknik til at inddrage deltagerne i evalueringen som en del af designprocessen. Til at understøtte effektspecifikationen blev der udviklet og afprøvet et effektkort. Udformningen af effektkortet var baseret på tidligere oplevede problemer med at strukturere effektspecificeringsprocessen.

Det sidste bidrag vedrører facilitering af deltagelse i evaluering og design, især den rolle, som facilitatoren spiller. Det at facilitere deltagelse i evalueringen kræver flere forskellige kompetencer. Udover at mestre brugerdeltagelses- og evalueringsteknikker skal facilitatoren også besidde udvidet viden om sundheds-it systemerne, den tekniske infrastruktur og have indgående viden om arbejdspraksis. Disse kompetencer kan være svære at finde indeholdt i én person. Det kan derfor være nødvendigt at dele facilitatorrollen blandt flere personer.

De fem bidrag kan indkoges til en kort opsummering på forskningsspørgsmålet. Deltagelse i evaluering kan forstås tilsvarende til deltagelse i design, fordi formativ evaluering er en integreret del af designprocessen. Design af arbejdssystemer understøttet af sundheds-it systemer, bør forstås og gribes an som en fortløbende og iterativdesignproces, i hvilken brugerdrevet formative evaluering er en integreret del. I det lys er det deltagerne i arbejdssystemet, som skal deltage i den formative evaluering der er integreret som en del af den løbende designproces af arbejdssystemet understøttet af sundheds-it.

PART ONE: INTRODUCTION AND RESEARCH APPROACH

The physician starts his ward round at the office where he tries to get the record of the next patient on the screen. However, it does not seem to work out. Nothing happens; the system seems to be frozen. The physician gets frustrated, hammers his hands at the keyboard, and ends up switching off the screen. The nurse tries to calm him down and concede that the computer was not working properly. She suggests that they try to look at the record on the computer at the ward.

They walk into the ward and meet the first patient. The nurse asks the physician if she should look up the patient's record on the screen for him. The physician says: "No, it must take the time it takes." He still cannot get the record up on the screen. He becomes really angry and says: "I do not want to take this trouble. I'll go over to the chief physician and tell him that I do not want to take part in this anymore". He walks out of the ward in the middle of the round. The patient looks at the nurse, confused.

(*Field notes 29/11-2006)*

Chapter One: **Introduction**

As shown in the short excerpt from my observation notes, the use of information systems in healthcare is still problematic and, at times, very frustrating. Unfortunately, this is not an unprecedented case. In periodicals and newspapers, one can read several letters from clinicians pointing out the inexpediencies related to use of technology and information systems. The letters span from complaints about the amount of time used on logging into the systems and the systems not supporting their daily work, to claims that such systems cause a substantial reduction in patient safety. All these types of problems are the result of using different healthcare information systems (HIS). These observations are supported by several studies showing the unintended consequences of the implementation of various kinds of healthcare information systems (HIS) (Nahm and Poston 2000; Ash et al. 2003; Ash et al. 2004; Han et al. 2005; Poissant et al. 2005; Scott et al. 2005; Del Beccaro et al. 2006; McDonald 2006; La Cour and Hellstern-Hauerslev 2007; Mabeck 2008b).

Despite the substantial number of unintended and undesired effects, the implementation and use of HIS has advantages and positive effects, such as reducing medical

errors (Bates et al. 1999; Mekhjian et al. 2002; Poissant et al. 2005; Hertzum and Simonsen 2008; Shamliyan et al. 2008) and improving test time response (Westbrook et al. 2006; Breil et al. 2009). However, we need to understand and overcome the challenges of implementing HIS in order to realize the potential positive effects of HIS implementation. In other words, we need to be better at implementing and using HIS in order to address the challenges and obtain the desired effects of HIS.

In general, the implementation of information systems is challenging and suffers from a high failure[1] rate (Heeks 2003; Shapiro 2005; Tichy and Bascom 2008). The implementation of healthcare information systems seems to be no different (Wears and Berg 2005; Heeks 2006; Talmon 2006). Successful implementation of HIS is a troublesome and complex endeavour – more difficult than "putting a man on the moon" (Berg 1999) or "land[ing] people on Mars" (Jones 2003).

There are many explanations as to why so many HIS projects fail. One of the primary arguments is that the technological factors are being given too much attention at the expense of other factors. Lorenzi and Riley (2003) advocate including change management theories into the field of HIS implementation in order to deal with the behavioural aspects of implementation that, if not dealt with, will lead to failure. Along with Ash et al. (2003), Lorenzi et al. (1997) point to organisational issues such as culture, power, and leadership not being managed properly as reasons for HIS failure. According to Berg (2001), the core reasons for failure are a) not acknowledging implementation as a process affecting the processes and structure of the healthcare organisation, b) therefore leaving the implementation to the IT department, and c) overlooking the fact that information system implementation is an organisational change process that cannot be planned and predicted. Azad and King (2008) suggest that workaround practices potentially hold the key to system failures.

Berg (1999; 2001) underscores the importance of recognising the role of the users and taking user involvement much more seriously and literally. Adequate and long-term user involvement is necessary to secure a fit between system and work processes. Furthermore, user involvement is the best way to ensure that the primary users experience a direct benefit from using the system – which is critical for system acceptance (Berg et al. 1998).

[1] Defining failure and success of information system projects is a complex field. Berg (2001) points out the difficulties of defining a successful implementation. There are many aspects of implementation success, e.g., effectiveness, efficiency, and satisfaction that could refer to satisfaction of both the healthcare workers and/or the patients. Different stakeholders may define success differently. In addition, what is successful tends to evolve over time. From this perspective, talking about successful implementation becomes meaningless. Instead, successful implementation is a process of carefully paying attention to the success criteria used by different stakeholders, how they evolve, and whether the criteria are shared among the different parties (Berg 2001). I acknowledge the difficulties, but I will refrain from going into the discussion as it is not a central aspect of the thesis. Instead I use success and failure in a common-sense manner, referring to the continuum of success and failure similar to that of good and bad.

Healthcare Information System - HIS

I see HIS as a subset of information systems in the way that all HIS are also information systems, but not all information systems are HIS. Thus, in order to be able to define HIS we need to first define information system.

There can be found a variety of definitions of information system ranging from information systems being a social system to that it is almost only a technical system. I have chosen a view of information systems that contains a bit of both. Laudon and Laudon (2007: p G-7) defines an information system as "interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis and visualization in an organization." cited in (Alter 2008). A definition from Watson (2008: p 9) says a little more about the components, "an information system is an integrated and cooperating set of software directed information technologies supporting individual, group, organizational, or societal goals." cited in (Alter 2008). Thus if we combine these two definitions we derive a definition of information system as an integrated and cooperating set of software directed information technologies collecting, storing, processing and disseminating information used to support group, organizational, or societal goals. I have purposefully omitted the individual goals because the focus in this thesis is on information systems in complex settings with multiple users and in which the information system supports some kind of collaboration. Based on that definition I define healthcare information systems as an information system that supports patient-related healthcare work within the context of the healthcare sector. Within this context, healthcare professionals comprise one of the main user groups; patients may be another user group of the system. The definition is inspired by Ammenwerth and de Keizer (2005) who define "a health information system as including all computer-based components which are used by health care professionals or the patients themselves in the context of inpatient or outpatient patient care to process patient related data, information or knowledge." (Ammenwerth and de Keizer 2005: p 45)

I have chosen the term healthcare information system in order to refer to information systems used within the organisational frame of the healthcare system, which includes more than just hospitals. In most cases health and healthcare information systems are used synonymously. However, to stress that the focus is on systems supporting the healthcare sector and not systems used in relation to health in general, such as a single-user application for registration of diet information, I have chosen the term healthcare information system. Similar terms which according to the definition above all can be categorised as healthcare information systems are: Hospital Information Systems, Health Information Systems, Healthcare and Management Information Systems, Clinical Information Systems, Electronic Patient Record, Medical Information Systems, Computerised Physician Order Entry etc.

Besides information system and healthcare information system I also use the term information technology (IT). IT is mainly used when I report on authors who themselves have used the term IT. In most instances IT is used more or less synonymously with information systems because it refers to IT systems used in an organisational context to support some kind of collaboration among a number of people.

Box 1.1

1.1 Exploring the thesis title

As the title discloses, this thesis presents an alternative approach to the organisational implementation of healthcare information systems. This approach is derived from work system theory, the field of participatory design (PD), implementation literature, and evaluation theory. It is my hope that this thesis will contribute mainly to the field of participatory design by expanding the application area for participatory design in order for PD to play an important role in organisational implementation and evaluation.

The title refers to both "participation" and "evaluation," which have been identified as two key aspects essential for improving the implementation of healthcare information systems (Berg 2001; McGowan et al. 2008; Simonsen and Hertzum 2008).

1.1.1 Participation and design

Participatory design[2] is a field of research concerned with involving users in the design of information systems – both by discussing the reasons for participation and by developing methods, techniques, and tools for user participation. In PD, the people in the organisation who rely on, or are going to rely on, information systems in performing their work hold the key to creating systems that will fit the users, the work they do, and the organisation in which the work takes place.

The notions of "fit" or "alignment" are widely used within socio-technical research and refer to the degree of match between the technological solution and the tasks to be supported, as well as the social and organisational context (Berg 2001; Markus 2004; Heeks 2006). There has been an increasing acknowledgement of the importance of treating human and organisational issues along with technical issues. Acknowledging these issues helps create a fit by aligning or adapting the technology and the organisation, leading to successful information system implementations. (Leonard-Barton 1988; Clegg et al. 1997; Markus 2004; Doherty and King 2005) When it comes to projects in complex and emergent organisational settings like the healthcare sector, addressing the human and organisational aspects of IT projects becomes crucial (Klein and Sorra 1996; Berg et al. 1998; Berg 1999; Aarts et al. 2004).

To secure the right fit between socio-factors and the technical factors, it is crucial in the process of design and implementation to involve the people who work in the organisation and who are the future users of the technology. PD takes the perspective of the prospective users and aims at designing systems that support the users in the work they do in the organisation. Thus, PD has the potential to improve the chances of a successful information system implementation (Shapiro 2005; Kanstrup and Bertelsen 2006; Pekkola et al. 2006; Simonsen and Hertzum 2008). When concerned with the implementation of HIS, an additional argument for turning to PD is that much of the information system implementation literature has focused mainly (and maybe too much) on the "socio-" or organisational part (Orlikowski and Iacono 2001; Coiera 2007). Whereas PD has a strong focus on designing technology, yet it acknowledges that the design should stem from in-depth knowledge of the work and organisation that the technology is going to be part of. Hence, PD can potentially

[2] PD as a research field will be further explored in Chapter Four

counterbalance the prevailing focus on the socio-factors and add a connection between the technical and the organisational parts.

I acknowledge the influence of my academic upbringing in a Scandinavian participatory design research environment. In the Scandinavian approach to PD (which is not limited to Scandinavia as a geographical region), there is a tradition of perceiving participation as attractive and important, not only because it increases the chances for successful implementation but also because people have the right to be involved in decisions and changes that affect their work and lives (Trigg and Anderson 1996; Kensing and Blomberg 1998).

1.1.2 Evaluation in relation to implementation

Another important aspect of improving the implementation of HIS is evaluation (Ammenwerth et al. 2004). We need to pay close attention to what happens during and after implementation. Thus, evaluation (should) play an important role in the process of implementation as "it documents the (unintended) effects, it informs the decision makers and provides a frame of reference against which the effect of new interventions/developments can be compared" (Talmon 2006: p 13). McGowan et al. (2008) also argue for evaluation to be part of HIS implementation, stating that "formative evaluation could mean the difference between success and failure" (McGowan et al. 2008: p 301). Berg does, in line with McGowan, suggest an "ongoing, in depth, multi-level evaluation of the implementation process" (Berg 2001: p 153) in order to learn from previous activities.

The aforementioned need to focus on factors other than technology covers not only implementation but also evaluation. Several researchers have suggested that evaluation should concern not only system issues but also human, social, and organisational issues (Southon 1999; Kaplan and Shaw 2004; Talmon 2006). Moreover, it has been suggested that iterative evaluation should be an integrated part of system implementation rather than only evaluating the outcome in terms of summative evaluations (Berg 2001; McGowan et al. 2008).

It seems obvious that learning from experience in terms of summative or formative evaluation can contribute to lowering the risk of failure by informing the next project or by informing the project while it is being undertaken, respectively. In the latter case, you can adjust the project if it seems to be on a failing course thus the term *formative* evaluation. Despite the obvious learning potential of evaluation, it can be very difficult to obtain support for doing evaluations (Rigby 2006). Rigby (2001; 2006) mentions several reasons for not doing evaluations such as lack of resources, loss of reputation (in case of a bad evaluation), and lack of competencies to carry out evaluations. Another reason could be that an evaluation can serve multiple agendas, meaning that despite the potential for learning, evaluations can also act as a control or a strategic political arrangement (Dahler-Larsen 2008). However, the latter mainly refers to summative evaluation, whereas formative evaluation has the potential to support an ongoing, reflexive learning process related to the ongoing process of design and adaptation of information systems and to the organisation related to information system implementation processes.

1.1.3 Design of healthcare work systems

The above leads us to the last part of the title, which suggest that we view and talk differently about organisational implementation. As mentioned previously, it is important and essential to address human and organisational factors along with technical factors to achieve successful implementation. However, that is not enough. In complex settings like the healthcare sector, human and organisational factors do change all the time, thus the information system will also have to change in order to fit the organisation. And the introduction of new or changed technology will affect the human and organisational aspects so that they will have to change in order to obtain fit. The changes needed cannot be foreseen in such complex and emergent settings as those dealt with in this thesis (Leonard-Barton 1988; Berg 2001). Consequently, we have an ongoing reciprocal process of emergent and planned changes related to the information system and its organisational surroundings (Orlikowski and Hofman 1996). Such a situation requires an ongoing process of design and redesign of organisation and information system to maintain a certain degree of fit or alignment.

To avoid the split between information system and organisation, which seems to encompass a variety of factors, Alter (2003; 2006) suggests that the objects to be designed should be the "work systems," which encompass technical, human, and organisational elements, as well as references to the organisational environment. Thus, instead of referring to the organisational implementation of healthcare information systems, I suggest that we talk about the design of healthcare work systems. Organisational implementation is reminiscent of something to be implemented in an organisation – something that first has been designed and built, then implemented, and at last is being used and maintained. By using design, understood as an ongoing process of design and redesign, we get rid of the linear mindset. And by using work systems, we not only bridge the gap between technology and organisation but also meld them together into an analytical entity[3] – the work system. This argument will be developed further in Chapter 3.2.

This approach to understanding and looking at organisational implementation is the result of iterative movement between my empirical and theoretical work, the latter mainly in terms of literature reviews. The iterative method explains why I use terms like implementation, organisational implementation, adoption, mutual adaptation, etc. in the research papers included in this thesis. It is not until the third and last study that I start to apply the work system perspective explicitly.

Before going further into the research question, how it is pursued, and the intended contributions, I would like to outline the context for healthcare information systems in Denmark, which is where the studies and discussions take place.

1.2 Context of the studies: The Danish healthcare system

The studies that form the empirical grounding for this thesis take place in the Danish healthcare system. In order to gain a better understanding of the context for the em-

[3] The work system encompasses different elements that, for analytical purposes, are arranged in 9 elements.

pirical studies, I will provide a very brief outline of the Danish healthcare system and the role of IT in the healthcare sector.

The Danish healthcare system is divided into three parts: the primary healthcare sector, which deals with general health problems and consists of general practitioners, practising specialists, practising dentists, physiotherapists etc; the secondary healthcare sector or hospital sector, which deals with medical conditions requiring specialised treatment and intensive care; and the tertiary sector, which consists of care homes. In other countries the tertiary sector mostly refer to highly specialised treatment (Vallårda and Krasnik 2002).

The general practitioner acts as a gatekeeper to the rest of the healthcare system, meaning that patients need to be referred to a hospital by a general practitioner unless their concern is acute and they go directly to the emergency ward. Oversight of the health care sector is mainly public and has three political and administrative levels:

- The state (initiating, coordinating, and advising; responsible for establishing goals for a national health policy)
- The regions (running the hospitals; responsible for the practice sector, including the general practitioners)
- The municipalities (responsible for home nursing, public health care, school health service, prevention, and rehabilitation).

The hospitals are financed and run by the regions, which charge a health tax to finance the hospitals. General practitioners and most of the other actors in the primary sector are private entrepreneurs but work under contract for the regions. They are paid by a mixed remuneration system of capitation fees and fee-for-service. The state is responsible for the national strategy for IT in the healthcare sector (Christiansen 2002; Prevention 2008).

1.2.1 Healthcare information systems in Denmark

The Danish healthcare system is facing great challenges. Demographically we are facing an increase in the number of elderly people and people with chronic diseases while the work force is decreasing. The number of healthcare professionals in particular has diminished over the past few years. On top of that, patients have increased expectations about the quality of treatment and service delivered. Concurrently, the political environment is placing increased demands, such as documentation, monitoring, and evaluation, on the healthcare system. As if that was not enough, new and expensive treatments and drugs increase the expenses dramatically. Implementation of healthcare technologies and information systems has been touted as one of the main options for addressing these challenges. It is a vision in the national strategy for digitalisation of the healthcare system that healthcare information systems should support better quality and efficiency of care, create better coherence, improve cooperation, and create better services for patients (SDSD 2008).

Though healthcare information technologies and information systems are considered responses to some of the above-mentioned challenges, HIS is not new in Denmark. Electronic patient records[4], have officially been on the agenda in Denmark

[4] In Danish: Elektronisk patient journal (EPJ). There is no exact definition of EPR. In the national IT strategy, an EPR is defined as "a clinical information system that directly supports process oriented examination, treatment and care of a single patient on a daily basis" (Sundhedsministeriet 2000). The

since 1996 when the Minister of Health published "Action plan for electronic patient record" (Sundhedsministeriet 1996). Long before that, in the seventies and eighties, the hospitals started developing and implementing specialized stand-alone systems and clinical databases. In 1974, a Danish IT company developed a patient administration system that was implemented in most hospitals (Mabeck 2008a, appendix 2). In the early eighties, some hospitals had automated ordering systems for tests, inspection, medication, etc., using punched cards. At that time, the individual hospital made the decision to develop or purchase HIS. Today the hospitals are governed in five healthcare regions. This long and distributed development has resulted in numerous systems and applications. One of the regions alone had more than 800 applications (Kold and Pedersen 2009). The regions have spent the last couple of years, after the municipality reform[5], consolidating and standardising their suite of systems in the hospitals. Most of the larger systems already implemented and any new systems purchased are standard systems from established HIS vendors.

The general practitioners started more than 20 years ago with implementing electronic patient records on an individual basis. In 2006 there were 19 different systems for GPs, but in 2009 there were only 11. All GPs in Denmark have electronic patient records.

Since 1996 hospitals and GPs have been able to exchange data electronically via EDIFACT[6]. That same year the ministry of health published an action plan for electronic patient records in which they focused on EDIFACT as a standard for data interchange. There has been a separate national strategy for IT in the healthcare system since 2000. The strategies have focused on how IT – mainly conceptualised as electronic patient records – can support the general stated objectives for the healthcare sector. The objectives are: high professional standards, effective use of resources, minimal patient risk, high patient satisfaction, and coherence in the patient trajectory (Sundhedsministeriet 2000; Sundhedsministeriet 2003, my translation). However, recently a new objective entered the strategy: the healthcare system as an attractive place to work (SDSD 2008, my translation). I see this new strategy as a way to address the challenges of recruiting and retaining staff in the healthcare system. And because clinicians' work life will be affected by HIS implementations, it is important to involve them in the process.

Although the implementation of health information systems has been going on for more than three decades in Denmark, and even longer internationally (Kaplan 1995), it is still not a trivial task. Denmark is generally doing well in relation to HIS implementation (Protti and Nøhr 2002; Bhanoo 2010), though it can be difficult to compare HIS adoption among countries. However, like other countries, Denmark struggles with various challenges related to HIS implementations.

---

understanding of the concept varies among healthcare professionals (Mabeck 2008a). However, within the healthcare informatics environment, it is commonly understood that an EPR is not one system but a collection of systems such as: electronic medication record, patient administrative system, booking system, Radiology Information System and Picture Archiving and Communications System, laboratory systems, and clinical process systems. The latter is the only one of the major modules missing in the Danish healthcare sector.

[5] Before the reform, Denmark had 14 counties responsible for delivering healthcare to their inhabitants. The reform merged the 14 counties into 5 regions.

[6] EDIFACT is an abbreviation for Electronic Data Interchange For Administration, Commerce and Transport.

1.3 Research question

One of the factors motivating my research has been the desire to prevent situations like the one described in the opening field note excerpt. The motivation for this thesis is found in a wish for improving the experiences of the clinicians whose daily work is supported by healthcare information systems. In other words I hope to contribute to improving the use and user of HIS in the healthcare sector. One way to do so is to overcome some of the challenges related to designing and implementing HIS.

Both *participation* and *evaluation* have been highlighted as key elements for improving the implementation of healthcare information systems (Berg 2001; McGowan et al. 2008; Simonsen and Hertzum 2008). However, the focus on these elements is not new. For the last 10–20 years the information system and HIS literature has emphasised the need for user involvement and has called for a focus on organisational and people issues in addition to technical issues (Leonard-Barton 1988; Leonard-Barton and Sinha 1993; Markus and Benjamin 1997; Macredie and Sandom 1999; Lorenzi and Riley 2000; Doherty and King 2001; Markus 2004; Bygstad 2005; Doherty and King 2005). The socio-technical literature has contributed substantially to explaining the high failure rate of HIS implementation projects and has also pointed to participation and evaluation as key elements among other important aspect such as understanding the emergent nature of the design and implementation process (e.g., Berg 1999; 2001). Given that participation and evaluation are important elements for designing successful HIS implementations, my focus will be on *how* users could/should be involved and participate in the design and evaluation of HIS implementations, which can be seen as the design of healthcare work systems. On the basis of the intentions to improve HIS implementation and the theoretical assumption, the research question is:

How can participation in evaluation be understood and approached in the design of healthcare work systems?

By addressing HIS implementation as design of healthcare work systems and the role of participatory design and evaluation in this context, I hope to contribute to the collective endeavour of improving the success rate for HIS design and implementation projects.

It is my intention that this thesis will contribute to our understanding of the challenges that managers and other practitioners face with respect to involving clinicians in successfully designing and implementing HIS. This includes the challenges related to evaluation as part of HIS implementation. Furthermore, I will respond to some of theses challenges by providing examples of how clinicians can participate in the design and evaluation of healthcare information systems.

This thesis is intended to contribute particularly to the field of participatory design (PD) in three ways: 1) by widening the understanding of design in participatory design in order for PD to play an important role in evaluation and organisational implementation; 2) by exploring the concept of participation, especially in relation to evaluation both theoretically, but first and foremost, empirically, by looking at three different PD projects in the Danish healthcare system; and 3) by theorising about and exploring the role of evaluation in participatory design processes.

The three studies that form the empirical basis for the anticipated contributions to PD are presented in the following sections before the structure for the thesis is presented at the end of this chapter.

1.4 Empirical overview

In this section the empirical foundation for this thesis is presented along with a very brief overview of the six research papers reporting on the empirical studies. The empirical foundation consists of three different studies within the Danish healthcare sector. All of the projects studied aimed to involve the users as central actors in design activities and can be categorised as participatory design projects.

The three empirical studies in this thesis deal with different aspects of the design of healthcare work systems such as participation, adoption and implementation, and design of the information technology artefact. The studies and related papers bring about awareness of various challenges and difficulties that subsist when it comes to designing, implementing, and using complex systems like HIS. One of the consistent challenges is how to involve the users in the various design activities. Table 1 provides and overview of the studies and the related papers. I will mainly refer to the studies by their short name as opposed to referring only to the study number in the hope that it will be easier relate to.

Table 1: Presentation of the three studies and the papers related to the studies

	Study 1 – Shared Care	**Paper I – Challenges**
		Paper II – Representation
	Study 2 – CLIMON **CLInical MONitoring**	**Paper III – Managing**
	Study 3 – Health Check	**Paper IV – Barriers**
		Paper V – Intervention
		Paper VI – Facilitating/Effect map

Figure 1 presents a chronological overview of when the studies were conducted and the main activities carried out during the studies.

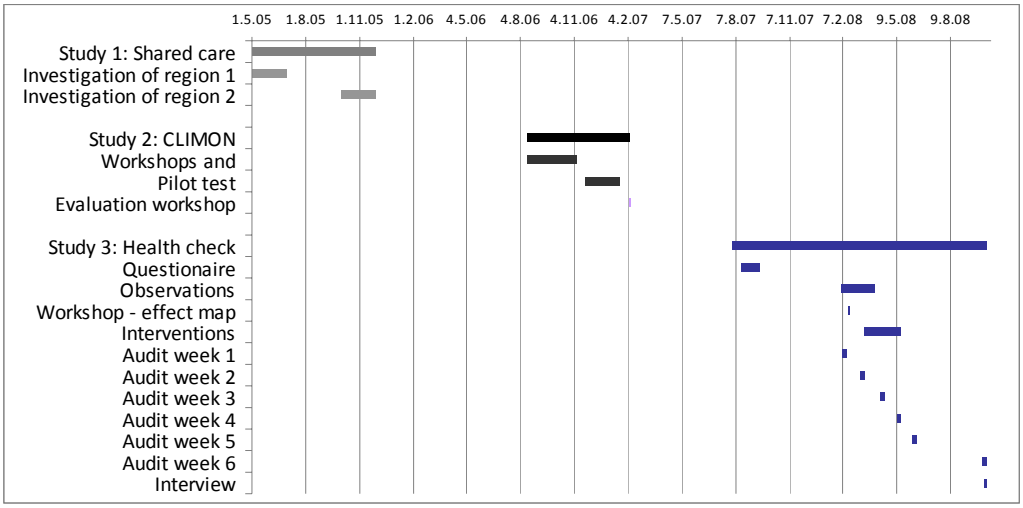

Figure 1: Overview of the studies and study activities

1.4.1 Study 1: IT-supported shared care (Shared Care)

The empirical work in this study took place throughout 2005. The work comprises 18 interviews with the parties involved, supplemented by 35 hours of observation and a number of relevant documents.

The study is a comparative case study of two IT-supported shared care initiatives for supporting the treatment of diabetes in hospital outpatient clinics and at general practice. The two initiatives included two different web-based systems, and they unfolded in two different healthcare regions in Denmark.

In the first initiative, the system originated from an outpatient clinic through a bottom-up approach and was originally meant only to support the outpatient clinic. However, a suggestion from the GPs, as well as a general national interest for shared care initiatives regarding diabetes, initiated the development of a "light" version of the system. The light version would then be implemented in the GPs' offices, thereby making it possible for the outpatient clinics and the GPs to exchange and share data about the diabetes patients.

In the second initiative, the system was purchased from a large IT vendor on the initiative of a central committee and implemented in the outpatient clinics. Later the system was rolled out to the GPs in the region – a classic example of a top-down process.

The two initiatives had two rather different development and implementation stories, although they ended up with the same problem: the secondary care sector (hospitals and outpatient clinics) adopted the shared care solution while the primary care sector (general practitioners) was more reluctant. One explanation for the GPs being more reluctant is the difficulty of involving all groups of future users in order to secure usefulness of the system, which was experienced in both regions.

The study is reported on in two papers: one focusing on the challenges for shared care, especially for the GPs (Paper I) and one looking at the difficulties of involving and representing diversified user groups (Paper II).

1.4.2 Study 2: Clinical monitoring (CLIMON)

This study took place from August 2006 to February 2007 and comprised participation in 4 full-day specification and development workshops, 62 hours of observation before and during pilot testing, 7 interviews with participants from a pilot test, and one interview with the project manager, as well as data from documents and an evaluation questionnaire.

The second study is a combined action research and case study of a prototyping project called CLIMON (abbreviation for "Clinical monitoring"). In 2006 the decision was made, in Region Zealand, to extend an existing electronic patient record with a module for monitoring vital values in different areas such as diabetes, asthma, and stroke, etc. The application would replace the traditional paper- forms. The project was articulated as an experiment focused on involving the clinicians – who were to be the future users of the system – and experimenting with effects to drive the development process, in contrast to requirement specification. For this purpose, a participatory prototyping strategy was chosen. A user group was formed with involvement of three doctors and three to four nurses from the three different hospital wards included in the study.

The prototype system was tested on the three different wards located at three different hospitals within the region. Before the two-month pilot test, there was a series of configuration workshops where the user group discussed the prototype, what data to be registered, and how to present it; they also discussed which effects to be achieved. However, the prototyping did not go as planned. The prototype was not ready until the third out of four configuration workshops. Instead, Word and PowerPoint mock-ups were used. The missing prototype hampered the involvement of users and the use of effect specification instead of requirement specification. The study has generated one paper that is focused on the management of the prototype project (Paper III).

1.4.3 Study 3: Medication process health check (Health Check)

The third study was carried out between 2007 and 2008 and contains three elements: First, a questionnaire survey investigating the adoption of an electronic medication record and a set of mandated work procedures and possible barriers to adoption that was sent to all mid- and lower-level managers of the hospital wards in the Region Zealand. Second, the study experiments with different interventions for promoting adoption and better use of the electronic medication record and how the effects of these interventions can be measured. The third part tests a tool for facilitating user involvement in formative evaluation; mainly in effects specification and in designing interventions to support post-implementation adaptation of the work practices and system to each other. The second and third elements were investigated with an action research approach. In order to experiment with interventions and user involvement, a medical ward was selected to take part in the project. A nurse and a young physician from the ward were assigned to the project. These individuals participated in the design of interventions and effects measures. The design process primarily took place at a workshop during which the tool for supporting user involvement was used. This resulted in a number of interventions aimed at enhancing the adoption of selected work procedures, which were carried out on the ward, and the effects were measured. The three elements of the study are reported in three different papers. One paper pre-

sents the survey results and interviews to elaborate the results (Paper IV). A second paper reports on the interventions and effects measures undertaken to implement a mandated medication procedure (Paper V). The third paper reports on the facilitation and design of an effect map to support participation in evaluation (Paper VI).

1.5 Thesis Structure

The thesis is divided into four parts. The first part comprises an introduction to the theoretical field of research, the context of the empirical work, and a presentation of the empirical studies. In addition, Part One a second chapter that includes a presentation of the overall research approach and research strategies, as well as some methodological considerations.

In Part Two, the four elements comprising the theoretical background are presented in order to provide a vocabulary and a basis for understanding and talking about the main topics addressed in this thesis. The concepts of HIS implementation and work systems are outlined in Chapter Three. In Chapter Four, participatory design is explored, and in Chapter Five, evaluation, mainly in relation to HIS implementation, is presented.

Part Three constitutes a synthesis of the theory and practice. In Chapter Six, a synthesis of the theoretical elements is outlined. The synthesis produces a theoretically derived approach to participation in evaluation and a conceptualisation of HIS implementation as ongoing design that contributes to answering the research question from a theoretical position. In Chapter Seven, the research question is pursued from an empirical viewpoint. The approach derived in the previous chapter is applied as an analytical framework on the empirical material and provides an additional analysis of the studies, apart from the analyses presented in the respective papers. Chapter Eight synthesises the theoretical and empirical findings into five main contributions. In Chapter Nine, the thesis concludes by summarizing the work and the main contributions of the summary report and the research papers. This chapter ends with the presentation of a number of implications for practice and research.

Part Four contains the six research papers that serve to enlighten the research question from an empirical perspective. The papers are numerated with roman numbers in order of appearance in the thesis. Papers I, II, III, and IV help us understand participation, while Papers V and VI show how participation in evaluation can be used in relation to the design of healthcare work systems.

In addition to figures, tables, and plain text, the thesis also incorporates boxes. The boxes contain definitions, explanations, examples, or reflections that I wanted to include but which did not fit coherently into the text or upon which I wanted to elaborate due to the importance of the content.

Chapter Two: **Research approach**

In this chapter I will present the overall research approach, including the research process and research strategies. The different research strategies are, to a certain extent, described in the respective papers. However, in this chapter I would like to elaborate on some aspects of the research strategies and show their role in the overall research design.

Not only is the research presented in this thesis *about* participation, it is also investigated in a participative way. It has been part of my motivation that this research should advance both theory and practice by developing scientific as well as practical knowledge. "To do this a mode of enquiry is needed that converts the information obtained by scholars in interaction with practitioners (and other stakeholders) into actions that address problems of what to do in a given professional domain"(Van de Ven 2007: p 9). This mode of inquiry, which Van de Ven terms *engaged scholarship*, is defined as "a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems" (Van de Ven 2007: p 9). Additionally Van de Ven defines four types of engaged scholarship: *informed basic research*, which describes, explains, or predicts a social phenomenon; *collaborative basic research*, which focuses on basic questions of mutual interest to the partners and entails a greater sharing of power and activities among the participants; *design and evaluation research*, which explores normative questions related to the design and evaluation of policies, programs, or practical problem-solving models within a profession; and *action/intervention research*, in which interventions are applied to diagnose and tackle a problem for a specific client.

More generally, engaged scholarship focuses on bridging the theory-practice gap by acknowledging practitioners as relevant stakeholders, on par with academic stakeholders, and *engaging* with theses stakeholders to study complex problems. In this context, engagement refers to scholars collaborating with stakeholders in each of the four research steps – theory building, problem formulation, research design, and problem solving – and to scholars being informed by the different interpretations and perspectives of the stakeholders (Van de Ven 2007).

As explored by Mathiassen and Nielsen (2008), Scandinavian information system research does, to a large extent, adhere to the principles and values of engaged scholarship. In a review of all 130 papers published in Scandinavian Journal of Information Systems over the past 20 years, these authors found that 44 papers could be categorised into the four types of engaged scholarship (Mathiassen and Nielsen 2008). Mathiassen and Nielsen point to historical reasons to explain this Scandinavian engagement, such as the commitment to trade unions and a focus on understanding and designing information systems for practical use. Despite a strong focus on engagement with and involvement of practitioners, only a few papers documented how this focus had influenced the research design and choice of methods (Mathiassen and Nielsen 2008).

In the following section I will thus heed the advice of Mathiassen and Nielsen (2008) and relate my desire for engagement to the research design and methodological choices.

2.1 Research design and strategies

The overall research approach builds on a flexible design. The flexible design acknowledges that not all aspects of the research (e.g., theory, research question, methods, sampling strategy, and so on) are decided on and fixed from the beginning (Robson 2002). It is an approach similar to Maxwell's (1996) model for interactive research, which implies a continuous interaction between purpose, research question, methods, conceptual context, and validity. Instead the research process has been formed through an interactive movement between the research interests, empirical studies, and theoretical inspiration/literature review, see Figure 2. The curved line in the figure is meant to illustrate the interactive movement. The curves should not be interpreted literally as they do not show exactly when I was concerned with what, nor how many times, for example, the research interest was revisited and changed.

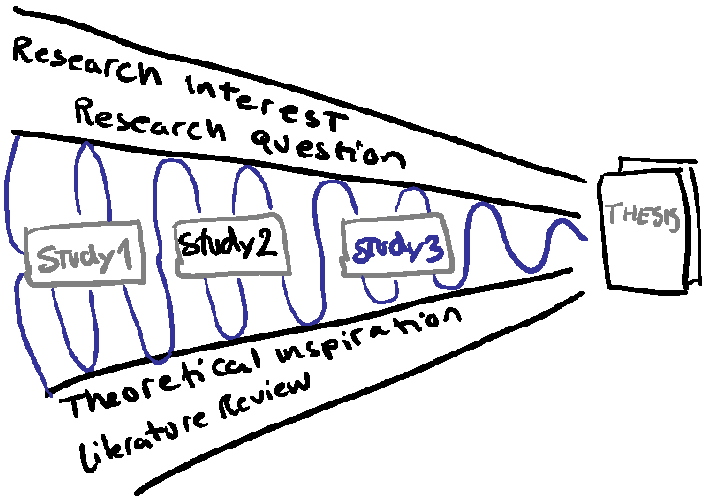

Figure 2: The overall research process, inspired by (Mabeck 2008a)

During this process the different research elements (theory building, problem formulation, research design, and problem solving) are repeatedly revised in collaboration with various stakeholders. The flexible and interactive research approach not only leaves room for the research process to be influenced by the stakeholders and collaborators but also for empirical and theoretical findings to influence the problem formulation or theory building, for instance. Another argument for having a flexible research design is that it is necessary when engaged in studying information system projects as they happen.

Here I present an example of how the methodological part of the research design in the first empirical study (the shared care study) changed during the process. Initially the research strategy was a case study of the pilot implementation of a shared care system for general practitioners. However, the pilot implementation got delayed so we could not follow the implementation. Instead we investigated the possibility of us having a more active role in the project. In collaboration with the project managers, an arrangement was made that would allow us to evaluate a stand-alone prototype of the system. At that point the research was no longer a pure case study but a case study combined with action research elements since we intervened in order to generate data for our research interest but also solved a practical problem – evaluat-

ing the prototype. However, our evaluation resulted in the pilot project being postponed. We still had not gotten the data we needed and our research interest had changed to investigating the difficulties in implementing shared care for general practitioners. Consequently, we turned our attention to another county that was in the process of implementing shared care for GPs to do a case study there. This is how the research strategy went from a pure case study to a comparative case study with action research elements.

The second study also involved of a mix of research strategies. The aim of this study was to experiment with effect-driven[7] IT development (Hertzum and Simonsen 2004; Simonsen and Hertzum 2005) by using an action research strategy. To gain access to the project we (the researchers) offered to do an evaluation of the project. For the evaluation part, an interpretive case study (Walsham 1995) strategy was chosen. The action research part played a smaller role than planned due to difficulties with the prototype. Thus the study became more of an interpretive case study than an action research study.

After the second study, I became acquainted with the work system framework as a perspective for framing the role of information systems. The work system framework affected my view on information systems, which was the object of investigation as my general research interest was (and still is) concerned with participatory design and the implementation of information systems. Consequently, the work system framework influenced not only the problem formulation and theory building for the third study but also how I viewed and interpreted the previous empirical studies.

The third study was planned in close collaboration with the project manager from the region. It was the only study that followed the planned research design. This investigation involved a survey strategy and an action research strategy. The survey was designed collaboratively by the project manager, a project worker from the region, me, and my supervisor. The action research study was designed mainly by me and the project manager, but it was designed to be highly participative in terms of involving the people being studied.

Action research is one of the four types of engaged scholarship. It was deliberately chosen as research strategy to facilitate engagement and, if not to bridge, then at least to minimise the theory-practice gap by producing both scientific and practical knowledge (Mathiassen and Nielsen 2008).

The research strategies and data generation and analysis methods are, to a certain extent, described in the respective papers. Still, I will take the opportunity to elaborate on selected aspects of the research and data analysis strategies in the following section.

2.1.1 Case study as a research strategy

Case study is a widely used research strategy, yet there are many opinions about what a case study is, how it ought to be conducted, and for what it can be used. These circumstances may also explain the many books describing case studies. I will, in the following, give a short and very basic description of how I have understood and used

[7] Effect-driven IT development was previously termed evidence-based IT development. However, the main idea is the same, that is, to replace the traditional requirement specification with a number of effects specified by the customer.

the concept of case study. To understand what a case study is I have mainly relied on Yin's description.

Yin describes the case study method as "an empirical enquiry that: investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 1994: p 13). The strength of "the case study is its ability to cover both a contemporary phenomenon and its context" (Yin 1981: p 98) In system development projects, it can be very hard to distinguish, for example, the design activities from their context – the development project – or, if studying the implementation process more generally, this can be very difficult to separate from the project and from the organisation in which the project takes place. Consequently, incorporating the context into the study raises the complexity and number of variables, which is why a case study needs to rely "on multiple sources of evidence and with data needing to converge in a triangulating fashion" (Yin 1994: p 13). The studies performed as part of this thesis all rely on multiple sources of data and data-generating methods. Furthermore, the findings have, in accordance with the tenets of engaged scholarship, been discussed with representatives of both the practitioners and the scientific community. Because and in spite of this enhanced complexity, case studies have the potential to build a rich explanation of the phenomenon studied, as opposed to, for example, a controlled experiment.

What exactly constitutes the "case" or the phenomenon studied can, as described above, be difficult to distinguish, but a case can be "the situation, individual, groups, organization or what ever it is that we are interested in" (Robson 2002: p 177). I have been interested in studying participation and evaluation in various phases of design, seen as organisational implementation. Because my interest is a particular phenomenon such as participation in evaluation and not the particular case, it indicates that it is an instrumental case study, which occurs when

> "a particular case is examined mainly to provide insight into an issue or to redraw a generalization. The case is of secondary interest, it plays a supporting role, and it facilitates our understanding of something else" (Stake 2000: p 437).

This is in contrast with intrinsic case studies, which are undertaken to understand the case it self (e.g., what happens at this particular clinic). The particular subject of study and 'case' is described in the respective papers.

Cases study is a wide-spread methodology, but it is also subject to criticism. For instance, there are claims that case study is only useful for exploratory purposes and not for hypothesis testing and that it is not possible to generalise from the findings of a case study. However, both Yin (1981; 1994) and Flyvbjerg (2006) refute these critiques. Case study data should not be subject to statistical generalisation; instead this methodology is useful for analytical generalisation in which existing theory can be used to explain and/or to compare with the results of the case study (Yin 2003). Furthermore, analytical generalisation implies a deliberate assessment of the degree to which the results from a case study could be instructive for what would happen in a similar but different situation (Kvale 2002: p 228). Analytical generalisation can be supported by a proper sampling of the case, depending on the phenomena and the purpose of the study. There are various strategies for selecting cases; "maximum variation cases," for instance, are very different in one dimension (e.g., form of organisation or location), and "critical cases" are exemplified by the notion that if it is

possible under these unfavourable conditions, it is probably applicable to other cases (Flyvbjerg 2006).

Yin argues that case studies may be an appropriate research strategy not only for exploratory research but also for explanatory and descriptive purposes and that the research strategy depends on what type of research question is asked. In general, how and why questions are more explanatory and are likely to lead to the use of case studies and experiments as the research strategy. The research question in this thesis can, in Yin's terminology, be categorised as an explorative how question, thus a case study approach is suitable. I have used a combination of mainly case study and action research as research strategies, but I have also incorporated a survey strategy. However, to stay consistent with Yin's terminology, some of the elements in the action research part of the third study can be seen as an experiment. Not an experiment in a controlled, quantitative sense, but rather a qualitative experiment investigating how certain interventions works.

As illustrated above, the research reported on in this thesis evolved during a process in which the research question and research methods were interactively shaped along the way. This evolution meant that my interests included related phenomena and, consequently, other kinds of questions that required different research approaches. As a result, I have used a combination of research strategies, such as survey and action research, and have not relied solely on case studies.

2.1.2 Action research as a research strategy

I have chosen an action research strategy for several reasons. a) action research aims to combine research and practice both by contributing to the practical concerns of the actual case and by producing relevant scientific knowledge (Rapoport 1970). I view action research as the one of the four types of engaged scholarship that most obviously tries to bridge the theory-practice gap because of its explicit involvement of practitioners. This point is illustrated in the following quote: "A major strand of action research is that the practitioners should participate in the analysis, design and implementation processes and contribute at least as much as researchers in any decision making" (Avison and Wood-Harper 1990: p 180 cited in (Oates 2006). Thus, action research is an obvious choice when wanting to do engaged and participative research. b) The strength of action research in studying new techniques. In the third study I was interested in how to facilitate participation in evaluation by use of an effect map combined with a work system perspective. This approach could be characterised as a new technique, thus action research was not only appropriate but also necessary in that situation because "we cannot study a newly invented technique without intervening in some way to inject the new technique into the practitioner environment" (quoted from Land in Wood-Harper 1989 cited from (Baskerville and Wood-Harper 1996). Despite being able to study new techniques by other means (e.g., laboratory experiments), action research is a very suitable method to develop and test new ideas and at the same time conduct scientifically and legitimate research. This is done through iterative action cycles of problem diagnosis, planning, action/intervention, observation, and reflection, as illustrated in Figure 3. c) Action research is concerned with creating organisational change through actions and simultaneously studying the process of change (Baskerville and Myers 2004: p 329). It is a key assumption of action research that interventions bring about understanding

(Baskerville 1999). As stated by Kurt Lewin, who is said to have coined the term action research, "if you want truly to understand something, try to change it" (Robson 2002: p 216). In the third study I was concerned with understanding changes in work practices related to the use of HIS. This was achieved by applying a number of interventions that were designed in collaboration with selected clinicians and which aimed at creating changes in the work practice (Paper V).

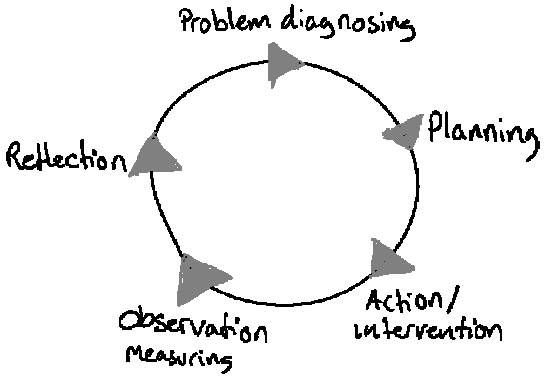

Figure 3: Action research cycle

When action research is combined with engaged scholarship it resembles or is equal to what some researchers (Whyte 1989; Greenwood et al. 1993; Wadsworth 1998) call participatory action research. The action research I have conducted can, according to, for example, (Whyte 1989), be categorised as participatory action research in which "people in the organization or community under study participate actively with the professional researcher throughout the research process" (Whyte 1989: p 514). However, I would like to avoid a discussion about different kinds of action research. Thus, I have chosen to label my action-oriented research using the title action research. However, both participatory action research in particular and action research in general, have inspired the participatory approach to formative evaluation described in Paper VI.

Despite its different forms, a distinguishing feature of action research is that the researcher intentionally participates in a "real-life" problem context, collaborating with other actors in the context to bring about changes in an attempt to solve or improve the problem (Baskerville and Wood-Harper 1998). However, action research is more than just practical problem solving, as the action researcher's approach to improvement stems from, and feeds back to, theories about, or enhances the knowledge of, a particular problem or aspects of that problem (McKay and Marshall 2001). In this way action research combines theory and practice as well as researchers and practitioners through a cyclic process of problem diagnosing, planning, action intervention, observation, and reflective learning (Avison et al. 1999), see Figure 3.

One of the advantages but also one of the challenges of action research is the dual aim of practical problem solving and scientific knowledge production. To address this challenge McKay and Marshall (2001) suggest that instead of thinking of action research only as iterations of one cycle, we should "conceptualise action research as consisting of two, interlinked cycles" (McKay and Marshall 2001: p 46): a cycle of problem-solving interest and a cycle of research interest. McKay and Marshall have illustrated it as two synchronous cycles (see the figure to the right in Figure 4). How-

ever, I call in question whether the cycles must always follow a synchronic course or if, for example, the problem-solving cycles can happen in shorter but more numerous iterations than the knowledge production in the research cycle (see the left figure in Figure 4) Nevertheless, the point is still clear; one needs to make at least an analytical distinction between the two cycles.

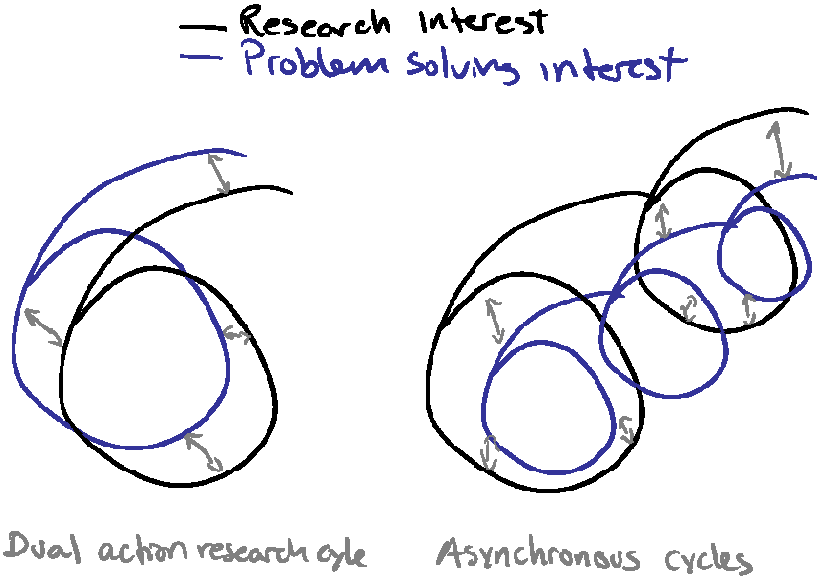

Figure 4: The dual cycles as illustrated by McKay and Marshall (2001) and the asynchronous dual cycles inspired by McKay and Marshall (2001)

The dual cycle view implies a need for thinking about two distinct methods. One method – action research – as the method chosen for doing research, and another method for solving the problem, whether or not this method has been explicated. The distinction between the two methods becomes even more important when the research interest or study object is the problem-solving method itself. This is often the case when action research is applied in information system research, which was the situation with the third empirical study described in this thesis. When problem-solving methods like SSM (Soft System Methodology), ETHICS (Effective Technical and Human Implementation of Computer Systems), and the iterative approach to formative evaluation presented in Paper VI are developed and refined through action research, they may, not unexpectedly, include elements from action research. Thus, the distinction between the problem-solving method and the research methods can be difficult to make (McKay and Marshall 2001). However, in these situations, it is even more important to be explicit about the distinction between the methods and the cycles.

By being more aware of and explicit about the two cycles, one can also respond to the general critique about action research being consulting work disguised as research (Baskerville and Wood-Harper 1996). Such an approach shows that action researchers are concerned not only with solving the problem but also with creating knowledge about the problematic issues and hence contributing to the research community. In the Health Check study, the problem-solving interest was related to a lack of compliance when using the electronic medication record and with related proce-

dures, whereas the research interest was concerned with how to involve clinicians and facilitate participation in organisational implementation activities such as the design of work systems. The latter has been reported in research papers (Paper V, VI) and at academic conferences[8] and in this way has contributed to the research community.

Action research has also been criticised for "the lack of impartiality of the researcher" (Baskerville and Wood-Harper 1996: p 240). This critique relates to researchers who disagree with the philosophy of science underpinning action research, for example, researchers with a positivistic stance (Susman and Evered 1978), whereas in action research, one accepts that the researcher can never be purely objective and will always be partial in some way. However, the role of the researcher and the partiality is worth reflecting on. The researcher is highly involved in and influential on the process – both the problem-solving process and the knowledge creation process – and the personal qualities, experiences, and knowledge of the researcher are decisive factors for both the research outcome and the problem-solving/improvement outcome. In action research studies within information systems research, the researcher is, in many cases, involved in the problem-solving process either as a designer or as a facilitator. In the third study, I was involved as a facilitator, and, as noted in Paper VI, the facilitator influences the course and outcome of the effect-specification process. The influential role of the facilitator (or designer) is a prerequisite for doing action research; however, it is important to be reflective about one's own role in the knowledge-generating and problem-solving processes, respectively.

2.1.3 Data analysing strategies

Just like the use of different research strategies and data-generating methods, different strategies for analysing data have been applied. The analysing methods are described in the respective papers in varying levels of detail. In the Shared Care study, the data – mainly interview transcripts – were coded using a sampling technique inspired by grounded theory (Glaser and Strauss 1967). In the CLIMON study, the data were first analysed in an interpretive manner (Walsham 1995) and later re-analysed by use of analytical induction, as described in Paper III. In the Health Check study, the survey data and the data from the medical audit record were analysed in a quantitative manner using statistical methods, as described in Paper IV and Paper V, respectively. In the quantitative analysis, the focus of the analysis was decided on before the data were collected and the collection of data was designed to fulfil the needs of the analysis. The data from the action study were analysed in a qualitative and inductive manner inspired by (Miles and Huberman 1994) and sometimes referred to as "analytical induction" (Ratcliff 1994). Analytical induction was also used in Paper III.

Analytical induction can be described as a five-step process: 1) Define phenomena of interest in tentative manner, 2) formulate a hypothesis to explain the phenomena, 3) study a situation to determine if the hypothesis can be confirmed, 4) if the hypothesis fails, either the hypothesis or the phenomena is revised so as to include the instance studied in the situation, 5) additional situations are studied to confirm hy-

[8] Paper V was presented at the GROUP 2009 conference and Paper VI was, in a previous version, discussed at IRIS 2009.

pothesis; each negative case requires a redefinition or reformulation (Ratcliff 1994; Robson 2002: p 322).

Analytic induction is as a more formal way of describing the process of participatory observation, which, according to (Baskerville and Wood-Harper 1998), is an essential part of action research and is thus also the form of engaged scholarship that includes action research. In participatory observation, either as a complete research method or as a method for data generation, observation and analysis are intertwined (Robson 2002).

2.1.4 Reporting and communicating research findings

One of the important aspects of engaged scholarship is communicating the findings of and knowledge from the research to the intended audience. In most cases research findings are reported by writing papers for a scientific audience combined with presenting at a scientific conference and maybe presenting to the host or sponsoring organisation, but not even necessarily. However, if we want to bridge the theory-practice gap, engaged scholars need to establish a more engaged relationship with their audience and be able to communicate their knowledge across the boundaries between theory and practice (Van de Ven 2007).

I have, from the beginning of my research process, been aware of communicating the knowledge and findings derived through the research to my audience. My audience consist of two primary groups, academic scholars, including my fellow researchers, and the practitioners concerned with user involvement, health informatics, and organisational implementation. The two target groups are rather different, and communicating with them using a single channel is neither fruitful nor possible. Practitioners very rarely read scientific journals; in contrast, researcher mainly read scientific journals, and if they happen to read periodicals and practitioner journals, the descriptions in these journals are often not exhaustive enough to be valued as academic research. Consequently, I have communicated my knowledge and findings through different channels. For the academic audience, I have presented my work at conferences[9] and as published papers in journals. To engage with the practitioner part of the audience, I have participated in practitioner conferences such as the yearly meeting of the Danish Society for Medical Informatics[10] and a yearly conference held by the Observatory for Electronic Patient Records.[11] I have also contributed to the debate through letters in *Dagens Medicin*, a weekly newspaper concerned with news in the healthcare sector. Last but not least, I have used my weblog (www.ehealth.smartlog.dk, created in November 2007) to communicate with practitioners and other people interested in the implementation of IT. The blog posts are

[9] I have presented my work at the following conferences and workshops: 3rd Scandinavian Conference on Health Informatics. Aalborg, Denmark (2005), Infrastructures in Health Care, DTU, Copenhagen, Denmark (2006), 2nd Human Factors Engineering in Health Informatics, Århus, Denmark (2007), Ledelse – brudflader og paradokser i ledelsesudfordringen, Det danske ledelsesakademi, København, Danmark, 2008, Medical Informatics Europe, Göteborg, Sweeden (2008), 42nd Hawaiian Internation Conference on System Science, Big Island, Hawaii (2009)

[10] In Danish, Dansk selskab for Medicinsk Informatik årsmøde, www.dsmi.dk. I see the yearly meeting of DSMI as a practitioner conference; there is no peer review and the audience is mainly practitioners, but there are also a number of researchers attending. I also see the DSMI meeting as an attempt to bridge the gap between researchers and practitioners.

[11] In Danish, EPJ observatoriet, which, in 2009, changed its name to E-sundhedsobservatoriet. http://e-sundhedsobservatoriet.dk/.

written in Danish, and some of the subjects are closely related to my research while others are more general. I have been contacted by various people that have read my debate letters and/or blog, including a CEO for a company producing healthcare information system software (electronic patient records), a manager from the medico industry, and a lecturer at a university college, which confirms that I have, in some way, managed to engage with people also outside of academia.

I have also been mindful to give feedback to my collaborators, either by presenting my results at formal presentations or at informal meetings. In both cases I aimed to create a space for engaging in discussions with the collaborators about the results.

PART TWO: THEORETICAL BACKGROUND

In Part Two the theoretical background for the thesis is presented. The theoretical elements presented in this section provide us with a vocabulary to discuss participation in evaluation regarding the implementation and design of HIS. The theoretical elements are reflected in the thesis title, and they are: participatory design, evaluation, HIS implementation, and the work system framework. The four elements are different in the sense that participatory design, which constitutes the main subject of this thesis, is a research field and a design approach. Healthcare information systems implementation is the domain for investigating and understanding PD. Evaluation is also a research field and a sub-subject because of its proposed role in the design of HIS. In contrast, the work system framework is applied as a perspective for understanding and investigating HIS and hence affects the understanding of design and implementation related to HIS. Because the work system perspective affects our understanding of information systems, and thus also healthcare information systems implementation, it has implications for participatory design and evaluation.

The four elements put together create an intersection, which is illustrated in Figure 5. The intersection of the four elements delineates the theoretical focus for the work carried out as part of this thesis.

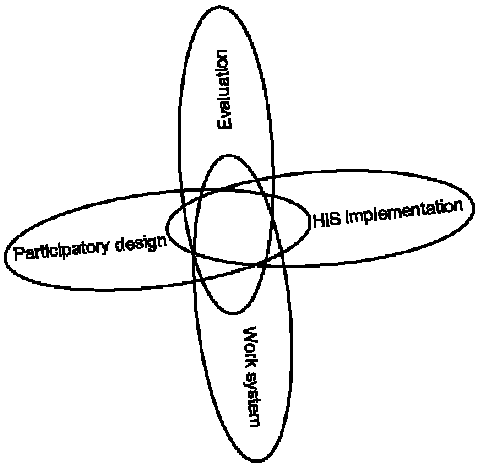

Figure 5: The four elements that constitutes the theoretical background

The theoretical background will be outlined by presenting each of the four elements in the following three chapters. In Chapter Three, HIS implementation and the work system perspective will be elaborated. Participatory design will be elaborated in Chapter Four, and in Chapter Five, evaluation, mainly in terms of formative evaluation, is elaborated. At the end of Chapter Five, some related approaches to evaluation are briefly presented.

Chapter Three: **Understanding HIS implementation and healthcare work systems**

In this chapter, two of the four elements are presented, HIS implementation and the work system perspective. One could argue that HIS implementation actually consists of two distinct elements, HIS and implementation, which is also correct. However, for the purpose of presenting the theoretical elements, I find it useful to juxtapose HIS and implementation as they, in this context, relate to each other and together constitute a main subject for this thesis. As described in Box 1.1, HIS is viewed as a subset of information systems, thus HIS implementation is also seen as a subset to information system implementation. Thus implementation will, in the following, be presented in relation to both information systems and HIS.

Implementation can mean many things thus I will start by explaining how I understand implementation and will later explain how it can be combined with a work system perspective.

3.1 HIS implementation

"The word implementation often causes problems" (Cornford 1995: p 45, cited in Magalhães 2000), mainly because it is used in different ways and is assigned different meanings by different people. In this section, I will briefly touch on some of the more traditional interpretations of the term implementation. I will then introduce some papers that present different, broader views of implementation, the latter of which have shaped my view of information system implementation and thus HIS implementation.

In a review of research on IT implementation, Lei and Mahapatra (1997) found that implementation was, in most research, conceptualised as "one phase of a total technology transfer process" (p 187). They placed implementation as the fifth phase after four pre-implementation activities: 1) basic research (marked investigation, innovation testing, IT user analysis); 2) technology development (cost/benefit investigation, feature/function analysis, IT design); 3) diffusion of information (market analysis, change agent analysis); and 4) adoption (analysis of, adoption decision, IT cost/benefit). Hereafter follows the implementation phase, which includes dealing with successes and failures, management, strategies for implementation, and impact on users, among other aspects. Implementation is followed by two post-implementation activities: outcomes assessment (diffusion rate, user satisfaction, success and failure, cost/benefit) and institutionalisation (organisational change, competitive advantages, integration). This view is in accordance with Klein and Sorra (1996: p 1057), who define implementation as

> "the transition period during which targeted organizational members ideally become increasingly skilful, consistent, and committed in their use of an innovation. Implementation is the critical gateway between the decision to adopt the innovation and the routine use of innovation within an organisation."

In a traditional system life-cycle approach, implementation is understood as a technical roll-out. It is a phase in the "classic" model of IT development, consisting of

analysis, design, code, test, and (technical) implementation (Boehm 1986). When implementation crosses the line to dealing not only with technical implementation but also with organisational aspects such as education of users, it is sometimes called "organisational implementation," but in many cases it is just termed implementation, despite any differences. I do mainly use the word implementation, but, as my view on implementation also entails a focus on organisational issues, it can be termed organisational implementation. Nevertheless, based on the perspectives on implementation described in the succeeding section, I consider implementation to encompass much more.

3.1.1 A broader perspective on HIS implementation

It is generally acknowledged that seeing implementation as a well-defined phase with clearly defined inputs and outputs is, in many cases, not adequate to understand the process of information system implementation. This is especially true in contexts where either the information system, the work it supports, and/or the environment of which it is a part is very complex (e.g., information systems in the healthcare sector) – or, in other words, when the implementation process entails emergent changes (Orlikowski and Hofman 1996). Hence, a considerable amount of information system literature has sought to improve, change, and enhance the understandings of implementation (Aarts et al. 2004).

Leonard-Barton (1988) proposed that implementation is an extension of the innovation process and that "implementation is a dynamic process of mutual adaptation between the technology and its environment" (p 252). Leonard-Barton's framework covers the initial implementation phase when technology is removed from laboratory settings and introduced to the user environment, and it has three implications: a) An adaption process is necessary because the technology will never fit perfectly into the complex user environment, which results in misalignments that must be addressed. b) The misalignments can be addressed either by altering/changing the technology or changing the environment or both in "cycles of mutual adaptation." c) Adaptation as a term is neutral; adaptation can have both positive and negative outcomes, but it is how you manage the process that will determine the outcome.

The mutual adaptation mentioned above is rather similar to what Giaglis terms "business engineering," which refers to a dual design strategy used to address "the alignment of business process change and information technology introduction in organisations"(Giaglis 1999: p 4). Business engineering is defined "as the integral, concurrent design of organisational processes and the information systems to support them" (Giaglis 1999: p 4).

Markus proposes "technochange management" as a framework for addressing "technology-driven organisational change" in which IT is implemented to drive organisation performance improvements. Markus argues that technochange differs from both IT projects and organisational change projects and hence requires a different kind of approach, including a different attention to the "solution and the process," than a combination of IT and change is able to deliver. Instead an iterative, incremental process focusing on a *technochange solution* consisting of a complete intervention –IT and complementary change, an "implementable" solution with minimal misfits, and an organisation primed to capture the potential benefits of the solution– is preferable. In addition, technochange encompasses a wider range of activities and

elements that, in traditional implementation approaches, would be seen as pre- and post-implementation activities, if addressed at all. Some of these activities called "shakedown" activities, which are undertaken when the solution has been launched, are: problem identification; reworking of activities and technical issues; and additional training and activities such as evaluation, continuous improvement, retraining, and technology updates, aimed at capturing the proposed benefits (Markus 2004).

In Berg's (2001) paper entitled "Implementing Information Systems in Health Care Organizations: Myth and Challenges," he refutes three myths about implementation. The first myth to be refuted is that implementation is a technical realisation of a planned system in an organisation. Instead it is an organisational change process that fundamentally affects the structure and processes of the organisation – a socio-technical change process. It is a mutual transformation of the organisation and the technology and should be conceived as organisational development, acknowledging that the HIS is intended to affect the organisation. The second myth is that information system implementation can be left to the IT department. As a continuation of the rejection of the first myth, the implementation should be managed by a project group with representatives from the IT department, top management, and future users. User involvement should play an important role, and methods supporting user involvement should be used. Furthermore, the implementation process should be flexible enough to take into account suggestions from users and changes arising form the implementation process itself. The third myth is the belief that the information system implementation and the required organisational redesign can be planned. Implementation is an uncertain and unpredictable process, and these inherent characteristics should be accepted and seen as learning opportunities rather than as obstacles that need to be overcome.

As a continuation of (Berg 2001), and based on a field study of the implementation of a HIS – namely a computerized physician order entry system – Aarts, Doorewaard, and Berg (2004) indentify three theoretical concepts that can help in understanding an implementation process: 1) *The socio-technical reality addressing the intertwinement of organisation, environment, and technology*. Part of this intertwinement is that the technical design is a result of the organisational arrangement, and the changes in the organisational conditions are rooted in the design. Hence, it is useless to try to determine whether problems are ultimately technical or human, as they are both. 2) *The unpredictable outcome of the implementation process: emergent change*. In complex settings, it is not possible to predict and plan the process in detail; rather, implementation can be understood as a process of emergent changes where new patterns and possibilities arise as a result of contingent events and decisions. 3) *Success or failure: producing fit.* There is no recipe for success as it is negotiated, but making the practice and the technology fit to each other seems to be a key factor. However, fit has to be actively produced and requires a thorough understanding of the work practices and how they can be improved and technologically supported.

Related to the notion of not being able to plan an implementation process, I would also like to mention *Plans and Situated Actions*, by Lucy Suchman (1987). In this book, Suchman explains why planning in terms of predicting or controlling actions is impossible due to the situated nature of actions. Instead, she argues that plans should be conceived of as "resources for situated action" (p 52), pointing out that we should

not give up planning as it does constitute some kind of resource, but that we should instead accept that plans have to be continuously revised.

Lastly, I would like to mention Orlikowski and Hofman (1996), who state that change in relation to information system implementation is an ongoing process and that the changes made during this process cannot be anticipated. Accordingly, they suggest an improvisational model of change management that includes three types of changes: anticipated (planned ahead), emergent (arising spontaneously), and opportunity-based changes (not planned for but purposefully introduced in response to unforeseen events or opportunities) (Orlikowski and Hofman 1996).

The literature presented in this section has shaped my understanding of implementation. I do not consider myself capable of defining implementation, nor do I think it is necessary for the purpose of this thesis. However, if I were to label my view on information systems and implementation, a socio-technical perspective, combined with a focus on what is sometimes termed organisational implementation, would probably be adequate.

3.1.2 The socio-technical aspects of HIS implementation

It is widely acknowledged that the implementation of information systems is far from merely a technical endeavour. Rather, information system implementations must also address organisational and human factors to be successful (Doherty and King 2005). This view can be found in various approaches to the implementation of information systems, including those mentioned in section 3.1.1. The decision to view the implementation of technology as inseparable from social and organisational factors is often referred to as a socio-technical perspective (Pasmore 1995; Clegg 2000).

There seems to be doubt about whether the socio-technical perspective stems from therapists assisting war-damaged soldiers (Mumford 2006) or whether it was derived from studies of British coal miners in the 1940s and 50s (Pasmore 1995). Despite these conflicting aetiologies, the socio-technical perspective is attributed to researchers affiliated with the Tavistock Institute. The Tavistock research led to the formulation of "a radical theory at the time that espoused the need to consider and optimize both the technical work processes and the social system operating within the work environment in order to improve organizational performance" (Westbrook et al. 2007: p 747). This theory is now widely accepted in many research environments, including information system research, and especially in today's HIS research (Berg 1999; Westbrook et al. 2007).

Finding the right balance between the socio-aspects and the technical-aspects in socio-technical research seems to be a challenge which is the subject of some of the criticism of socio-technical research. The bulk of the socio-technical literature tends to be very profound when it comes to the sociological aspects and deals with the technical aspects on a more conceptual level – viewing IT as a "black-box" (Orlikowski and Iacono 2001). Sometimes socio-technical research is extreme in its focus on the socio-issues. As Coiera describes it, socio-technical system "analysis can at its most extreme become a form of socio-ludditism, an anti-technology belief that because technology in human hands under-performs or misbehaves, it must be bad" (Coiera 2007: p 99).

Coiera (2007) encourages socio-technical researchers to put "the technical back into the socio-technical systems research" by finding a more technical language to describe the sociological issues in order to draw benefit from the vast amount of socio-(technical) analysis already there. Coiera suggests using the knowledge from the analyses in the design of IT systems instead of using only the socio-technical analyses to criticize the current instances of IT systems and current practices of design.

A similar issue was raised earlier by (Orlikowski and Iacono 2001) when they called upon researchers to be more concerned with the IT artefact itself in information system research instead of taking it for granted or presuming it to be unproblematic as soon as the artefact was built and installed. But, in general, inadequate treatment of organisational and social factors is identified as one of the most significant factors in failing IT projects (Doherty and King 2005).

Despite various attempts to operationalise the socio-technical approach – or at least make it accessible to practitioners in terms of coherent methods (e.g. Mumford 2000) or principles for design (Clegg 2000) – it has not had much practical or commercial success (Bygstad 2005; Doherty and King 2005). Ehn (1992) points to the lack of democratisation in the practical application of socio-technical approaches as a reason for the modest success in Scandinavia. However, Ehn also states that the socio-technical tools and design methods are very useful and in theory favour democratisation, but that the democratisation elements seem to disappear in the practical application. This also serves as an explanation for why participatory design developed from a discontent with socio-technical approaches still resembles many of the socio-technical approaches. In addition, the socio-technical approach has evolved in a more participatory direction (Ehn 1992).

I consider my self to have a socio-technical perspective; however, I find the duality of the socio-technical problematic. It sounds like a socio-technical approach to implementation consists of (only) two elements that must be given equal weight. But, in general, the socio-part seems to contain many different elements compared with the technical part. But are they still meant to be given equal attention? As we have seen in the above comments, finding the right balance between the two elements is not easy. Furthermore, it can be difficult to grasp what is hiding behind the socio-part, apart from aspects such as culture, organisation, power, and human. The term *technical* can be interpreted to include various artefacts such as hardware, software, and infrastructures. The lack of practical success for the socio-technical approach might partly be explained by this duality; at least insomuch as there has been an ongoing discussion of where the focus ought to be, as exemplified above.

To summarize, information system implementation in complex settings like the healthcare sector cannot be anticipated, hence the implementation process ought to be flexible and open to user input and emergent changes. Implementation is not only a technical matter but is just as much, or even more so, an organisational and human matter. Thus implementation should also be concerned with changes in work practices and other organisational issues apart from technical issues. However, there seems to be some difficulty in finding the right balance between the socio and the technical elements. The result is a socio-technical gap – a mismatch between the human and organisational needs and what the technological system is able to support.

3.2 Work systems

This section presents the work system framework (Alter 1999a) as a perspective for understanding information system, and thus also HIS, implementation. Alter has suggested the work system as an analytical framework to understand information technology and how it relates to the surroundings. Taking the problem of balancing the socio and the technical as my point of departure, I see the work system framework, as suggested by (Alter 1999a), as good and concrete suggestion for avoiding the socio-technical gap. As Alter puts it:

> Treating IT-reliant work systems as the core of the IS field will insure that both people and technology are present in the analysis, and will also avoid the commonly mentioned but unnecessary socio-technical split between the social system and the technical system. (Alter 2003: p 374)

The work system framework offers a set of terms to cover the social and technical aspects while retaining a general socio-technical mindset. The work system also implies the basic understanding that IT system(s) are deeply intertwined with the work practices and business processes and that the technology is not particularly interesting in and of itself, but rather in the way that it supports the business processes and the work system of which it is a part. A main argument is that "the work system may perform well despite the poor design and unfriendly nature of the information system. Similarly, the work system may perform badly due to problems that have nothing to do with the information system" (Alter 1999b: p 48).

The work system theory encompasses the work system framework, a static model presenting the elements in the work system, and the work system life-cycle model showing how the work systems form changes through iterations. However, for the purpose of this thesis, we will only be concerned with the work system framework as a perspective to analyse and understand participation and evaluation related to HIS implementation. Thus, I will not go into the other aspects of the work system theory.

Several years ago, information systems were something for experts and were mainly used by companies producing information system software. Today, information systems are an integrated part of almost every kind of company or field in the sense that they support work activities, production processes, and bring forward the information we need to make decisions. The healthcare sector is no different. Peoples' performances rely heavily on the performance of the information system – and vice versa.

It can be difficult to pinpoint where the information system starts and where it stops. The information system discipline has a problem defining itself, and there is no agreed upon definition of information system (Alter 2008). Alter suggests that instead of focusing too much on the information system, we should focus on the work system it supports. In most cases the interest is in the performance of the work system anyway – not the information system itself. Similarly, Earl (1992) advocates "putting the business back into IT" (p 100).

In the first volume of *Communication of AIS* Steven Alter presents "a general, yet useful theory of information systems" (Alter 1999a). It was meant as a response to an ongoing debate about core concepts of the information system field. But the theory was developed to help business and IT professionals understand and analyse information systems in order to improve them. Work system theory relies on general sys-

tem theory and thus reflects many of the ideas of system theory. I will refrain from going into system theory but will describe the work system framework.

To understand the basic premise of work system theory you must take a step up the micro–macro level perspective ladder from the information system step to the work system step. Which step to stand on depends on what you want to see. If you want to have a broad overview at the expense of the details, you should take a couple of steps up. But if you want to see the details you must walk down to one of the first steps. Consequently, you will not be able to keep the overview. In other words, the analytical level depends on the focus of the investigation. The focus in my research is the use of healthcare information systems in healthcare work practices; thus, the work system perspective seems to be suitable to encompass my research interest.

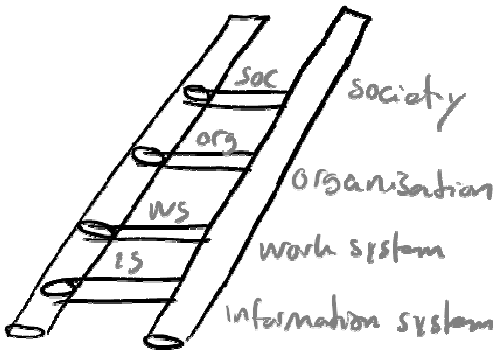

Figure 6: The ladder of perspectives

Alter has created a step above the information system level and below the organisational level (see Figure 6). At this step focus is on the work system, which provides a detailed view of work activities and the people performing them but a less detailed view of the information system that supports their work activities, compared with the step below. The organisation in which they perform the work is also important and influential, but in order to limit the focus, it is not as central to the analysis as it would be if one was standing on the organisational step.

The work system perspective is valuable, for example, where information systems are highly integrated into the work of the organisation, which is the case with many of today's information systems. As Alter puts it, "the real world we face has fewer and fewer information systems whose effectiveness can be evaluated totally separate from the work systems they support" (Alter 1999b: p 52). We are not talking about highly automated information systems but about cases where information systems are used to support and coordinate people cooperating in complex and emergent settings. Many healthcare information systems aim to support clinicians in accomplishing various activities related to treating patients; in some cases the data stored in the systems are also used for administrative purposes. Berg (2001) calls these primary and secondary care processes, respectively. In my work I have focused mainly on the support of primary care processes.

It is important to bear in mind that work systems exist only as a mental construct used to analyse and understand situations and problems related to information system implementation. Furthermore, the scope of the work system is a decision rather than a given, and the scope might change as the analysis unfolds (Alter 2006: p 33).

3.2.1 Work system framework

A work system is "a system in which human participants and/or machines perform a business process using information, technology, and other resources to produce products and/or services for internal or external customers" (Alter 1999b: p 44). Work systems can function with or without relying on information technology. An information system can, under certain circumstances, be defined as work system in itself (Alter 2008). However, my interest is in work systems that rely heavily on information system(s), mainly because most of today's work systems already rely on some kind of information technology. Thus, when I use the term work system, I am referring to work systems relying on information systems. Alter (2003) denotes it an IT-reliant work system, which is defined as "work systems whose efficient and/or effective operation depends on the use of IT" (Alter 2003: p 367). The IT in question could be one single system or a portfolio of IT systems. In these cases, the information system and work system are distinguishable but profoundly connected. Figure 7 shows the nine elements in a work system.

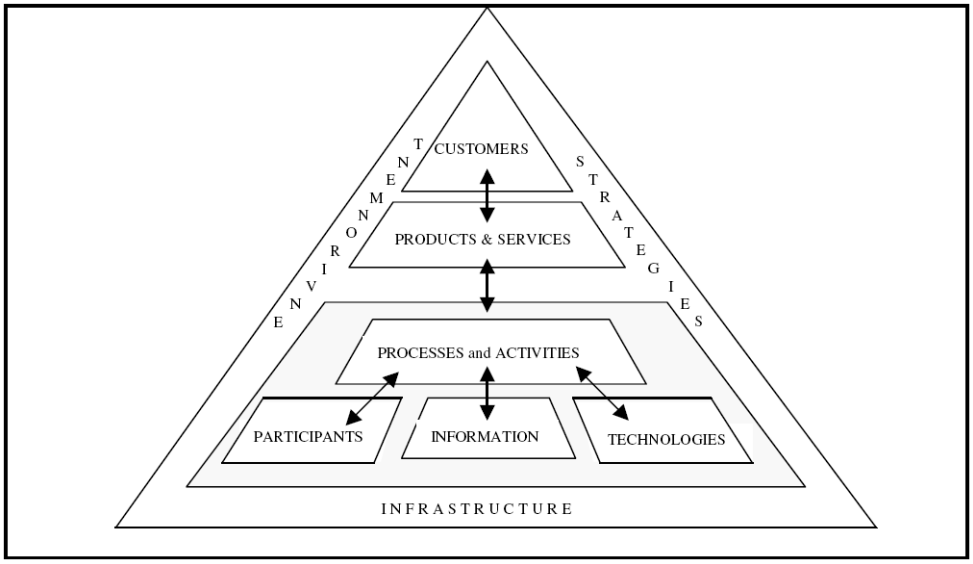

Figure 7: The work system framework (Alter 2009)

A work system consists of both internal and external elements. The internal elements (captured in the grey trapezium in Figure 7) constitute the sub-system performing the actual work, resulting in products and services. See Table 2 for an overview of the elements in the work system and a short description of them.

Table 2: Overview of elements in work system based on (Alter 2003)

INTERNAL	**Processes and activities (also referred to as work practices or business process)**	The work performed consists of numerous processes and activities. The actual processes and activities often deviate from how these are designed and formally described.
	Participants	People performing and taking part in at least some of the processes and activities. Some might use technology extensively while others do not use technology.
	Information	Codified or non-codified information used and created by participants performing their work. The information may or may not be stored on or captured by a computer.
	Technologies	Tools and techniques participants use while doing their work. E.g., cell phones, spreadsheets, PDA, software, cars, medication trays. The tools may or may not be associated with IT.
EXTERNAL	**Products and services**	The output of the work system. It can be tangible or intangible products, e.g., physical things or peace of mind; IT can be information or social products or a combination of the above.
	Customers	People, internal and/or external, receiving direct benefit from the products and services produced by the work system.
	Environment	The organisational, cultural, competitive, technical, and regulatory environment within which the work system functions. Though the system does not rely on the environmental factors directly in order to operate, the environment does affect the performance of the work system.
	Infrastructure	Human, informational, and technical resources that the work system relies on in performing the work. E.g., training and support staff, databases, networks, and programming technology. The resources may be internal or external and they may or may not be shared with other work systems.
	Strategies	A strategy, to the extent that it is clearly articulated, may help explain why the work system performs the way it does.

To understand a work system it is necessary also to understand the environment, for example, the external infrastructures and the managerial, organisational, regulatory, and competitive contexts that affect the operation of the work system. In most cases one does not have influence over the external elements, and thus one cannot change them. However, the external elements do, to some extent, affect the operation of the work system, and it is therefore important to understand the external environment For example, the regulatory environment can influence the design of certain work

processes or the technical infrastructure, as in the case of treating and storing sensitive patient data.

Within the socio-technical literature, the term "work system" has been used occasionally, which indicates that focusing on the work system as opposed to the information system, is not a new thing. However, the term has not been defined and used as an analytical object as clearly and explicitly as Alter does it in the work system theory (Alter 2008) – at least not in English texts. However, in a report about work analysis, Schmidt and Carstensen (1990) discuss the Danish term for work system, "arbejdssystem" as one of the elements to be concerned with when analysing work. They define arbejdssystem as "a system of cooperating actors and appertaining technical equipment" (p 245, my translation), thus an arbejdssystem is a social system. The arbejdssystem is related to its surroundings through its function, meaning that the arbejdssystem is a means to achieve a goal or a need stated by the surroundings. Like Alter, Schmidt and Carstensen underscore that the work system is an analytical entity and that it is important to be explicit and define the (sub)system to be analysed. Schmidt and Carstensen also distinguish between the structure and process related to the work system. The work system has a structure but can be transformed. However, Schmidt and Carstensen do not define what elements an arbejdssystem consists of apart from actors and technical equipment, making it difficult to define the arbejdssystem as a subject for analysis.

The work system framework suggests a different way of looking at information systems and thus also healthcare information systems. In other words, the work system perspective proposes that the focus shift from being on the HIS to being on the healthcare work systems supported by different healthcare information systems. What this means for the implementation of HIS will be elaborated in Part Three, where a participatory design approach to organisational implementation of HIS building on a work system perspective will be presented.

Chapter Four: **Participatory Design**

The purpose of the following chapter is twofold. First, it serves as an introduction to the research field that the work presented here aims to feedback to – participatory design. Second, it serves as a theoretical basis for understanding participation in evaluation. Thus, this chapter contributes to answering the research question by serving as a starting point for understanding participation in evaluation as part of design.

The field of PD is explored through the core principle of participation and through examples of literature that discuss the conceptualisation of design in PD. After exploring participation, a number of selected papers that deal with the future challenges of PD and request PD to develop and evolve are presented. Of these aspects, an enhanced conceptualisation of design is the most important. In continuation of this, a model for understanding complex participatory design processes is presented. Last, some examples on how PD is applied in relation to healthcare information system research are presented to show how PD is applied in Scandinavian healthcare information system research.

There is little hope for being able to find or create a single definition of participatory design that is both comprehensive and precise because, as Töpel puts it, "PD is not only *about* multiple voices and their inclusion in design – but also *has* multiple voices" (Törpel 2005: p 177). Furthermore, PD as a research field and a design approach has developed over time, meaning that what is considered PD today may not have been considered PD in the 1970s when PD was formed as a field of research. Several papers explore the historic origins of PD and provide very comprehensive overviews of PD from various perspectives (E.g. Bansler 1989; Floyd et al. 1989; Clement and Besselaar 1993b; Schuler and Namioka 1993; Kensing and Blomberg 1998). Thus, I will not challenge those papers in providing a historic overview. Instead, I will try to say something about PD by looking into the one principle that can be said, for certain, to constitute the core of participatory design, namely the principle of *participation.*

4.1 The impossible endeavour of defining PD

PD is often described by its principles and practices, as no coherent definition can be found. However, PD researchers seem to have different focus areas within PD and, hence, different principles and/or techniques that they see as most important. Therefore, it can be difficult to put forward a list of core principles or a minimum requirement for PD. Instead, PD may be seen as an umbrella term encompassing different issues concerning design either through theoretical discussions or through empirical investigation in a variety of projects.

Clement and Besselaar (1993a) took a retrospective look at PD by analysing a number of projects. To be sure they included all relevant projects, they used an intentionally broad definition to identify the initial sample: "A prominent feature of the projects had to be the intention to involve users as central actors in system development activities" (Clement and Besselaar 1993b: p 29). On the basis of their sampling, they indentified ten essential projects, and from those projects, Clement and Besselaar (p 31) indentified five ingredients for PD projects: 1) access to relevant information, 2) independent voice in decision making, 3) user-controlled development re-

sources, 4) appropriate development methods, and 5) organisational/technical flexibility. Four of the ten projects identified had all of the ingredients, while the other six included only some of the ingredients. The ingredients can be interpreted as principles for PD projects.

Kensing, Simonsen and Bødker (1998) do also present a number of principles. In the paper: MUST – A method for Participatory Design the authors present six indispensable principles on which their PD method, MUST, is based. The principles are: 1) participation; 2) close links to project management; 3) design as a communication process; 4) combining ethnography and intervention; 5) co-development of IT, work organisation, and user qualifications; and 6) sustainability. Later the principles were reduced to four principles: 1) coherent visions for change, 2) genuine user participation, 3) IT designers' need to experience the users' work practices and 4) anchoring visions for change (Kensing et al. 2007; Bødker et al. 2008).

To avoid a discussion of which are the "most" core principles of PD (that should therefore be emphasized at the expense of others), I will confine myself to exploring the principle of participation. Nonetheless, by exploring participation, we will get to touch upon some of the other principles mentioned above.

4.2 Participation – the core principle of PD

Participation, broadly understood as people being involved in or taking part in information system design activities, is, without a doubt, *the* indispensable principle of PD that all PD researchers can agree on. Some researchers operate with a clear distinction between participation and involvement (see Box 4.1); however, I will use these terms in somewhat similar manners without the specific distinction.

Participation vs. involvement
In many cases user involvement and user participation refer to more or less the same thing, namely potential users taking part in system development activities. However, some researchers (E.g., Barki and Hartwick 1989; Jarvenpaa and Ives 1991) argue for the importance of a clear distinction between user participation and user involvement. In this distinction, user participation refers to "a set of behaviours or activities performed by users in the system development process" (Barki and Hartwick 1989: p 53), and user involvement refers to "a subjective psychological state reflecting the importance and personal relevance of a system to the user" (Barki and Hartwick 1989: p 53).

Box 4.1

In the following sections we will explore participatory design by looking into the why, who, how, what and when of participation.

4.2.1 Why involve participants?

Many reasons can be found for involving participants. Greenbaum (1993) points out three different perspectives as arguments for participatory design. The first is a pragmatic perspective:

> It is generally acknowledged that approximately 60- to 80% of all problems can be traced to poor or inadequate requirement specifications. Obviously, computer systems need to better suit people's working practices. Since those who do the work know how it is done, we need to involve the designers of the systems with day to-day work experience early in the project, when the basic design choices are made. (Greenbaum 1993: p 47)

Thus, a pragmatic argument is that one should do PD because it will result in better systems and secure the adoption of the systems. Participants possess in-depth knowledge of the work tasks and work practices to be supported by the prospective design and should be involved in the design to help elicit the system requirements. In work system terms, this argument would mean that the participants have in-depth knowledge about the processes and activities that they perform in the work system but also extensive knowledge (tacit or explicit) of the work system to be improved.

The second perspective is a theoretical/philosophical perspective relying on the work of Heidegger and Wittgenstein. The basic argument is that users/workers and system developers have different experiences and, since they do not have much common ground, they will experience difficulties in understanding each other. One way of creating mutual understanding is to provide them with a common ground through PD techniques. This common ground can be established through mutual learning, where the participants teach the developers about their work practices and the developers teach the participants about system design and technological possibilities (Ehn and Sjögren 1991; Kensing and Munk-Madsen 1993).

The third perspective is political and rests on the argument "that in a democracy people have the right to influence their own work place, including the use of computer technology. As systems developers we have the obligation to provide people with the opportunity to influence their own lives" (Greenbaum 1993: p 47). The political perspective was predominant in the early PD projects where the goal was to achieve democracy in the work place through participation of all employees (Bansler 1989). It seems that PD in general has become less of a political endeavour and more of a rationalistic or pragmatic endeavour. However, more recently there have been researchers arguing for bringing the political/emancipatory aspect back into PD (Bjerknes and Bratteteig 1995; Balka 2006; Bossen 2006).

There are also other arguments for why users should be involved. Though many of these arguments can in some way be related to Greenbaum's three perspectives, I will present some additional arguments for why users should participate in order to show the variation in arguments for undertaking PD. In an editorial for the special issue on PD in *Design Issues*, Sanoff states:

> PD practitioners share the view that every participant in a PD project is an expert in what they do, whose voice needs to be heard; that design ideas arise in collaboration with participants from diverse backgrounds; that PD practitioners prefer to spend time with users in their environment rather than "test" them in laboratories. Participatory design professionals share the position that group participation in decision-making is the most obvious. (2007: p 213)

Here, the participants should be involved simply because it is the most obvious thing to do. As the participants are the experts, they need to be heard, and design ideas stem from collaboration with participants. In the introduction to another special issue

on PD, this time in *Human Computer Interaction*, Trigg and Anderson, continuing Greenbaum's political argument, emphasise that participants should be involved because they have the right to be: "Although differences abound, participatory designers share a fundamental respect for the people who use technology and for the right of people to have a direct influence on decisions that affect their lives"(Trigg and Anderson 1996: p 181). Trigg and Anderson (1996) and also note that a common characteristic of people practicing participatory design is a fundamental respect for the users of technology, which in itself can be an argument for involving them.

Bjørn-Andersen and Hedberg give two practical and one political reason, respectively, for participation: 1) improving the knowledge upon which systems are built, 2) enabling people to develop realistic expectations, and 3) reducing resistance to change and increasing workplace democracy by giving the members of an organisation the right to participate in decisions that are likely to affect their work (Bjørn-Andersen and Hedberg, 1977, cited in (Bjerknes and Bratteteig 1995: p 74).

The promises of participation

Many of the arguments presented for doing participatory design do, in various ways, rest on an implicit assumption that if we manage to involve participants in the right way, we will achieve better systems, democracy, increase the likelihood of adoption, etc. So, on one hand, there are great expectations that PD can improve the success rate of information system implementation (Shapiro 2005), and, on the other hand, PD provides great promises that it can live up to the expectations. However, whether this is the case is questionable. For example, a review of the influence of user involvement in the system development process on information system success did not confirm any relationship between user involvement and information system success (Ives and Olson 1984). I will not go into a discussion of whether or not PD promises too much. Instead, I will take the stance that PD is right[12] and thus is attractive despite the fact that it may not improve system quality. However, influenced by my Scandinavian upbringing, I believe in democratic values and that people should have opportunities for influence and co-determination in work-related issues such as design and implementation of information systems. In other words, the work in this thesis rests on the assumption that participation in design is attractive and is thus worth trying to understand and apply.

Box 4.2

After having put forward the reasons for why to enforce participation, it would be appropriate also to look at some arguments for why not to involve participants. One argument (also mentioned in Box 4.2) is that user participation does not necessarily influence the information system success. Another argument is that user participation does not seem to enforce radical changes (Scacchi 2004), which in some cases are valued as necessary, for example, in the tradition of business process reengineering (Hammer 1990).

[12] In the meaning morally justifiable or incumbent; in accordance with what should be; equitable, justly to be preferred or commended (The Chambers Dictionary 2003, 9th edition, p 1303).

4.2.2 Who is participating - workers, users, or participants?

Participatory design is a neutral term in the sense that it does not say anything about *who* is participating. In the early generations it was the *workers* who participated. But when the projects started to include management, the term *users*, meaning the prospective users of the technology being designed, was used. The term users was also used in projects without management participation, referring to the people who were going to use the technology. However, the term user has some disadvantages. Bødker (1996: p 217) points out that users are not just users of a computer system. They are different; they belong to different hierarchy levels, they cooperate with others, and they are part of an organisation that enforces certain structures and relations. Greenbaum and Kyng also find the term user problematic, as it tends to draw attention away from the actual work that people do, and instead focuses on the situation where they sit in front of the screen (Greenbaum and Kyng 1992: p 3). Bannon (1991), in his paper From Human Factors to Human Actors, advocates having a better understanding of users not only as the human factor of systems but by understanding them as skilled actors that are both users and designers, as they often need to tailor and make modifications to the systems. For an elaborated discussion of the term user in relation to PD, refer to (Suchman 2007: p 188-193).

According to the issue about *who* is participating, an implication of the work system perspective is that those participating would be the participants of the work system – those performing the processes and activities supported by information and technologies to deliver the product and services to the customers, or, in this case, the patients. This group might entail, for example, both on-the-floor hospital workers and managers at various levels in the organisation. In early PD, the participation of management was inconceivable, as it would have contradicted the aim of empowering the workers in relation to the management (Ehn 1992). However, it was recognised that management plays an important role in the design and implementation of information technology. The focus then shifted toward involving stakeholders throughout the organisation, at the same time acknowledging the potential conflicts that exist between the stakeholders (Bødker 1996). PD also became one way of dealing with the inherent conflicts existing in the organisation (Kensing et al. 1998). Despite the involvement of management having been on the PD agenda since the early 1990s, their participation is often intentionally restricted (Kensing and Blomberg 1998).

One could also argue that other stakeholders related to the work system should participate, for example, the customers, or, in our case, the patients. In healthcare there has been an increased focus on involving patients in the design of health-related technologies. I have studied healthcare information systems that support the work system in which mainly clinicians perform the core activities. For this reason, I have focused on the involvement of clinicians and not patients.

4.2.3 How to involve participants?

A large part of PD research is concerned with developing methods, tools, and techniques to support the involvement of participants. A method can be seen as a kind of recipe prescribing certain actions (see Andersen et al. (1986) for a distinction between methods, tools, and techniques). There exist several participatory design methods comprising a collection of tools and techniques as well as a certain perspec-

tive. Examples of such comprehensive methods are MUST (Bødker et al. 2004), Contextual Design (Beyer and Holtzblatt 1998), and ETHICS (Mumford 1993).

Tools and techniques can be divided in two categories: 1) those supporting the studies of the work, such as observation and video analysis, inspired by ethnographic techniques, and 2) those supporting the design process, such as scenarios and prototyping (Kensing and Blomberg 1998). The first group of techniques are related to the pragmatic argument for involving participants, revealing the needs of the participants by exposing their work practices. However, participants are not always able to explicitly account for their actions. For example, it can be very difficult for a physician to explain how she establishes an overview of a patient and what that overview consists of. Another aspect is the say/do problem. One might think one performs a certain task in a certain way – maybe the way it is suppose to be performed by the procedure manuals – but in many cases people do things differently than they say they do.

The second group of techniques related to design originates from the problem of trying to apply the tools and techniques of traditional system development methods in a collaboration between workers as prospective users and researchers (Greenbaum and Kyng 1992). The early PD projects sought to create workplace democracy by involving the users in a democratic design process. However, the very formalistic ways of traditionally expressing design were not understood by the workers, and thus it was difficult to create equal collaboration between workers and researchers. Consequently, much of the PD research shifted toward developing more inclusive approaches and methods for engaging and involving the workers/users in design in order to support user-developer communication and mutual learning (Kensing and Munk-Madsen 1993; Bødker et al. 2004). Some of the widely used techniques within PD to support user-developer communication are mock-ups and prototyping. (See Paper III for a short description of various types of prototyping.) Involving stakeholders from different hierarchical levels of the organisation also evoked a need for new methods and techniques. The MUST method (Bødker et al. 2004) can be seen as a response to that need.

The tools and techniques are not necessarily specific to the PD method, and the same tool can easily be found in different methods (e.g., mock-ups can be used individually but are also used within both MUST and Contextual design). For a comprehensive list and explanations of tools and techniques see (e.g., Kensing and Munk-Madsen 1993; Beyer and Holtzblatt 1998; Bødker et al. 2004).

4.2.4 Participation in what and when?

Participatory design was neutral in terms of who was participating, but it is not neutral in the question of *what* the participants participate in. They participate in *design*. In many of the PD cases described, people participate in the design of small-scale or stand-alone systems, many of them with homogeneous user groups (Oostveen and Besselaar 2004). This is also true for PD in healthcare settings (Bjerknes and Bratteteig 1988; Pilemalm and Timpka 2008a). Shapiro (2005) encourages the PD community also to engage in large-scale information system projects and to apply PD in those settings, as he strongly believes that PD has something to offer, especially large public information system projects.

In most of the PD literature I have read, design does seem to refer explicitly or implicitly to design understood as the first phases of a traditional system development lifecycle, for example, as presented in (Giaglis 1999), or design in feasibility and pilot studies, with a strong focus on user needs and requirement specification. In the MUST method, it is explicitly stated that PD is a method for design, understood as a coherent vision for change as part of the contractual bid (Kensing et al. 1998). However, in other texts (e.g., Sjöberg and Timpka 1998; Simonsen and Hertzum 2008) the understanding of design is more implicit, but it still leans toward design as something related to system development. . The perception of design as pertaining to development is substantiated by the many PD methods and techniques that support early system development activities, such as mock-ups and future workshops (e.g., Kyng 1988).

Conversely, there are a number of articles wherein the understanding of design goes beyond that of design only as a phase in a system-development life cycle. For example, Bratteteig advocates for user participation in redesign, where redesign includes both technical and organisational changes after the implementation and use of an information system (Bratteteig 1994). Dittrich et al. (2002) present a study where design also happened during what normally would be regarded as use. What is meant by design will be elaborated at the end of this chapter.

How much participation is needed in order to do PD? As described in Section 4.1, there is no minimum requirement for participation when trying to define PD. The degree of participation, as well as the reasons for participation, does differ in the various PD projects and understandings of PD. However, participation can be seen as a continuum where at one end participation is limited to providing designers with knowledge of the users' job tasks. The users are involved because their description of their work tasks is considered valuable for the design, but they have little or no influence on the design or the outcome. Many PD researchers would probably not characterise projects with such limited participation as PD projects. At the other end of the continuum users are involved not only because their contributions are considered of great value for the design but also because they have the right be involved and have influence on changes affecting their work. Here the users take active part in a number of activities right from the beginning of the projects and are given a large amount of influence on the design and outcome (Kensing and Blomberg 1998; Granlien 2008).

In addition, there is no exact answer to how much participation is optimal. The degree of user involvement depends on the project; for example, if you develop a compiler, or if you copy existing, well-functioning features and apply them in a similar domain, a limited degree of participation might be adequate (Grudin 1993).

In the previous sections, our understanding of participation in relation to participatory design has been elaborated through the investigation of why participation is attractive, who should participate in what way, and when they should participate in what. In the latter, the design part of PD has been briefly touched upon. In the following section more attention will be given to the aspect of design. Different perceptions of design in relation to PD will be dealt with by presenting some articles in which challenges related to the conceptualisation of design in participatory design are put forward.

4.3 Some challenges for participatory design

PD has been, and still is, a developing research field. One of the main drivers for this development has been the expansion of the application area of PD. Computers and information technologies have developed drastically since 1970 when PD first surfaced. Furthermore, because (or as a result) of the transition from an industrial society to an information society, at least in the western world, combined with new technological possibilities, the kind of projects that PD researchers are now engaged in are very different from the projects of the 1970s. Thus PD has evolved and developed over time.

As mentioned earlier, PD has multiple voices and thus evolves in multiple directions. However, some researchers have pointed out areas where they see a need for PD to evolve and expand. This could be because they would like PD to evolve in a certain direction. It could also be because they do not see that PD has developed at the same pace and in the same direction as the changes in the application area. I will focus on the latter in the following. I have selected a number of papers pointing out challenges for the development of PD. The challenges have helped explain some of my empirical findings and have shaped my understanding of design. Some of the challenges will be further addressed in the theoretical framework presented in Part Three. There may be other relevant challenges presented in other articles not mentioned here.

Markus and Mao (2004), in their paper Participation in Development and Implementation - Updating an Old, Tired Concept for Today's IS Contexts, came up with a suggestion for how participation theory in information systems can be "revitalised" to accommodate the changes in the information system practice. The scope of information system projects has changed substantially, and in many cases it now encompasses the entire organisation if not several organisations. Consequently, only a very small percentage of prospective users can be involved in the design or configuration/adaption of the system. This undermines one of the arguments for participation – that it leads to a commitment to using the system if the users have taken part in designing. Furthermore, Markus and Mao suggest a more fine-grained conceptualisation of the different kinds of users, and they recommend distinguishing the users in terms of the stakeholder groups of which they are a subset, who selected the users, and how the user groups are composed.

Another issue is that in many of today's so-called information system projects, it can be difficult to distinguish the "system" from other aspects of the IT-enabled change process, such as job redesign and development of infrastructure or the work space. Thus, Markus and Mao (2004) argue that researchers studying participation in the changed information system context should replace the system with "solution." They define solution as "a package of IT plus complementary changes" (Markus and Mao 2004: p 526). The suggestion of looking at the solution as opposed to the system is in line with Alter's suggestion to make work systems the analytical object.

Wagner and Piccolo (2007) point to the problems of achieving *true* participation. True in the meaning of real engagement in the process – not just formal participation, but true participation – which can be very difficult to obtain, and many projects fail in involving and engaging users despite good intentions. True participation is similar to the principle of genuine participation in MUST (Bødker et al. 2004). Wagner and Piccolo found that users are often very busy with their daily work and they generally

will not become engaged before their work is impacted by the new technology or the changes, which often means at the time of "go-live." Thus, it is difficult to engage users in early phases of design and implementation. This is not to say that there is no value in involving users from the beginning, but one needs to think differently about how and when to involve users. Consequently, Wagner and Piccolo suggest viewing post-implementation activities as necessary activities where true user participation can occur, instead of seeing them as a sign of project failure (Wagner and Piccoli 2007). The implications of Wagner and Piccolos findings are rather far-reaching and radical in the sense that they suggest that participation in the early design process is of little value or, at least, very hard to gain insight from. Instead, they argue, participation should be emphasised in the later design processes, which is contrary to most PD literature. In addition, it can be argued that participation in the late phases of design is problematic as fundamental design decisions would most likely already have been made.

Dittrich et al. (2002) suggest broadening the understanding of design, taking participatory design beyond software development. By looking at IT in use and existing work practices (as opposed to a software development project) Dittrich et al. had to change their understanding of design from that of an activity only for professional software developers to an activity also performed by what they called "user-designers," where users are designing for design in use in many different locations. Furthermore, according to Dittrich et al., "design is seen as continually on-going in many different locations and forms, and intricately interwoven with use" (2002: p 131). These findings call into question the basic assumptions for PD and the methods used. Consequently, software design processes and developing methods need to be reconsidered and more closely linked to continuous user feedback (Dittrich et al. 2002).

The users-developer relationship and communication is an important aspect of participatory design. Despite this importance, it is a rather understudied aspect of user participation (Gallivan and Keil 2003). Gallivan and Keil (2003) found that user participation has to be managed in order to achieve the potential benefits of participation. It is important to be aware of what the users do *not* tell you and that the users are not necessarily capable of seeing and explicating the "true" problems – at least not if these problems may be rooted in more fundamental problems or underlying assumptions. In an example from (Gallivan and Keil 2003), the users kept complaining about system response time – which could be seen as a less sensitive explanation for not accepting the system. However, the true or real reasons seemed to be rooted in more fundamental issues of motivation incentives, task/technology fit, and unspoken issues about whether the users or the developers controlled the design process (Gallivan and Keil 2003).

As a continuation of Shapiro's call for PD to engage in the development of large-scale (public) development projects (Shapiro 2005), Simonsen and Hertzum point to four challenges for PD if it is to be extended beyond initial design. These challenges are: 1) obtaining appropriate condition and focus for PD, 2) managing a multitude of stakeholders, 3) managing stepwise implementation, and 4) conducting realistic large-scale PD experiments. To deal with these challenges, they suggest a "sustained PD approach," (see Figure 8) extending the iterative PD approach by integrating the main principles from Orlikowski and Hofman's (1996) improvisational model for change management.

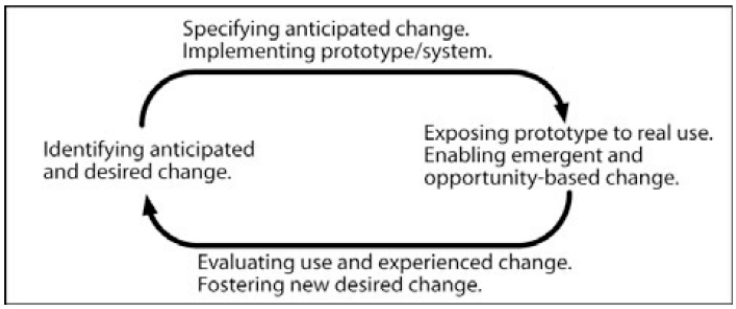

Figure 8: Outline of a sustained PD approach (Simonsen and Hertzum 2008)

Simonsen has expanded this iterative approach to design by suggesting that ethnography should play an important role during real use in order to identify emergent changes and suggest new design possibilities (Simonsen 2009b). Simonsen has also expanded the design approach to serve as a general understanding of complex design processes, which he presented during his inaugural lecture for a professorship in Design Studies at Roskilde University on November 11th, 2009[13]. In this lecture, Simonsen explained that complex design processes are also change processes (illustrated by a change from A to B, see Figure 9) and they are iterative and experimental in nature because they enforce mutual learning among numerous actors. However, complex design processes are also concerned with emergence, as new possibilities are experienced and indentified when the IT systems are being used in real-life settings. If we are to take emergent opportunities into account, design does principally become an ongoing activity where an evaluation of the design in use becomes part of the design process. The design process illustrated in Figure 9 is, among others, based on studies from the Danish healthcare sector.

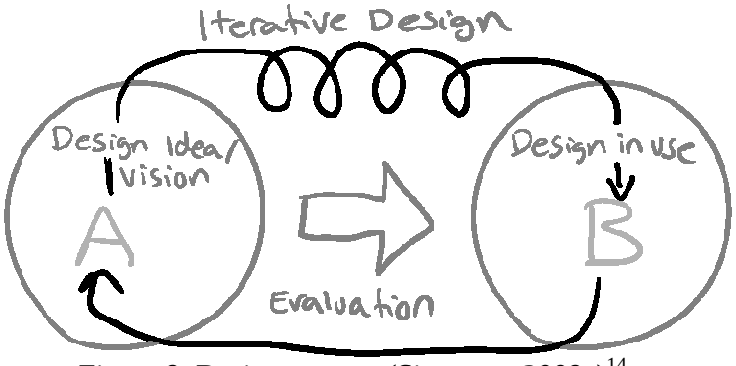

Figure 9: Design process (Simonsen 2009a)[14]

In this section the conceptualisation of design in PD has been challenged and a broader understanding of design has been suggested.

Like the literature that suggested a broader view of implementation (see Section 3.1.1), the literature presented above has shaped my understanding of design and what challenges PD needs to address. In particular, the design process presented by

[13] The lecture can be seen here: http://www.ruc.dk/cbit/nyheder/forelaesning_JS/
[14] The figure is a remake of the figure that Jesper Simonsen presented in his inaugural lecture. I have translated the text to English.

(Simonsen and Hertzum 2008; Simonsen 2009a; b) has formed my basic understanding of complex design processes in participatory design.

4.4 Participatory design in healthcare

PD has been widely applied in healthcare information system projects during the past decade. In the following section, I will present some different examples of participatory design in Scandinavian healthcare settings to show the variety of PD studies in healthcare. The examples seem to be quite similar to PD projects carried out in fields other than healthcare.

One of the first PD projects in a healthcare setting was probably the Florence project. This project focused on the work of nurses and how it could be supported by technology and also on how nurses could be enabled to participate in designing information systems to support their work. The project resulted in a work sheet system appreciated and used by the nurses (Bjerknes and Bratteteig 1987; 1988).

Sjöberg and Timpka (1998), in the introduction to their 1998 paper, point to what they consider the surprisingly scant prevalence of PD in the development of healthcare information systems. They conducted a study of a PD process in the early design of a technology-assisted network created to support teamwork and organisational learning among a group of co-located general practitioners in Sweden. They found two main implications for using PD in healthcare, 1) the need to consider the consequences and the form of participation, and 2) that instructions for the non-designers should be used to introduce them to the process and objectives of the design.

Pileman and Timpka (2008a) developed a renewed framework for PD in healthcare in response to a number of limitations they indentified in existing methods. The main argument for a renewed PD approach is that PD methods in healthcare have mainly been applied to small-scale systems with homogeneous user groups. It has been a general critique of PD that it is mainly applicable in the design of small-scale, standalone systems (Shapiro 2005; Simonsen and Hertzum 2008). However, the complex characteristics of the organisation and work performed in healthcare requires large-scale systems. Consequently, there is a need for extending the PD methods to apply to those settings.

Clemensen and colleagues (Clemensen et al. 2007) reported on a PD study of the development of home-based treatments for foot ulcers. They involved representatives from several user groups in the study – patients, general practitioners, and visiting and hospital nurses. Based on their findings, they provide a number of recommendations for doing PD in healthcare: establish a multidisciplinary research team, gather a group of participants with representatives from all stakeholders of the field in question, do not anticipate the results, and create a relaxed and undisturbed environment to facilitate creativity.

A different example of PD in healthcare comes from Simonsen and Hertzum (2008), who proposed and applied an iterative PD approach as part of a large-scale PD experiment on a Danish hospital ward. The experiment consisted of a configuration and a five-day, full-scale pilot test of a clinical process module. On top of generating experience with participatory configuration and implementation of the module, the experiment was intended to provide empirical input to the research questions: “How can desirable effects be identified and specified in collaboration with the clini-

cal staff, and how can realistic experiments be conducted using EPR systems during real clinical work?" (Simonsen and Hertzum 2008).

The PD method MUST has also been applied in healthcare to evaluate a shared care initiative to support shared pregnancy records. MUST was deemed relevant for healthcare projects, and especially for shared care projects, where neither IT designers nor healthcare professionals have good models for how such shared care applications should look (Kensing et al. 2007). "PD has also been suggested as a way of supporting the healthcare philosophy of 'patient empowerment' where patients actively take part in the healthcare process" (Kensing et al. 2004).

All the above are examples of PD applied to stand-alone projects and the initial phases of design and development.

Through two cases studies of electronic patient record implementations at a Danish hospital, Kanstrup and Bertelsen (2006) introduce the concept of participatory IT support, and they contribute with knowledge for defining skills for participatory IT supporters. Pointing to the similarities between PD and local IT support, they suggest that PD should pay attention to the area of IT support.

Chapter Five: **Evaluation as part of Design**

In Chapter Five, the last of the four elements is presented, namely evaluation. Evaluation was briefly mentioned in relation to the presentation of the design process outlined in section 4.3. In this chapter, the theoretical foundation for evaluation in relation to design and implementation of information systems is presented.

Evaluation is a large research field in its own right, and it is related to a number of domains, such as teaching and social programmes. But evaluation also constitutes a substantial research area within information system and healthcare information system research. This chapter begins with a brief introduction to evaluation in relation to HIS. The type of evaluation mostly relevant for the theoretical intersection is formative evaluation, which will be described in relation to summative evaluation. Also, some thoughts on evaluation criteria and objects of evaluation will be presented. Finally, some related work on evaluation will be presented.

Evaluation in its various forms has been part of information system research, and also a key component of HIS research, since the 1970s (Hamilton and Chervany 1981; Talmon 2006). In healthcare, evaluation has played and important role in supporting decision making related to patient treatment – for example, in relation to the notion of evidence-based medicine. But according to (Southon 1999), evaluation should also play a role in supporting decision making related to IT and change, such as choice of technology and how to implement it.

Evaluation within health informatics has been influenced by the traditions of medical evaluation, particularly randomised control trials. However, this approach has been criticised for its inability to address the complex contextual issues associated with HIS implementation and for the presumption that factors such as hardware and training can be disentangled from the social factors (Klecun and Cornford 2005). To evaluate implementations in complex and emergent settings a rather different style of evaluation might be needed (Southon 1999).

In recent years, the field of HIS evaluation has widened, and evaluation is now considered a broad activity that deals with many aspects of HIS implementation, such as technical, organisational, economic, ethical, and legal issues (Doherty and King 2003; Kaplan and Shaw 2004; Talmon 2006). Evaluation is no longer seen only as a post-project activity aimed at assessing the "result"; it is also an ongoing activity at all stages in HIS development and implementation, and its purpose is to support reflective (organisational) learning and prevent failures, or, as Berg et al. (2003: p 299) put it, "From evaluating failure to evaluating to prevent failure." However, this seems to be more of a wish than an actual trend, especially when looking outside the field of HIS evaluation research and into the practical world of HIS project managers and policy makers. Here, evaluation still suffers from a lack of focus, funding, and appropriate methods. And if an evaluation is undertaken, it is mostly concerned with cost-effectiveness (Rigby 2001; Ammenwerth et al. 2004; Lehoux 2006; Rigby 2006).

5.1 Two types of evaluation

Evaluation is often divided into two types: summative and formative evaluations, also termed outcome/result and process evaluation (Hansen 2005). There has been

some discussion about whether the two types of evaluation are mutually exclusive or whether they can be combined. The conclusion seems to depend on the purpose of the evaluations. A summative evaluation provides information on the outcome or effectiveness of an intervention to support the decision makers in whether to continue, adopt, or terminate the intervention. For an overview of summative evaluation as post implementation evaluation of information systems, see (Kumar 1990). A formative evaluation is meant to provide information throughout the process of implementing an intervention in order to help improve the process to accomplish the means and improve the outcome of an eventual summative evaluation. In this perspective, summative and formative evaluation do not exclude each other, but if the purpose is learning, they do. In a learning perspective, formative evaluation is concerned with supporting a reflexive learning process, whereas the summative evaluation is concerned with control. The formative side would argue that learning can only happen if there is no external inspection or control and, as a result, no possible threats. (Dahler-Larsen 2008)

Summative evaluation methods are based on the assumption of a stable target and environment. The design of summative evaluation builds on a set of conditions; if these conditions or the circumstances change during the implementation or use, either due to internal or external factors, "there is little point in holding people to account for a situation beyond their control and which may no longer be relevant" (Farbey et al. 1999: p 249). Instead, Farbey et al. (1999) argue that, in a setting where conditions, values, and external factors are changing, an evaluation process that can include unanticipated and opportunity-based effects is preferred. Instead, a formative evaluation method, which is able to handle uncertainty and unexpected occurrences, is required. This view is supported by Hansen (2005), who recommends formative evaluation when the goal is to create improvements by means of learning, and summative evaluation if the goal is to control performance (Hansen 2005).

Hamilton et al. (1981) state that formative evaluations can be used to qualify the summative evaluation. Farbey et al. (1999) had the same belief; however, they have realized that if the setting changes, there is no point in holding onto the original evaluation criteria (i.e., if the premises for the evaluation or the criteria have changed). Farbey et al. (1999: p 250) define formative evaluation as "evaluation for informing the present and learning from the past." Thus formative evaluation is beneficial in its own right as it helps organizations avoid repeating the same mistake (Farbey et al. 1999). An important aspect of formative evaluation is the potential for including emergent and opportunity-based effects since, in practice, benefits often stem from unanticipated possibilities related to the introduction of IT (Kaplan and Shaw 2004). In the following quote, Orlikowski and Hofman explain why we need to account for emergent changes:

> Over time, however, use of the new technology will typically involve a series of opportunity-based, emergent, and further anticipated changes, the order of which cannot be determined in advance because the changes interact with each other in response to outcomes, events, and conditions arising through experimentation and use. (Orlikowski and Hofman 1996: p 13)

A formative evaluation process that includes emergent changes potentially conflicts with McGowan et al.'s (2008) definition of formative evaluation, which they define as an "iterative assessment of a project's viability through meeting defined bench-

marks" (p 297). There is a conflict if the benchmarks mentioned in the definition above are pre-defined and stable; if this is not the case, and the benchmarks are considered to be iteratively re-defined during the evaluation process, McGowan et al.'s definition can also account for emergent changes. However, for formative evaluation to be part of and to improve the complex and unforeseeable process of organisational implementation, iteratively reflecting upon and (re)defining the evaluation criteria is necessary. In Box 5.1 I present the understanding of formative evaluation that I have reached during my research process, meaning that my definition is based on theoretical inspiration and informed by the empirical experience with design, implementation, and evaluation.

Formative evaluation
Formative evaluation is an iterative assessment with the purpose of improvement through iterative feedback and learning. The focus is on achieving the best possible as opposed to achieving a pre-defined goal. Formative evaluation should be designed in such a way that it can recognise and include emergent and opportunity-based effects and act upon them to achieve the best possible outcome.

Box 5.1

This definition or understanding is a continuation of Berg's point about "evaluation to prevent failure," and it aims at capturing all the advantages of formative evaluation stated by (Kaplan and Shaw 2004: p 222) such as: allowing for changes and uncertainties, capturing the fluid nature of project and evaluation objectives, enhancing organizational learning and buy-in, identifying unexpected or emergent benefits, monitoring and learning from the process of user "re-invention" and mutual adaptation, and influencing system design or implementation.

However, one needs to be aware of the possible downside of learning, as "overindulgent learning can generate out-of-control activity" (Ward and Elvin 1999: p 206) and create project escalation (see Paper III for description of escalation). Thus one has to find the right balance between learning and control, similar to the balance between continuity and change (Bratteteig 1994).

Formative evaluation is one type of evaluation and it has previously been described almost as a counterpart to summative evaluation, or at least in relation to how it differs from summative evaluation. Formative evaluation is most appropriate for supporting opportunity-based and emergent changes and when the evaluation has a learning objective.

5.2 Evaluation criteria and their implications

Regardless of the definition or type of evaluation, a key activity in doing evaluation is specifying a set of evaluation criteria. These criteria can be formulated in terms of indicators, performance indicators, critical success factors, effects, benchmarks, standards, etc., and often they are used synonymously with the term evaluation. In summative evaluation, the specification of the criteria plays an important role because the criteria cannot be changed during the evaluation in the way that they can in formative evaluation (Farbey et al. 1999; Kaplan and Shaw 2004). According to

(Smith 1995) and (Dahler-Larsen 2008), a set of pre-defined evaluation criteria have a number of possible implications (Table 3).

Table 3: Implications of indicators in evaluation

Tunnel vision	Focusing on quantifiable measures at the expense of unquantifiable, and focusing on the anticipated effects at the expense of opportunity-based effects
Suboptimisation	Pursuit of narrow local goals and effects at the expense of larger goals on, for example, the organisational level.
Short-sightedness	Focusing on short-term goals, measurable within the time frame of the evaluation, at the expense of long-term benefits
Measure fixation	Pursuit of the reported measures only, rather than of the associated objectives
Misrepresentation	Manipulation of data to improve the reported behaviour, which then differs from the actual behaviour
Misinterpretation	It is easy to misinterpret data since the effects measured are a reduction of the complexity of the instance being evaluated, and the external influence can be difficult to capture.
Gaming	Different kinds of strategic behaviours, for example specifying very low goals to make them easier to obtain or to improve them the next year.
Ossification	Pursuit of the predefined effects measured at the expense of innovation and blindness to opportunity

The possible implications listed in Table 3 indicate that performing evaluations based on pre-defined evaluation criteria happens at the expense of a number of positive effects and opportunities, such as innovation, the possibility of pursuing opportunity-based effects, or the chance of reaching a better outcome than specified. In this perspective on evaluation, approaches like effect-driven IT development (Hertzum and Simonsen 2004; Simonsen and Hertzum 2005) and the GEP-HI Guidelines for Good Evaluation Practices in Health Informatics (Nykänen and Brender 2008) will run into difficulties, as they are primarily based on predefined indicators. One of the key concepts of effects-driven IT development is to specify desirable effects from the use of an IT system and to base the procurement contract on these effects. The effects can also be used as formative measures to (in)form the design and implementation process. In the case where the contract is based on effects, one of the pitfalls could be that when developing and implementing the system, one only focuses on attaining the effects specified in the contract. If this happens, the project or organisation risks suffering from tunnel vision and suboptimisation and thus risks missing out on emergent and opportunity-based effects that could leverage the outcome beyond what is stated in the contract.

5.2.1 Specifying evaluation criteria

According to Cameron and Whetten (1983, cited in (Seddon et al. 1999) the first question one must ask when evaluating organisational performance is, “from whose perspective is the effectiveness being judged?” Here they assume that the effects evaluated are related to effectiveness; this is not necessarily so, but we will return to that later. However, reflecting on the perspective is important because what counts as

desirable effects depends on who you ask. Grover et al. (1996: p 182 cited in Seddon et al. 1999) list four different classes of evaluation perspectives: 1) users, 2) top management, 3) information system personnel, and 4) external entities (e.g., politicians).

Some of the evaluation literature points to the issues about the perspective of the evaluation (e.g. Kumar 1990; Seddon et al. 1999; Klecun and Cornford 2005). However, few are concerned with *who* is to specify the effects. For example, Kumar (1990) points out that evaluation criteria are, in most cases, defined by those who have designed the system or managed the implementation. Not even in rather concrete tools aimed at supporting evaluation like Effects Measures of Public IT Projects (Telestyrelsen 2007) or Guidelines for Good Evaluation Practices in Health Informatics (GEP-HI) (Nykänen and Brender 2008) is there guidance on who is to specify the evaluation criteria.

To summarize, I have argued that formative evaluation is the most useful and constructive type of evaluation when concerned with the design and implementation of healthcare information systems. Formative evaluation is especially relevant when the purpose of doing evaluation is improvement and learning, as the iterative process in formative evaluation creates opportunities for personal and organisational learning.

The implications in this section do, in principle, account for both summative and formative evaluation. However, formative evaluation, as presented in the preceding sections, has the potential to address the negative implications because the criteria are iteratively reflected upon and open to being changed, as in the approach to formative evaluation presented in Paper VI. However, in order for formative evaluation to support learning and improvement, for example, by including emergent and opportunity-based changes, it is important to be aware of and address the negative implications of pre-specified evaluation criteria.

5.3 Related work on evaluation in relation to design

Various researchers have proposed frameworks where evaluation plays a central role either in relation to information system development and/or to implementation and organisational change. In the following section I will briefly describe three frameworks in which evaluation plays a significant role.

5.3.1 Benefits realisation management

Benefits realisation can, in some respects, be compared with the formative evaluation approach presented in Section 5.1 and in Papers V and VI. Benefit realisation focuses on how to manage and organise IT-enabled business change "such that the potential benefits arising from the use of IT are actually realised" (Ward and Elvin 1999: p 197). To do so, Ward et al. (1996) suggest a cyclic process model for benefit management that includes five elements: indentify and structure benefits, plan benefits realisation, execute benefits realisation plan, and evaluate and review results. In addition, "effective benefits realisation requires an ongoing commitment to, and focus upon, the benefits, rather than the technology, throughout a system's development, implementation and operation" (Ashurst et al. 2008: p 352). Ashurst et al. (2008) have investigated a number of information system projects, and they have found that most projects focus on the delivery of the IT solution but they only have a very lim-

ited focus on work re-design, process re-engineering, organisational and benefits realisation (p 365). Consequently, they suggest looking more into the competencies needed in the organisation to mange benefits realisation: benefits planning, benefits delivery, benefits exploitation, and benefits review (Ashurst et al. 2008). More concretely, Ward and Elvin suggest building on stakeholder involvement, including senior management commitment, active management of benefits along with approaches to system development and project management, and the need for focusing on understanding the origins of the need for change.

Benefits realisation is mainly concerned with theoretical models, whereas my research aims at contributing to the practice field; hence, I have been more concerned with *how* to identify and structure benefits and *how* to plan and execute benefits realisation in terms of effects.

5.3.2 Results-driven incrementalism

Results-driven incrementalism requires a project to be divided into a number of short (approximately 3 months), intensive cycles of implementation, each with a focus on delivering measurable business benefits. The target business results are used to drive decisions, divide the implementation into non-overlapping increments, ensure that each increment implements both software functionality and complementary changes, and to use results as the basis for the next increment (Fichman and Kemerer 1997). Results-driven incrementalism is based on the proposition that effects occur within three months. For some effects that is a rather short amount of time. Results-driven incrementalism, like benefits realisation, does not take opportunity-based and emergent effects into account.

5.3.3 Business engineering

Giaglis (1999) presents a business engineering framework that advocates integrating process-based organisational design and the evaluation of business processes and information systems. In his review of process-based organisation design, information systems evaluation, and information systems development literature, Giaglis indentifies a number points all directed at the need for improved evaluation of information systems in the context of business engineering. For example, he states that information system development methods do no pay enough attention to the importance of and difficulties with evaluation ex ante. Giaglis also points out that information system evaluation ought to be integrated into the design of business processes, but that existing information system evaluation methods focus solely on the information system project without paying explicit attention to the business process. Through this review and a case study, he proposes “to substitute the IS project with the business process as the fundamental unit of analysis in IS evaluation” (Giaglis 1999: p 24). However, this recommendation seems to be too general compared with the processes and activities of focus in a work system perspective. Furthermore, business engineering is seen from a management perspective and is not concerned with involving the business process participants (Giaglis 1999).

Part Two has been concerned with presenting the four elements that constitute the theoretical background for this thesis. The four elements provide a theoretical basis for thinking and talking about participation, evaluation, design, and implementation

of HIS. However, before we are able to use these theoretical elements, either for analysing and understanding participation in the empirical work or for applying the knowledge derived, we need to establish an analytical framework and an approach based on the intersection of the elements. This approach will be established in Part Three.

PART THREE: UNDERSTANDING AND APPROACHING PARTICIPATION IN EVALUATION

Part Three comprises a synthesis of the theoretical and empirical knowledge derived from the work related to this PhD thesis. The first chapter in this part (Chapter Six) accounts for an analytical development of an approach to organisational implementation of HIS based on a participatory design perspective. The approach includes seeing implementation as ongoing design of work systems and provides a basis for answering the research question. The approach is a synthesis of the elements that constitute the theoretical background. In Chapter Seven, the approach is used as an analytical framework to analyse and discuss the empirical material from the three studies. Incidents from the papers and studies will be analysed and discussed through the analytical framework in order to increase our understanding of participation in evaluation, as well to provide examples of how participation in evaluation has been approached as part of an application of the framework. Chapter Eight presents and discusses five central contributions of this thesis, apart form the contributions presented in the papers. Chapter Nine comprises some concluding remarks that include implications for research and practice and suggestions for further research.

Chapter Six: **A participatory design approach to organisational implementation**

In the following chapter a synthesis of the theoretical elements from Part Two is outlined. This synthesis results in an approach to HIS implementation based on formative evaluation as part of ongoing design of healthcare work systems. The approach also serves as an analytical framework for understanding participation in evaluation as part of the design of healthcare work systems.

The approach can be viewed as a result of the research process that was illustrated Chapter Two, Figure 2. The approach has emerged through an interactive process of theoretical inspiration and empirical experiences and findings, a process following the principles of analytical induction. This means, first, that participatory design of healthcare information systems has been defined as the phenomenon of interest. Second, based on the theoretical background, a framework was formulated as a hypothesis to explain the phenomenon. Third, the framework was analytically applied to explain the first two studies, during which the framework was adjusted. Last, the framework was operationalised and applied during the third study, which can serve as the next step of refinement.

In order to present and discus the framework, various intersections between the four different theoretical elements and their mutual influence will be outlined.

6.1 A healthcare work system perspective on HIS

The first intersection to look at is the one created between HIS implementation and the work system perspective.

Alter (2003) suggests that IT-reliant work systems should be the core matter of the information system field as information systems are only interesting in the ways that they contribute to and/or support several work systems. The work system perspective breaks away from an IT-centric view and places the technology on the same level as the other elements in the work system, such as the participants, management, and culture that influence the success of the work system. Furthermore, since both people and technology are part of the work system, a work system perspective avoids the split between the social and technical system (Alter 1999a; 2002; 2004; 2007).

Despite the fact that the work system framework is rather business oriented in its terminology, I have found it very useful and applicable in a healthcare domain, among others, as an analytical perspective. However, I have suggested some change in the terminology and to the model in order to adapt the work system framework to a healthcare domain, which is shown in Figure 10. Additionally, I have added two arrows between participants and information and technologies, which I found was missing in the original model. For my purposes, the additional arrows are not so important, but they refer to people altering or structuring (Barley 1986) the technology and vice versa. Also what information can be presented and processed is affected by the technology, and the technology depends on what kind of information needs to be supported. The changes are illustrated in Figure 10.

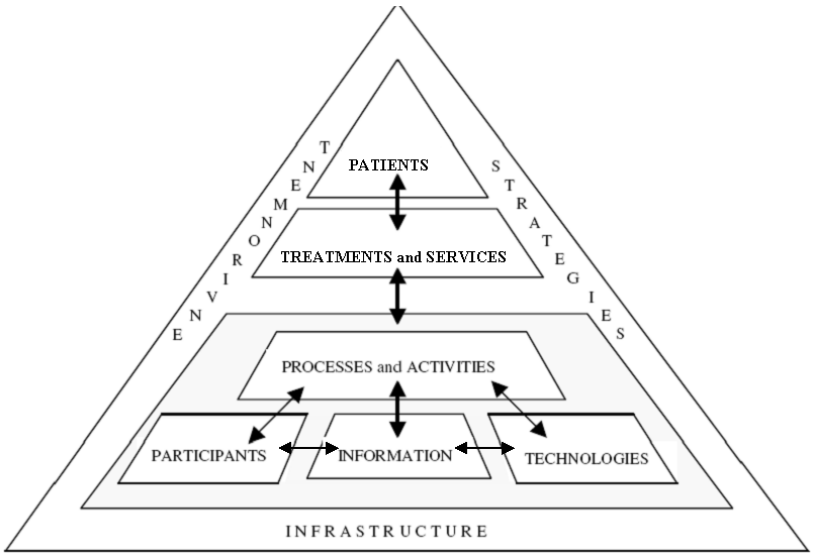

Figure 10: Healthcare work system model, based on Alter's (1999) work system framework

The work system perspective offers a different understanding of the core matter of interest and has the potential to bridge the gap between the socio and technical, as described in Chapter Three. In addition, a healthcare work system provides a frame for explicitly delineating the object(s) or scope of analysis. Furthermore, the explicit focus on the work carried out in the work system – in terms of the processes and activities that are performed to deliver treatment and services to the patients – has at least three positive implications: 1) It avoids an IT-centric perspective where the technological possibilities and constraints determine the project. 2) By focusing on supporting the work carried out by people in the work system, the chances of improving the usefulness for the participants are increased, and so are the chances of creating useful effects of changes in the work practices. 3) The focus of the work system is, as I have experienced it, quite similar to the focus the participants have in doing their everyday job. They are concerned with getting the right support for performing their work activities in order to treat the patients. They sometimes talk about the organisational environment, but they know they do not have much influence on it.

As mentioned in section 3.2, a work system does not exist in nature but is an analytical and mental construct, thus the scope of the work system depends on the analytical purpose. A healthcare work system could be made for an entire hospital, a department, or, as was the case in the Health Check study, around a specific process (in this example, the work system was constructed with the medication process being the core work process). This means that a HIS might support several work systems, which imposes some (technical) challenges on the adaptations made to the HIS when improving the work system. For example, the adaptations in the HIS needed for improving one work system might deteriorate another work system relying on the same HIS. On the other hand, a healthcare work system often relies on several health information systems to process the information needed to perform certain activities. For example, the work system subject to analysis in the Health Check study relied on, among others, an electronic patient record module, a lab module, an online drug

database, and a patient record containing a description of patient trajectories both on paper and electronically.

What has been argued here, according to the work system theory, is that the analytical focus needs to shift from HIS to a healthcare work system relying on one or several HIS. This shift in perspective has significant implications for thinking about implementation, which will be presented in Section 6.3. But first we need to take a look at the intersection between participatory design and the work system perspective.

6.2 Participation in the design of work systems

Here we will look at the implications of the intersection between participatory design and a work system perspective. First we will look at the implications for what is to be designed in participatory design, and later, what this means with regard to participation.

Some of the papers presented in Chapter Four that challenged participatory design called for changes in the understanding of what design is and when it takes place (Dittrich et al. 2002; Wagner and Piccoli 2007; Simonsen and Hertzum 2008). Other requested changes are related to the understanding of what is being designed (Markus and Mao 2004). The work system perspective is compatible with many of these requests and can, to a large extent, comply with the requests for change.

To start with the latter, the work system perspective offers a different understanding of what ought to be designed. The work system encompasses more distinctly defined and described elements than, for example, the "solution" that Markus and Mao (2004) suggest as the thing to be designed. Therefore, if we accept the premise of the work system perspective that the healthcare information system is not interesting in and of itself, the interest is on the performance of the work system and how the HIS can contribute positively to this performance. What ought to be designed is HIS-reliant healthcare work systems. I will not claim that this is a completely new thought, as it is somewhat similar to what has been argued in much of the socio-technical literature, for example. Here it has been advocated that one should design socio-technical systems and not only information systems. Participatory design also has a similar view. In PD, the users and the work they perform, as well as the organisation in which the work takes place, play an important role in the design process. However, as argued in section 3.2 the work system perspective helps prevent a socio-technical split and it offers a set of terms and a frame for analysing the work system to be designed. As I conceive it, the work system is more explicit about the perspective and the role of the HIS in relation to the work and the organisation in which it takes place.

In order to correspond with a healthcare work system perspective, I have altered the design process presented in Figure 9 to encompass design of healthcare work systems instead of information systems, or an indefinable change from A to B. Rather, A is the envisioned healthcare work system, illustrated by a triangle, and work system B is how the work system looks[15] after the (re)design. The altered design process for designing healthcare work systems is illustrated in Figure 11.

[15] Should not be interpreted as the work system necessarily is stable and that the form of the work system is final, rather the work system is an emergent entity.

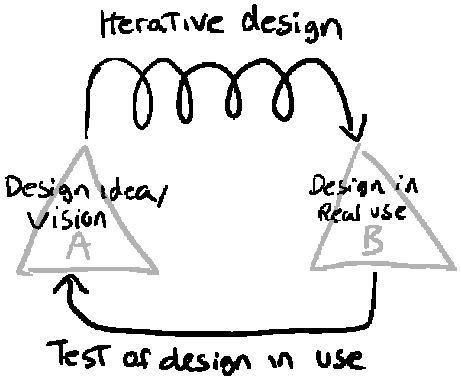

Figure 11: Design process for designing healthcare work systems inspired by (Simonsen 2009a)

The design process outlined in Figure 11 is concerned with forming a design idea or vision for the work system. The work system is then iteratively (re)designed, for example, at workshops; then the design should be tested in real use either in a formal, planned pilot test or by continuing the daily work, depending on the how extensive the changes are. The next step is to reflect on the design in use – how the work system performs – and to identify emergent and opportunity-based changes. Then, based on the test, the design vision can be refined in order to incorporate the opportunity-based changes.

In section 4.2.2 I discussed who ought to participate and what they should be termed. The work system theory focuses on business professionals as the group of people contributing to the improvement of the work system. However, from a participatory design perspective, I would argue in favor of the participants being involved in design activities aimed at improving the work system. This view seems to be compatible with the work system theory, which advocates empowerment and involvement of participants to secure engagement and job satisfaction (Alter 2006).

As illustrated in the healthcare work system (Figure 10), the participants are directly related to processes and activities as well as information. These relationships also indicate which elements in the work system they are most knowledgeable about. In designing the work system, the participants can, with a small amount of effort, contribute with input to the design of processes and activities as well as with what information they need in order to carry out these activities. That is because they already have knowledge about their work practices and what information they need as part of their daily job. In other words, they are specialists at being participants in the work system, thus it makes sense to involve them in designing the work system. In contrast, they are not specialists in the HIS, and hence involving them in HIS design is less simple.

It might be that the participants need help to facilitate reflections about their own work practices in order to provide inputs to work system design. Furthermore, an (external) facilitator might help create the fine balance between continuity and change that is difficult when involving participants in (re)design (Bratteteig 1994).

By looking at participatory design from a work system perspective and vice versa, we see that participants from the work system should be involved in designing the whole HIS-reliant work system(s) they participate in, not just the HIS they might be users of.

6.3 Conceptualising HIS implementation as ongoing design

The third intersection to be sketched out combines the two previous intersections and relates to how HIS implementation is understood as the ongoing design of healthcare work systems. As mentioned at the end of Section 6.1, focusing on healthcare work systems instead of HIS has implications for understanding HIS implementation.

Based on the iterative design process for designing healthcare work systems presented in the previous section, the implementation of HIS is, from a work system perspective, concerned with the design of the healthcare work system. It is a design process in which the design vision entails substantial changes to one or several of the health information systems supporting the work system to be redesign/improved. HIS implementation becomes an element in the ongoing process of designing and improving the work system. And as described in Chapter Three, implementation is seen as an unpredictable, ongoing socio-technical endeavour of creating fit between the information system and an emergent work system in an emergent organisation. Consequently, the implementation of a new or changed HIS to support the work system fosters anticipated, emergent, and opportunity-based changes in the elements of the work system. These elements thus need to be redesigned to obtain fit among the elements of the work system and the HIS supporting it – so called organisational implementation activities. These changes then require redesign of the HIS in order to fit and support, for example, new work practices, and then the process starts again. In this manner, the implementation of HIS enforces an ongoing design of the HIS-reliant work system. Improvement of the performance of a healthcare work system requires changes in the supporting healthcare information system(s).

Above I have argued that the (organisational) implementation of HIS can be conceptualised as an iteratively ongoing process of design and redesign of the HIS-reliant healthcare work system, as illustrated in Figure 12.

.

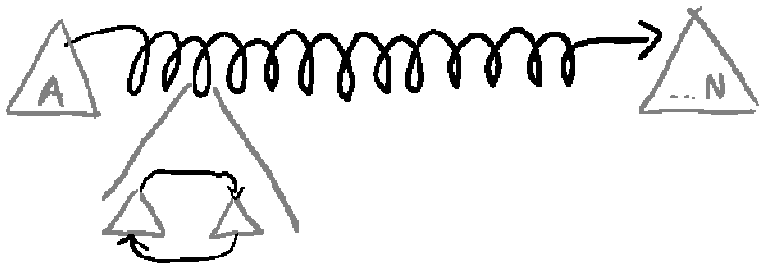

Figure 12: Implementation as ongoing design of work systems

Along these lines, the work system perspective provides a basis for seeing and discussing the scope, challenges, and central importance of organisational implementation. In contrast, a more narrow HIS perspective tends to be combined with a prevailing technological focus, which has a tendency to make organisational implementation a near peripheral activity (Hertzum 2002).

As described in Section 3.2, this thesis is concerned with HIS-reliant work systems, which is why the wish or need for improvement of such an HIS-reliant work system should be the starting point of the design process. Design from scratch is rare (Bratteteig 1994), and most of today's healthcare work systems already rely heavily

on HIS. This is also the case for the Danish healthcare sector, as described in Chapter One. Consequently, designing HIS-reliant work systems mostly deals with adapting existing HIS, for example, in relation to the release of new versions or by implementing new modules to existing HIS.

This conceptualisation of HIS implementation as the design of healthcare work system is in many way similar to what Markus calls technochange, which occurs when IT is used strategically to drive organisational performance improvements as described in Section 3.1.1. Markus (2004) argues that technochange requires a fundamentally different approach than found in IT projects and organisational change programs, or in a combination of the two. "Effective technochange requires a different kind of attention to the features of the '*solution*' and a different change *process* from those prescribed by either IT project management or organizational change management" (Markus 2004: p 5). This is because good IT is not necessarily the answer to technochange success, and organisational change management knows a lot about change readiness and job redesign but has little knowledge about how IT alters and affects the organisational change (Markus 2004).

Markus points to the need for a different process when concerned with technochange. A long the same lines, the ongoing design of healthcare work systems might entail a need for a different organisation of the process. The ongoing element is intended to be taken literally but it is just as much a mindset. A mindset that accepts that one can not design the perfect work system nor the perfect HIS and therefore the HIS is never thought of as finished. The same apply to the work system; it is never finished or stable and always contains room for improvement. The ongoing element, especially when approached literally, challenges the organisation of most organisational and information system development work which is organised as projects. A project is defined by being temporarily. It could be that the ongoing element/process can be organised as a series of projects but it might also require a completely different organisational structure. However I have not investigated how to manage ongoing processes thus, I will delineate me from a discussion of the strengths and shortcomings of various organisational structures.

What has been suggested here is a way of conceptualising and approaching HIS implementation as the iterative and ongoing design of healthcare work systems. The proposed conceptualisation is based on a work system perspective and is inspired by the suggestions for widening the understanding of design in PD, technochange management and aim to account for the emergent unpredictable nature of implementation. It is in light of this framework and conceptualisation that the research question should be understood. By that I mean that participation and evaluation are investigated in terms of participation *in* evaluation in the design of healthcare work systems. How evaluation relates to the process of designing work systems will be explored in the following section.

6.4 Evaluation as part of designing work systems

Evaluation has already been mentioned in Section 4.3, Figure 9 as an element in the design process. In the following we will explore how evaluation and participation in evaluation can be understood. Later, in Chapter Seven, and in Papers V and VI, how to apply participation in evaluation is elucidated through empirical examples. But

first, I will present some theoretical thoughts on how formative evaluation can be understood in relation to PD and as part of designing healthcare work systems.

In the design process outlined by Simonsen (2009a), evaluation may occur as part of the iterative design activities and as an evaluation of the design in real use. Simonsen (2009a) does not explicate what is meant by evaluation in the iterative design process, but he gives an example of a real use evaluation (Hertzum and Simonsen 2008; Simonsen and Hertzum 2008; Simonsen 2009a). In this design process (see Figure 9), the design activities are illustrated as an iterative process, whereas the evaluation of real use is not. However, if the formative evaluation approach is applied as real use evaluation, then evaluation is also an iterative activity, as was the case in the Health Check study. Here the audit of the nurses' records was carried out iteratively to monitor the changes in the work practice and to see if they lead to the desired effect. Based on the results of the iterative evaluation, smaller interventions were established to impose changes. In other words, both the design an evaluation is performed iteratively.

In parallel with using formative evaluation for evaluating the effects imposed by the design, the evaluation becomes an intervention it self. This is because the result of the evaluation often causes or imposes changes, for example, by modifying the course of the design of the intervention. In this way the formative evaluation influences and facilitates the design and redesign of the work system.

This leads us to yet an alteration of the design process in which evaluation is part of the design process and the intervention is (re)designed based on the evaluation. Also the notion of "design in use" has been moved because it is implicit when designing work systems that the information system is evaluated as part of the work system it supports. The relation between real use and work system will be elaborated in section 6.4.1.

The iterative design process illustrated in Figure 13 is characterised by; a) a design vision for the healthcare work system, the intervention that is believed to create the changes needed to entail the vision, the changed work system, b) and a formative evaluation of whether the intervention has lead to the desired changes in the work system. The changes in the work system might be enabled by changes in the healthcare information system; but it could just as well be due to changes in other parts of the work system or changes initiated from the external elements, such as changes in laws, regulations, or strategic choices.

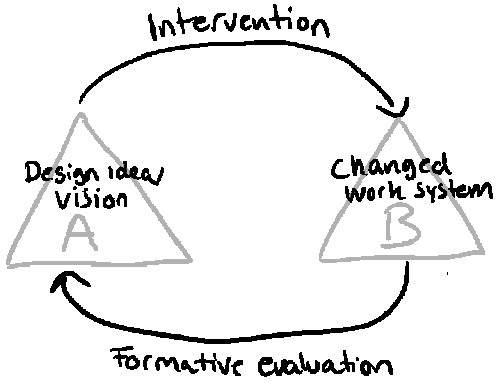

Figure 13: Design process for a healthcare work system based on iterative design and formative evaluation

The design process illustrated in Figure 13 can be applied on different levels. For example the figure can illustrate a process where the design and redesign of a healthcare work system only includes small changes in the existing healthcare work system and the supporting HIS. It can also illustrate a process where the design and redesign includes adding a new healthcare information system to support the work system in interaction with, or separate from, existing systems. In the latter process, smaller iterations of this design process might be necessary as part of designing the intervention. This also implies that the work system is defined on different levels so that the work system in the smaller iterations is a sub system to that of the larger process.

Evaluation can be conducted differently depending on where in the design process it takes place or at which level e.g. whether it is evaluation is part of a smaller iteration or evaluation in terms of formative evaluation of real use. According to the definition from Chapter 5, Box 5.1, formative evaluation is mainly characterised by the improvement and learning purpose and not by how it is going to be carried out (except that it should allow for emergent and opportunity-based effects to occur). This allows for formative evaluation to be carried out very formal or more informally depending on what is most appropriate. An example of an informal evaluation could be showing a mock-up to the participants and getting their feedback, or simulating a new way of doing a particular task and seeing how the physical set-up works and what the participants think of it. In these kinds of evaluations there may not be any explicit or predefined criteria for the evaluation. The formative evaluation conducted in the Health Check study is an example of an evaluation in the formal end of the scale.

In order to encourage and support participation in design, one also needs to consider participation in evaluation, as evaluation constitutes a substantial part of the design process. This again entails a need for a profound understanding of evaluation and its prospective role in design, both theoretical and empirical. In the following sections, particular aspects of evaluation will be explored in light of the implementation perspective presented above, such as identifying the object of evaluation, the role of evaluation criteria, and how to specify them.

6.4.1 The work system as object of evaluation

An important aspect of evaluation is the *object* of evaluation. Generally the object of formative evaluation is a kind of intervention such as the implementation of a healthcare information system.

Evaluation of HIS is a complicated undertaking since the judgement of the potential and the outcome of an HIS depends on a number of interrelated but incommensurable factors. In addition, the desired outcome depends on the stakeholder, who might judges the success of the HIS differently (Seddon et al. 1999; Klecun and Cornford 2005). “This means that, in practice, it is not clear how to measure the success of benefit of a system, or even what ‘success’ really means, or for whom” (Klecun and Cornford 2005: p 1). In other words, it can be very difficult to account for the independent and dependent variables, and the number of possible confounds is almost infinite. This is one of the reasons that the randomized controlled trials-inspired terminology is not useful in the formative evaluation approach outlined in this thesis. However, it does not mean that one should not try and point out, for ex-

ample barriers hindering the effects which are also part of effect specification process in the formative evaluation approach applied in the Health Check study (Paper VI).

In Chapter Three, as well as in Paper VI, it is argued that the HIS-reliant work system should not only constitute the level of analysis but also *be* the object of analysis. In relation to this Alter (1999b) argues that if we focus on the information system, we tend to be concerned only with steps in the business process that the information system is part of. Thus, other parts of the work system are de-emphasised because they are outside the scope of the information system. However, those parts are still critical and important for the performance of the work system, though they are not directly supported by the information system. Consequently, the evaluation of the information system alone is not fertile.

As mentioned, the notion of design in use or real use is contained in the work system perspective. When the object of design and evaluation is a HIS-reliant healthcare work system then it is implicit that the HIS is evaluated based on some degree of use. This is because the HIS is evaluated based on how it supports the work system subject to evaluation. This way we avoid the discussion of what constitutes use or real use in relation to deciding when an evaluation is valid as a real use evaluation. It can be rather difficult to decide how far down the continuum – ranging from lab test to simulation to real use – one has to go, in order to do real use evaluation. I would like to give an example that illustrates the problem of defining real use. Hertzum and Simonsen (2008; Simonsen and Hertzum 2008) reported what they characterised as a real-world evaluation. A clinical-process module was tested and evaluated in a stroke unit on a neurological ward during a 5-day trial. The system was used on laptops, PDAs, and on a large projected screen during ward rounds, team conferences, and nursing handovers. Five years of patient data were migrated into the system, and integration with other systems such as the patient administration system and laboratory system was simulated by having a back office staffed 24 hours a day, manually typing in all relevant data coming from other systems.

This HIS was used in a real use setting on one ward treating real patients; however the technical integration was simulated. Is this an evaluation of real use if the integration is simulated and the HIS is only used for five days and on one ward but it is a system prospected to be used everyday on the entire hospital.

The evaluation provided many valuable results for improving the clinical-process system and the related work practices. On the other hand, this kind of real-use trial would not be appropriate for evaluating the technical integration and support. A more pragmatic view could be that the degree of real use depends on the focus of the design process and thus on what is to be evaluated. However this example was also meant to illustrate the problem in creating an unambiguous characterisation of real use.

To summarise, the object of evaluation ought to be the interventions and changes in the work system, thus the evaluation criteria becomes the *desired effects* of the *changes* in the *work system*. This is regardless of whether these changes are related to the design of the information system, the implementation process, or regulatory change, etc. Furthermore, having the work system as the object of evaluation the matter of design in use or real use is avoided as it is embedded in the concept of the work system.

As briefly mentioned above, "desired" does, to a large extent, depend on the stakeholder. In other words, what is a desirable effect depends on who is to specify the effects, which will be dealt with in the following section, where we will look at the implications of a participatory design perspective on evaluation.

6.4.2 Specifying desired effects

As mentioned in Section 5.2.1, the perspective for the evaluation influences the specification of effects. The different evaluation perspectives can be compared with the different steps on the ladder of perspective (Figure 6). Here the users, in terms of participants, are placed on the work system perspective step; the top management would probably be mostly concerned with evaluation and the organisational level, whereas external entities are concerned with the society level. Information system personnel are concerned with and responsible for the information system and thus belong to that step.

In the healthcare sector, we find a different division of possible evaluation perspectives. Apart from a horizontal division, the perspective for evaluation can also be divided vertically. For example, the users or participants belong to different groups of professions such as nurses, physicians or secretaries. The management might include chief physicians and charged nurses. However, the point is that the different actors in the healthcare sector have different perspectives and thus judge desirability differently (Nissen 2008).

The evaluation perspective is related to who is to specify the evaluation criteria. If we combine the principle of participation from PD with a work system perspective and apply it on evaluation, those to specify the criteria in terms of desirable effects of changes in a work system must be the work system participants. They are nevertheless part of the work system subject to evaluation. Besides, the evaluation will most likely affect the design process and thus influence the work system and their work. Thus, from a participatory design perspective, the only right thing to do is to involve the participants. It would also be democratic to involve them in the evaluation and in specifying the evaluation criteria. In this way the participants have influence over the evaluation and, according to Smithson and Hirschheim (1998), they even get to determine the result, as those who get to answer the questions of *what*, *how*, and *when* to evaluate tend to influence the result. Another argument, beyond the democratic, could be that of engagement (Markus and Mao 2004). If the participants were involved in specifying the effects, they would be more committed to actually obtaining them. Paper VI is concerned with how to facilitate participation in evaluation.

Letting the participants specify the effects also means that they are to decide which types of effects they find important, for instance, whether the effects relate to effectiveness, efficiency, quality, or satisfaction. Different groups of participants might value desirability differently and thus point at different kind. For example, the managers might be concerned with efficiency and economic aspects; the physicians with effectiveness and quality; and the nurses with quality, service and satisfaction (Nissen 2008). An example of the differences among the professional groups was found during the specification workshop in the Heath Check study. Here the nurses' notes all related to daily problems with delivering an appropriate service and with the quality of treatment the patients received, whereas the notes from the physician was

mainly concerned with solutions for improving the quality and effectiveness in the medication process.

Smithson and Hirschheim (1998) point to the underlying assumption of the evaluation approach as indicative of the type of evaluation criteria, whether the evaluation is grounded in the hard, rational/objective end of the continuum (e.g., random controlled trials) or the soft, subjective part. The formative evaluation approach outlined here and in Papers V and VI belongs somewhere in the middle of this continuum however is open to being dragged in either direction. This approach does not operate with strict and stable variables but rather hypotheses and suggestions. But the approach still makes use of quantifiable measures like record audit; however, these measures are combined with subjective judgements.

Another viewpoint could be that the criteria depend on the underlying assumption of the participants and the facilitator involved in the evaluation. It is important to be aware that effects specified aim at improving the work system. As described in Paper V and VI, the participants are involved not only in specifying effects but also in designing how they can be achieved. Thus the specific effects measures are also somewhat related to *how* the work system is sought to be improved. In other words, the effects measures influence the design of the work system.

In the preceding sections of this chapter, different aspects of evaluation in design have been discussed and theorised about. I have also explored what to be evaluated, with which kind of criteria, and who should specify and decide on the criteria.

6.5 Participation in evaluation in design of work systems

In this section we will recapitulate the participatory approach to implementation laid out above, which emanated from the intersection of the theoretical background outlined in Part Two.

The contribution of the approach presented here is to see implementation of information systems as an ongoing process of participatory design – a design process informed and enhanced by formative evaluation. A main argument for an ongoing design process is that, because in complex socio-technical settings implementation processes and results of technological changes cannot be anticipated, and to allow for emergent and opportunity-based changes, an ongoing adaptation of technological and non-technological elements is needed. The process of ongoing adaptation is conceptualised as an ongoing iterative design process.

In relation to the ongoing design of work systems as a perspective on implementation, the role of evaluation is quite well stated by Hedman and Borell (2005: p 115), who consider it a pragmatic view on evaluation: “Once a particular system has been implemented the focus of the evaluation should be on continuously improving the benefit received.” The quote also serves as an argument for focusing on formative evaluation as it supports the improvement/learning perspective. The quote is also in accordance with the work system perspective that was developed in order to help managers and business professionals be more effective in evaluating and improving work systems (Alter 2006: p v).

There are two main arguments for formative evaluation being an explicit element in a participatory design approach to organisational implementation understood as the design of work systems. First, formative evaluation informs and affects the design process and thus can be understood as a design activity in and of it self. Second,

evaluation has the potential to facilitate participation in design. By taking part in specifying evaluation criteria, deciding on how to measure them, and suggesting how they can be achieved, the participants are highly influential in the design process (Paper V + VI).

Chapter Seven: **An empirically based understanding of participation in evaluation**

In this chapter the approach developed in Chapter Six will be applied as an analytical framework to the empirical material. Applying the approach as an analytical framework serves a twofold purpose: 1) The approach serves as a tool for understanding and explaining primarily the first two studies, which were conducted before a coherent approach had been derived. Rather, the first two studies generated input to inform the development of the approach. 2) The second purpose is to empirically account for the approach. In the previous chapter the approach was developed analytically based on mainly a theoretical synthesis. However, in this chapter the empirical findings that have given input to the approach are presented, accompanied by empirical examples from the application of main parts of the approach.

The Health Check study was designed from a work system perspective with the aim of involving the participants in designing a healthcare work system rather than an HIS. Furthermore, the Health Check study aimed at approaching participation in evaluation as part of the design process. Hence, the Health Check study can be seen as an application of the approach however; an application in which the ongoing element was applied more as a mindset than literally. Before getting to analyse the application of the approach, the empirical material will be used to enhance our understanding of participation.

All of the studies and associated papers, to different degrees, contribute to enhancing the understanding of participation and especially to understanding some of the challenges for participation. Papers III, V, and VI also deal with how to approach participation in evaluation in particular by providing examples of how participation has been facilitated.

First, this chapter will present how the empirical work contributes to enhancing the understanding of participation. It follows the structure from Chapter Four, which will allow us to look more specifically at how participation in evaluation can be approached in the design of healthcare work systems. At the end of the chapter we will briefly touch on some challenges for managing participation in evaluation and design.

7.1 Participation

In Chapter Four the understanding of participation was explored through the established participatory design literature. Throughout Chapter Six, participation in evaluation and design of work systems was outlined as a component in a participatory design approach to organisational evaluation. In the following, the why, who, how, what, and when structure from the participatory design chapter will be used to explore what the empirical studies and papers say about participation in order to increase our understanding of participation. The following sections contain both analytical and discussion aspects.

The three studies constituting the empirical work of this thesis all had the aim of engaging and involving the participants as central actors in design activities. Thus, they fulfil Clement and Besselaar's definition for sampling PD projects, which is, "a

prominent feature of the projects had to be the *intention* to involve users as *central actors* in system development activities" (1993b: p 29, italics added; 1993a).

I find Clement and Besselaars definition very useful as a starting point for looking at PD projects, particularly because of the word *intention.* By that I mean that if there is an intention to involve the user as a central actor in the project, then it is considered a PD project, and it can be analysed or assessed as such. Whether the projects are successful in involving the users as central actors in development activities, and hence can be categorised as PD projects, is another question.

7.1.1 Why participation?

> Had the wards had the responsibility, one would "feel" more for the system, an old programming trick that apparently has been lost. The program is characterised by being developed by programmers who do not create a programme to suit the customers' routines, but instead adjust whatever enterprise resource system is lying on the shelf already. A user group was set up before purchase, but it was a farce that the decision to buy the program had already been made. I do not think an online bank could survive with such an application; in any case, I would switch banks if it had such a poor system. We have made lots of suggestions for improvements, but each time we were regarded as grumblers too old to understand computers. They never wanted to listen to the users. Introducing computers to the health sector is supposed to help us lighten our work, increase patient safety, and improve patient treatment. If some of this could be recognized in the system, then there would be no reason to undertake this investigation. (Translated from Danish)

This quote is an answer from the questionnaire survey undertaken as part of the Heath Check study reported on in Paper IV. The answer provides several reasons for involving the prospective users that are in line with the arguments in Chapter Four. One reason for participation is to create a "feeling for the system," another reason is make sure the system will fit the work it should support. However, as the quote emphasises, it is not enough to involve the users; they should also be listened to and have *actual* influence on the decision. In other words, they should be genuinely involved.

Papers I and II also provide various examples on why participation and particular, genuine participation is necessary if the HIS is to support the work system of the participants.

7.1.2 Who should participate?

In the theoretical counterpart of this section, I discussed which groups of people should participate and what we should call the people – users, workers, or participants. However, in practice, the "who" question raises even more issues.

As Markus and Mao (2004) point out, it is no longer possible to involve all of the participants, as there will often be several thousands of them. Consequently, the participants and groups of participants are not all taking part, but only a few representatives are participating. In Paper I (p. 7) we can read how the GP representing the groups of GPs is not seen as a "true" representative. Paper II explores some of the challenges with representation in relation to the case of general practitioners.

A similar problem arose in the CLIMON study, in which the nurses working in the clinic on a daily basis did not feel represented by those participants taking part in the prototyping (described in Paper III) at the configuration workshops. During the evaluation interview after the pilot test, some of the nurses commented on the fact that those participating in the configuration workshops were not in the clinic on a daily basis. In other words, the nurses and physicians participating in the design of an HIS to support a work system did not take part in the work activities in the work system on a daily basis. They were chief physicians, and the nurses were either charge nurses or nurses with other administrative tasks. Nevertheless, they participated in designing an HIS to support work activities they rarely carried out themselves. In this project, clinicians were selected as participants because they were experts in the medical field that the system should support and as a way to secure management support.

In the Health Check study, the management was invited to participate in the study, but they only participated briefly at the beginning and at the end of one workshop. They were invited to secure active management support; however, as they were not part of the work system on a daily basis, they did not possess detailed knowledge of the work practices and were not expected to provide substantial input to the design process. The positive side effect of the management not taking part was that the other participants did not feel intimidated by the management being present. However, it can very well be argued that the project suffered from a lack of management support (see Paper V). This indicates that it may be necessary to have representatives from all of the different groups of participants. However, as we have seen in some of the studies, it is not easy to represent anyone other than one's self. In fact, the concept of a representative user is problematic (Beyer et al. 2004).

Another problematic aspect that one could run into when including different groups of participants is the risk that the participants will have suggestions going in opposite directions, according to their different rationales (Nissen 2008), as was the case with the GPs and the outpatient clinicians in the Shared Care study. The clinicians wanted as many details as possible for research and epistemological purposes (Paper II), and the GPs wanted as little as possible. However, similar disagreements were not experienced in the two other studies.

7.1.3 How to involve participants?

In the Shared Care project, different groups of participants were involved during the development of the information system (Paper I). Via our study, the GPs also participated in evaluating the two systems, especially in the first of the two cases, in which the GPs tested a stand-alone prototype of the GP-version of the system. The test led to the implementation of the system being postponed due to negative feedback from the GPs.

In the Health Check project, the involvement of the participants was planned based on the challenges experienced in the previous studies. One way to address the challenge (experienced in the CLIMON study) of structuring effects specification was the development of the effect map as a tool and technique to facilitate participation. (See Paper VI for details on how the effect map helped facilitate participation.) In this study the participants were involved in specifying effects for changes in a work system. The effects supported not only effects specification but also the design of the

interventions aimed at transforming the work system in order to obtain the effects specified. This was done by having the participants suggest which changes and interventions might lead to a given effect. In the Health Check study the participants were involved in redesigning the interventions during weekly meetings as the interventions unfolded.

During the CLIMON study it was experienced that the notion of effects in and of itself had the capability to support participation. Talking about effects does not require any language skills above daily language, compared with, for example, use cases, which require some knowledge of UML to do the use-case diagramming. Furthermore, compared with system functionality, talking about effects does not require any technological skills (supported by the work system perspective), thus effects support or facilitate participation as an every day language with no technological overhead attached to it. Barlach and Simonsen (2008) have experimented with how effects specification with users could replace use cases in information system design. Similar to the findings in Paper VI, they found that effects can be used for communication with the users without them having to be technological experts.

7.1.4 Participation in what and when?

As discussed in the previous chapter, participation should not be limited to the design of HIS in the traditional sense of system development. Instead, design is an ongoing activity not limited to the beginning or end of a project or a process. The studies presented here are concerned with design in various stages. For example, in the CLIMON study, the design was mostly concerned with designing an HIS. The participants took part in designing early versions of the HIS, first on paper, then as a PowerPoint mock-up stage, and later as a prototype. The project participants were only sporadically and unintentionally designing the work system.

In the Shared Care study, the GP participants were meant to be involved in designing an HIS that could support their work system in terms of configuring the HIS already used to support other work systems at the outpatient clinics. Thus, their participation can be categorised as taking place at a later stage in the overall design process than compared with the CLIMON study, for example, but still at an earlier stage than in the Health Check study.

In the Health Check study, the participants were involved in redesigning the work system covering the medication process, which included redesigning an HIS that had been released more than four years earlier. Apart from the work system focus in the design process, it was a different kind of design process that the clinicians took part in compared with the CLIMON study. In the CLIMON study, the participants were involved in the design of the basic functionality and interface of a *new* HIS, whereas in the Health Check study, the participants had years of experience with the HIS supporting the work system subject to redesign. However, because the HIS was so established and integrated with other HISs, there were many constraints to what changes could be made. As part of being involved in designing a work system, the participants in the Health Check study were involved in designing the interventions that transform the work system and the effects measures to evaluate the changes. An example of that is described in Papers V and VI.

Earlier I argued that design in general, and thus also the design of work systems, ought to include an evaluation element, for example, in terms of formative evalua-

tion. As argued in the previous chapter, formative evaluation is part of design, thus participatory design should also be concerned with participation in formative evaluation.

In the CLIMON study, we experimented with how to involve the participants in formative evaluation, but the experiment was rather unsuccessful in that matter. The evaluation was not very formative, and it was difficult to structure and facilitate participation. This experience is briefly described in Paper VI, Section 3. The lack of a formative evaluation made it difficult to gauge project progress, which seems to be problematic in iterative prototyping projects and enhances the risk of project escalation (see Paper III). In the Health Check study, the participants took part in what could be gauged as a successful formative evaluation (Paper VI).

Based on the approach presented in Chapter Six, the participants should participate in evaluation and design of work systems in all stages of the design process.

In the following two sections we will look more into how the empirical work contributes to the understanding of participation in evaluation and how it can be approached in terms of designing healthcare work systems.

7.2 Participation in the design of healthcare work systems

The Health Check study was designed from a work system perspective with the aim of designing a healthcare work system, namely the work system covering the medication process. The aim was to shift the focus from how the HIS functioned – in this case, as an electronic medication record – to focus on the medication process and how it could be improved. I experienced in the previous studies that if the HIS is the centre of attention, people only seem to be concerned with how technology can do this and that, instead of also looking at how work practices can be rearranged. During the Health Check workshop, the participants suggested different changes to obtain the same effect, and they were changes in both technology and work practices. Furthermore, the broader perspective for the workshop provided an opportunity for the participants to suggest changes or effects without having to worry about whether the suggestions related to the HIS or not, as would have been the case if they were participating only in design of the HIS.

A work system perspective requires the facilitator/participatory designer to be quite knowledgeable about all the elements in the work system, as well as the external parts, in order help facilitate the specification and selection of effects and changes to aim for. For example, the designer needs to know the constraints and possibilities of the HIS(s), the medication procedures, and legislation in order to avoid designing anything that violates the procedures. To read more about the use of participation in the design of healthcare work systems, see Papers V and VI.

In the first two studies (Shared Care and CLIMON), the clinicians were participating mostly in the design of the HIS. However, in the CLIMON study, the clinicians from one ward (during a training session on the prototype of the HIS) had a long discussion about what kind of computer – laptop or stationary – the prototype should run on and where it should be placed on the ward. This particular session can be interpreted as work system design. They where concerned with what kind of hardware and which placement of it would support the core activities of the ward in the best possible way. After two hours of discussion, the clinicians agreed that a stationary computer, where the screen and keyboard were placed on a wall in the ward but the

computer was placed outside the ward to reduce noise, would be the best arrangement. But during the pilot test, they found that the arrangement was not very good. This example illustrates the need for evaluating the interventions as part of the work system.

If users are involved in designing healthcare information systems detached form their everyday work practices, they have difficulties in being genuinely or truely involved.

7.3 Participation in evaluation

As mentioned earlier, evaluation in different forms ranges from informal feedback-like evaluation to formal formative evaluation of effects as part of the design process at various stages. In this section we will focus on how participation in evaluation can be understood and approached by looking at the examples from the empirical studies.

In the Shared Care study, there was no planned evaluation of the system to inform the design. A group of GPs had been in contact with the developers when planning the design. However, as part of our research project, my research colleagues and I conducted an evaluation of an evolutionary prototype (see Paper III for an explanation of evolutionary prototype) by asking the GPs to test this stand-alone version of the prototype in their clinics. We created a diabetes case and asked the doctors to use the system for this case while thinking aloud. Afterwards, the GPs were interviewed about their experience with the prototype. Through the evaluation in these simulated settings, the participants had a chance to participate in a qualified evaluation because they got to know the system and got an idea of how it would work in their work settings and hence how it would support the work system. Based on the results of this evaluation, the prototype was modified and the scheduled roll-out got postponed, and the HIS was redesigned based on the outcome of the evaluation. In this case, the researchers facilitated the GPs' participation in the evaluation, and the evaluation affected both the design and the implementation process. This serves not only as an example of how participation in evaluation can be approached but also as an argument for being concerned with both participation in evaluation and the work system as part of design.

Prototyping[16], as it was intended to be done in the CLIMON study, could have been a way to engage the participants in evaluation as part of the design process. According to the plan, the participants would specify a number of effects for the use of the application. On the basis of the effects specified, the designers would design a prototype that the participants could test and evaluate and, on that basis, suggest changes, new effects, etc. It was not conceptualised that way at that time, but the notion of usage effects is rather similar to effects of changes in a work system. However, as described in Paper III, the prototype was not ready until very late in the specification process. Instead, participation in design was attempted to be obtained by use of paper-based documents containing the specifications. However, the participants had a hard time understanding and relating the specification to their work system when they were asked to evaluate them. To compensate, PowerPoint mock-ups were developed to help the evaluation of the graphical interface, in particular. In ret-

[16] In PD prototyping is viewed as a technique for supporting participation and mutual learning. I have just emphasised its function as supporting participation by providing the participants with an artefact they can evaluate and, on that basis, provide qualified feedback to the designers.

rospect, it is rather obvious that it was difficult for the participants to truly engage in the evaluation of the paper specifications and mock-ups, both because they had difficulties in understanding the rather technical and formal language of the specifications documents and because it was difficult for the participants to imagine how an HIS based on theses documents would support the work system and their work practices. The participants having difficulties in relating the HIS to the work system stood out distinctly when observing how the clinicians, during the pilot test, were much more capable of evaluating the prototype in relation to how it supported the work system.

This case provides an argument for evaluation as a way to facilitate participation and yet is also an argument in favour of the work system perspective. In the Shared Care study, the participants were not involved in designing either the evaluation or the evaluation criteria, yet the evaluation influenced the design process. In the CLIMON study, the participants took part in specifying the evaluation criteria, but it was difficult for them to evaluate the HIS in relation to the criteria when the HIS was only represented by paper specifications and mock-ups, and also later when it was a running prototype but isolated from the work system.

Because of those experiences in the two first studies, the third study was designed from a work system perspective with a focus on participation in evaluation. The Health Check study was designed to have the work systems participants take part in formative effect evaluation, which serves to inform the design process. As part of the study design, I designed a formative evaluation process to as a way of facilitating and approaching participation in evaluation as part of design. The process is illustrated in Figure 14. The process is heavily inspired by action research, which is often the case when problem-solving methods are developed while having action research as the research method, as mentioned in Chapter Two.

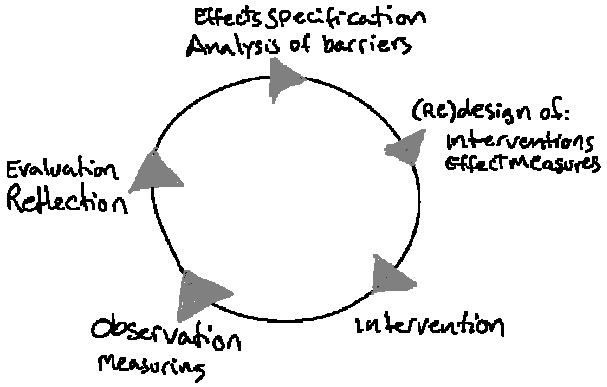

Figure 14: Formative effect evaluation

The formative evaluation process is a systematic effect evaluation aimed at supporting the design of healthcare work systems in terms of improving the work system. The formative evaluation process can be conceived as an instantiation of the approach to the ongoing design of healthcare work systems as outlined in Chapter Six.

Here follows a description of how the formative evaluation process (Figure 14) relates to the participatory approach for the ongoing design of healthcare work systems (Figure 13). Effects specification and analysis of possible barriers and problems are to be done as part of specifying the design vision. The design of interventions and

effect measures is a component in designing the interventions to change the work system Observing and measuring the changes as well as reflecting on the appropriateness of the interventions and their effects is part of the formative evaluation of the work system. Evaluation of whether the effects are achieved and reflection about whether the interventions and effects are appropriate is also part of the evaluation phase.

The formative evaluation approach focuses on the evaluation element and encompasses an important issue that is not explicated in the design process figure, namely the reflection phase. It is important to reflect not only on whether the interventions designed are appropriate and whether the effects are achieved but also whether the design vision is still desirable. Or, put in other terms, whether the effects specified are still desirable. This is especially important in order to avoid the negative implications of indicators mentioned in Chapter Five but also in order to be open to emergent and opportunity-based changes. An example from the Health Care study can be used to illustrate that the effects specified might not be desirable at all times. In the 2002 implementation plan for the electronic medication module, one of the effects specified was that 99.5% of all prescriptions should be done by a physician in order to reach unified medication[17]. However, in the Health Care study, it was found that unified medication was improved by letting the nurses do some of the prescriptions – acting against the effect specified 4 years earlier in the implementation report (Paper V).

To assist participation in the specification of effects and effects measures, I designed an effect map to help structure the effects specification (see Table 4). The map facilitated participation in designing interventions that foster changes in the work system that should realise the effects (Papers V + VI). The map is designed to be used at all stages of the overall design process.

[17] Unified medication refers to the intention that information on medication, such as prescriptions, shall be written and stored in one place only. The information can be accessed and read by others, but it should only be recorded one time in one place. This strategy is believed to reduce medical errors (Bourke et al. 2001).

Table 4: The effect map with explanation of the columns (Paper VI)

Superior Effect	Effect	Hypothesis about what creates the effect	Influence (on attaining)	Barriers (for obtaining)	Intervention	Effect measure	Target group (intervention)
For specifying effects. Effects can in most cases be divided into subeffects creating a hierarchy or tree structure. The two columns are an attempt to present this hierarchy.		Contains hypothesis and suggestions on what changes would lead to attaining the effects.	For stating whom or what might be influential on attaining the effects. Either because they are influential on what is suggested in column C or on the intervention suggested in column F.	For stating possible barriers hindering the specified effect to be attained. It could also be experienced problems or barriers that are believed to hinder an effect, which may not yet be specified.	Suggestions for interventions that are believed to help obtaining the effect either directly or by removing a barrier.	For describing the effect measure appropriate for measuring whether the effect has been obtained or not.	To specify the target group(s) of the intervention, such as who will be directly affected by the intervention.

The iterative process with its reflective elements, combined particularly with the barrier category in the effect map, is meant to support the inclusion of emergent and opportunity-based effects. As explained in Paper VI, the columns in the map are not meant to be filled in any particular order. Hence, if the participants point to barriers or inexpediencies they have experienced or witnessed, then imagining what effects removing these barriers could lead to is a way of indentifying opportunity-based effects.

So far the focus has been on understanding and approaching participation in evaluation with a rather limited number of participants. However, in the end of this section I will emphasise some examples from the studies where participation in evaluation was approached in a way that created an opportunity for a larger number of people to take part in evaluation.

The pilot test carried out in the CLIMON project created an opportunity for a larger group of participants than those participating in the workshops to be involved, as the people working on the ward took part in the pilot test and thus also the evaluation. In this pilot test, the people (those working on this particular ward) participated in evaluation mainly just by doing their jobs, but they were also encouraged to write down suggestions for changes in the use of the HIS, in a log-book. Additionally, as part of doing the evaluation I was responsible for, I interviewed a number of clinicians who had participated in the pilot test but not in the design workshops. By being part of the changed work system subject to evaluation, and through the evaluation interviews and the log-books, a larger group of participants than those attending the workshops participated in the evaluation.

The evaluation was meant to inform the successive cycles of design, but the project was terminated after the pilot. Thus, this particular evaluation ended up not being part of a design process – at least not within this project.

To a certain extent, the same can be said for the case with the questionnaire in the Health Check study. Questionnaires are mostly associated with summative types of evaluation because the process of designing the survey, sending it out, and getting responses is resource-demanding, cumbersome, and takes time. Consequently, the feedback loop is rather long, but if we conceive design as an ongoing process and design the question to fulfil the purpose, then surveys of this kind can serve as evaluations informing design. In the Health Check study, the results of the questionnaire did actually inform the onward planning of the study as well as the design process. Though, I would acknowledge that it might be difficult for the participants who have answered the survey to trace their influence.

In the questionnaire survey part of the Health Check study, 233 people participated in evaluating the HIS and associated procedures (Paper IV) by responding to the survey. In this way the questionnaire involved a lot more of the work system participants in evaluation than, for example, the effects specification workshop did. However, there seems to be a relationship between the number of participants and the type of evaluation activities they can participate in, but the different evaluation activities can potentially supplement each other. Hence, it would be fair to have a discussion of the criteria for participation in evaluation similar to the discussion of participation in design from Chapter Four in which criteria such as being central actors or having genuine influence is mentioned.

7.4 Managing and facilitating participation

In Chapter Six it was suggested to conceptualise implementation as the participatory, iterative, and ongoing design of work systems in which evaluation is part of the design process. However, managing participatory and iterative design processes is not necessarily a trivial task.

Paper III reports on the challenges of managing iterative participatory design processes such as prototyping. Managing iterative processes like prototyping is difficult because it depends on iterative activities where the plans are supposed to change during each iteration. Thus traditional management tools such as plans and control are difficult to apply. Control is hampered by the difficulties of measuring the degree of fit created by each iteration. Additionally, the project progress can be difficult to gauge due to the difficulties of setting up and agreeing on exact objectives (Baskerville and Stage 1996). Furthermore, the input from the participants is hard to control and predict. In fact, the input from the participants is not supposed to be controlled and predicted; if it was possible to predict, participation would not be necessary. However, the involvement of participants adds to the complexity of managing prototyping and iterative design processes.

I will restrict myself from the discussion but just mention that agile project management methods might be more appropriate for managing iterative projects with user involvement. However, as described in Paper III, iterative projects such as prototyping can also be managed within the frame of traditional management methods using different management strategies based on the project management iron triangle of scope, time, and resources (Paper III).

In the early days of PD, the participatory designer was the one designing the information system, but in today's PD projects, the PD researcher most often holds the role of a person facilitating participatory design. An example could be the researcher

facilitating a design process between a group of users from the purchasing company and a group of developers from a software company. The term facilitator is used to indicate the focus being on the facilitating role; however, the facilitator is, in action research and/or participatory design, often synonymous with the participatory designer or researcher.

In the Health Check study, part of the action research study was to experiment with how to facilitate participation in evaluation in relation to the design of a healthcare work system. I was the facilitator of the effect specification, during which I tried to involve the workshop participants in specifying effects and suggesting interventions to reach the effects. The effect map-tool was developed in order to support and facilitate the participation in evaluation as part of design.

To facilitate participation in evaluation of changes in a work system, the facilitator must be knowledgeable about the various aspects in the work system, or at least be able to draw on people with in-depth knowledge of the elements. Furthermore, it was my experience that my ability to facilitate participation in evaluation depended just as much on my knowledge and understanding of the practice and norms as it did on my personality and ability to establish credibility among the participants. To gain knowledge of the practices and norms, I spent time observing the participants and the work they do. This preparatory work did, apart from establishing confidence between me and participants, make me capable of questioning some of their ingrained work practices. The latter was of great importance as the work system subject to evaluation had been relying on the same HIS for several years, and as a result, the work practices were rather settled. I also experienced that because I was an outsider – meaning that I was not a clinician and not from the hospital – it was easier for me to question various aspects of the work system. Also I found that I was the one suggesting more drastic changes. Thus in order to create a balance between continuity and change (Bratteteig 1994) or tradition and transcendence (Ehn 1992).

I am aware that my previous experiences, knowledge, and personality affect how I fill out the facilitator role and thus also the outcome of the design process, and even the project as such. This personal influence on the facilitator role is similar to the personal influence that is evident in the action researcher role.

Chapter Eight: **Contributions**

In the previous chapter the empirical material was analysed and discussed to provide an answer to the research question. However, before we get to the conclusion, I would like to bring out five points that, apart from the contributions from the research papers, constitute the central contributions of the work presented in this thesis. The five points all contribute to answering the research question.

8.1 Work system versus information system

In some ways the work system perspective is not that different from what is proposed in socio-technical perspectives like (Berg 1999) or in participatory design (e.g., Bødker et al. 2004), where in-depth knowledge about the organisation and the work practices is important for being able to design the information system to support the users and the management. However, I would argue that the work system perspective does provide something different than a socio-technical perspective. The work system perspective provides an explicit shift in focus from HIS to an HIS-reliant healthcare work system. It also provides a set of terms to talk about and define the object of interest. The work system perspective acknowledges the importance of context; however, it provides a basis for discussing and defining a scope – a level of analysis for what is of central importance to the design and implementation of health information systems.

But most of all, I think the work system is useful for changing the focus from an isolated information system to the work system being most important. The work system helps by "putting IT in its place" (Earl 1992: p 100 (the title)), as Earl probably would have placed it.

I think the outcomes of the two first empirical studies presented in this thesis would have been a lot different if the focus of the projects had been the work systems rather than the information systems. For example, the failure of the CLIMON project can be explained by the participants not being involved in designing a work system but only in designing an information system. This resulted in a system that did not really support the work practices. Besides that, the system did not take into account that there existed other information systems supporting the work system that this new system should be a part of.

The results of the questionnaire reported on in Paper IV could serve as an argument both for participatory design but also for the work system perspective. This is because the work system perspective is concerned with how well the HIS supports the running work system as opposed to focusing on the HIS as an isolated element. Instead of approaching implementation with a main focus on installing and integrating (both technically and into the work practices) an information system, it is my guess that compliance with the medication procedures, which were the reason for implementing the HIS in the first place, would have been a lot better if the focus had been on redesigning the work system to perform in accordance with the procedures. In the action research part of the Health Check study, the work system perspective was successfully applied to improve the medication process both in terms of compliance with the procedures and the associated use of the HIS supporting the work system. Moreover, the work system perspective also helped facilitate participation.

8.2 HIS implementation as ongoing design

The work system perspective has implications for the conceptualisation of HIS implementation. In Sections 6.2 and 6.3 I used theory to argue for organisational implementation of HIS to be understood as the ongoing design of healthcare work systems. However, this point is also supported empirically. As the empirical work in this thesis is based on three different HIS projects lasting approximately six months each, I have not had the opportunity to investigate ongoing design empirically. Rather, the empirical material appears to support the argument for design to be ongoing. The results of the survey reported in Paper IV can be interpreted as indicating the need for ongoing design and implementation. In Paper IV it is shown that despite the time required to get used to the HIS, and despite a number of interventions aimed at improving the use, the HIS is still not used as desired. This outcome can be interpreted as a need for ongoing activities to fit the HIS to the work system and to evaluate whether the HIS improves the work system as desired. It could also be argued that the lack of use can be blamed on bad design and lack of proper user involvement, or that the implementation process was not handled well enough. However, these arguments do not exclude the possibility that it might be valuable to approach design as an ongoing process.

In the action research part of the Health Check study reported in Paper V, we see an example of how the effect of the interventions wears off after the interventions and the project have ended. This indicates a need for systematically assessing whether the desired effects are *still* achieved. It could also indicate a need for ongoing design, or both. However, there seems to be a tension between organising implementation as brief projects with clear project goals and the need for ongoing design and implementation (Paper V).

Doing or obtaining ongoing design is not a trivial task. Tyre and Orlikowski (1994) have found that technological adaptation only happens during a brief window of opportunity following the initial implementation; hereafter the technology as well as the context of use tend to congeal together, which might entail unresolved problems being embedded into organisational practice (Tyre and Orlikowski 1994). As a result, it is necessary either to find away to keep the opportunity window open or to repeatedly re-open the window of opportunity to obtain ongoing design.

An additional point about the ongoing element is that it is just as much a mindset and a way to conceptualise design as it is something to be carried out in practice. In the Health Check study, ongoing element in the design was applied more as a mindset and it was applied in a project setting. However, whether the lack of sustainability in the changes of work practices is due to the project organisation is an unanswered question. It is briefly discussed in Paper V.

8.3 Participation in evaluation

Formative evaluation, as described in Chapter Five, aims at creating improvement by supporting reflective learning and informing successive iterations. In this iterative process of evaluation, the evaluation becomes an intervention in it self, as it informs the process and most likely changes the design of the work system that is subject to the evaluation. In this way, a formative evaluation affects design; hence, if we value

participation in design, subsequent participation in evaluation ought to be of interest for the participatory design field.

A more significant argument for being concerned with participation in evaluation with regards to the design of healthcare work systems relates to the literature that requests the understanding of design in PD to be broadened to also cover, for example, design-in-use. As pointed out in the previous chapter, participation in evaluation seems to be easier to establish when the intervention to be evaluated is evaluated based on the effects it has on the work system. If, for example, the intervention is changes in an HIS supporting the work system, then evaluating the changed work system entails the HIS being evaluated in the context of use.

Evaluation of work systems as opposed to HIS evaluation has at least three implications: 1) The result of the evaluation will inform the design, thus participation in evaluation leads to participation in design-in-use. 2) The participants are engaged in evaluation as part of doing their job, thus they can hopefully still contribute to the production[18], which, in healthcare, is an important issue. But it is more important that the participants are engaged at a time when they are affected by the intervention and thus are more motivated to truly participate, as described by (Wagner and Piccoli 2007). 3) The evaluation of the work system implies that HIS is evaluated as part of the usage context. This is because, when evaluating a healthcare work system you also evaluate how the HIS perform in relation to the work system.

Having the work system as the object of evaluation also means that you can be part of an evaluation just by participating in the work system and not necessarily be aware of your participation in the evaluation. In the Health Check study, all of the clinicians on the ward in some way participated in the formative evaluation, though it was only the participating nurse and physician who took part in specifying the effects and interventions. The clinicians on the ward were subject to the interventions being evaluated as they were participants in the work system being evaluated.

8.4 Effects specification as part of participation in evaluation

The formative evaluation approach and the effect map to support it (presented in Papers V and VI) entail the participants being involved in specifying effects of changes in a work system. In addition, they are also involved in specifying exact measures of the effects, possible interventions to reach the effects, and possible barriers hindering the effects – all of which is based on their knowledge of the work system. As described in Paper VI, the workshop participants agreed on the effects specified, and there were only small differences in the suggestions on how to obtain the effects. This was despite the fact that they were from different professionals groups and were likely to have different rationales and thus aim for different kinds of effects. One explanation could be that the effect map also provided a hierarchy of effects, showing how the different effects might be related to the overall effects such as patient safety and improved medication – effects that all parties seemed to be able to agree on despite different rationales.

[18] Doing PD in the healthcare, I have often been confronted with the shortcoming of personnel resources as an argument for not being able to do PD. In all of the projects I was involved with, to get funding for buying the clinicians out of their regular schedule, it was a requirement to have them participate in design activities.

The effects specification can be conceived as a technique for involving the participants in a formative evaluation. As mentioned in Paper VI, the notion of effects and the work system perspective helped facilitate participation because the participants almost instantly were able specify effects and suggest changes in the work system. They did not have to learn about technological possibilities or technological terms to express system functionality. These finding are supported by similar findings by (Barlach and Simonsen 2008). However, if the effects specified or some of the barriers mentioned require changes in the healthcare information systems(s) that support the work system, a facilitator with technological knowledge is necessary. The role of the facilitator or participatory work system designer will be discussed in the next section.

But before we turn to discussing the facilitator role in the next section, I would like to describe effect specification and the formative evaluation approach, as well as the role of the facilitator, with an analogy inspired by and borrowed from (Suchman 1987) and (Orlikowski and Hofman 1996). They use the analogy to explain plans and situated action and models for change management, respectively. The analogy is the differences between the European and Trukese[19] way of navigating.

> "The European navigator begins with a plan – a course – which he has charted according to certain universal principles, and he carries out his voyage by relating his every move to that plan. His effort throughout his voyage is directed to remaining 'on course.' If unexpected events occur, he must first alter the plan, then respond accordingly. The Trukese navigator begins with an objective and responds to conditions as they arise in an ad-hoc fashion. He utilises information provided by the wind, the waves, the tide and the current, the fauna, the stars, the clouds, the sound of the water on the side of the boat, and steers accordingly. His effort is directed to doing whatever is necessary to reach the objective." (Berreman 1966: p 347 cited in Suchman 1987)

The traditional approach to design and implementation is comparable to the Europeans, who start with a plan – the requirement specification and implementation plan. The participants specifying the effects can be compared to the Trukese stating their objective. However, it is up to the facilitator and implementation manager to respond to the conditions and do whatever is necessary to reach the effects specified. But the analogy stops here because, in the formative effect evaluation approach, the objective/effects can be changed along the way if they are no longer desirable.

8.5 Facilitating participation

All of the studies contained elements that showed how evaluation can facilitate participation in design, and the Health Check study, in particular, showed that the notion of effects and the work system perspective was also helpful in facilitating participation. However, these tools and techniques are not enough to facilitate participation; there also needs to be a facilitator – a person who facilitates the application and use of such techniques or approaches. In order to apply a work system perspective, the facilitator needs to understand and be knowledgeable about the elements in the work

[19] The Trukese refers to the people from Micronesia, which is a group of hundreds of small islands located in the Pacific Ocean, north of New Guinea.

system as well as the suite of health information systems that support the work system. This does not mean that the facilitator is alone in the endeavour of improving the work system. In the Health Check study, the participating nurse and physician were the ones to intervene and carry out the changes on the ward and among their colleagues. The participants were opinion leaders (Rogers 1995: p 27) promoting the changes in the work system, and they had the role of encouraging their colleagues to participate in the evaluation of the work system. Additionally, the project manager contributed not only by managing the project as such; the manager also contributed with extraordinary in-depth knowledge of the HIS supporting the work system. This knowledge made it possible to quickly determine which changes were possible to obtain through adapting the HIS, and in such cases, how the HIS should be adapted.

It seemed to be an advantage that the main facilitator role was occupied by someone outside the clinical environment, both because it made it easier to question the work practices and the norms and suggest more drastic changes, but also in order to re-open the windows of opportunity for improving the HIS-reliant work system.

Chapter Nine: **Conclusion**

The motivation for this thesis was found in a wish to contribute to improving the use of HIS to support the clinicians working in the Danish healthcare sector. Both participation – in terms of participatory design – and evaluation – in terms of iterative or formative evaluation – have been highlighted as key elements for improving the design and implementation of healthcare information systems. Based on the assumption that participation and evaluation do play an important role in improving the design and implementation of HIS, the research question pursued in this thesis was: how can participation in evaluation be understood and approached in the design of healthcare work systems?

The research question was investigated both empirically – through three different studies in the Danish healthcare sector – and theoretically – by suggesting a mainly analytically developed approach to the design and implementation of HIS.

The theoretical background for the thesis is found at the intersection of four theoretical elements: participatory design, evaluation, HIS implementation, and a work system perspective. A synthesis of the theoretical elements and the empirical experience has resulted in an approach where design and implementation of HIS is conceptualised as an ongoing participatory design process of healthcare work systems, a process in which formative evaluation of the changes in the work system is part of design. The participatory design approach provides a basis for how to understand and approach participation in evaluation as part of an iterative ongoing design process.

The empirical contribution of this thesis is presented in the six research papers in Part Four and in the additional analysis in Chapter Seven. The empirical research has also contributed to the development of the participatory design approach to implementation. The two first studies informed the approach and the third study provides an application of central aspects of the approach. How the empirical work has contributed to the development of the approach is briefly touched upon in Chapter Six and more thoroughly descried in Chapter Seven. Moreover, the analysis of the empirical material in Chapter Seven along with the six research papers provide input and answers to the research question. Apart from providing input into answering the research question, the six papers also contribute to the fields of PD and organisational implementation of HIS. In the following, I will briefly outline the main contributions from the six papers.

Paper I: In this paper, three challenges for implementing HIS to support shared care between hospitals and GPs in Denmark are identified. The challenges can partly be explained by the inherent problems of representing the general practitioners in the design of the healthcare information system.

Paper II: The second paper points to the challenges for the PD community to address – issues of participation and representation of different groups of participants in HIS design projects with diversified groups of professionals or people with different work tasks.

Paper III: This paper reports on a participatory prototyping project. Based on the analysis of the case, the paper presents a 3-by-3 framework of coping strategies for managing prototype projects. The paper also points to challenges for managing participation in design and evaluation.

Paper IV: Based on a questionnaire survey, this paper points to the need for an enhanced focus on organisational implementation activities such as training, modification of work practices, and interventions targeted at selected barriers. The paper documents that mandated use and time are not enough to lead to consistent adoption. Rather, a systematic approach to organisational implementation is needed.

Paper V: This paper provides insight into the challenges of performing interventions to achieve specified effects. We found that designing and performing effective interventions to achieve specified effects is a challenge and that such interventions need to be combined with evaluation of whether the effects are in fact achieved. Furthermore, an ongoing organisational implementation process, including interventions and systematic evaluations, may be necessary in order to implement new ways of working.

Paper VI: This paper reports on an application of the main elements in the participatory design approach to implementation. It is that the work system perspective along with the notion of effects helps facilitate participation due to a broader and less technology-focused perspective, which also enhances the potential for improving the work system. Additionally, the effect map has demonstrated its applicability in facilitating participation in evaluation and design.

The research reported in Papers V and VI also serves as an answer to the research question by providing an example of how participation in evaluation in the design of healthcare work systems can be approached. In other words, the study provides an instance of the participatory design approach presented in Chapter Six. From the analytical and practical application of the participatory design approach, four main contributions are derived and presented in Chapter Eight.

The first contribution is the substitution of the healthcare information system focus with a focus on HIS-reliant healthcare work systems. The work system perspective provides a basis for defining a scope – a level of analysis for what is of central importance to the design and implementation of HIS – which is how it supports the work system. The work system perspective addresses and encompasses many of the concerns about the role of healthcare information system and organisation that have been presented in relation to the design and implementation of information systems.

The work system perspective, along with the different perspectives on implementation presented in 3.1, is the basis for the second contribution, which is the conceptualisation of implementation as an ongoing, iterative design process – a process enhanced and informed by formative evaluation. The ongoing design of healthcare work systems addresses the need for iteratively creating fit between HIS and the organisational aspects, as pointed out in much of the socio-technical literature. Seeing implementation as an ongoing design process also expands the application field of participatory design so that PD becomes part of, and concerned with, implementation.

Contribution number three concerns the role of formative evaluation as constituent in the design process. It is argued that formative evaluation can be understood as an integral part of an iterative design process. Thus, if we value participation in design, then participation in evaluation should be part of participatory design when evaluation is part of design. Furthermore, participation in evaluation can potentially increase the engagement in obtaining the effects specified; participation in evaluation also addresses the need for involving the participants at a time when it is relevant to them and when they can truly engage in the design/evaluation process.

The fourth contribution stems mainly from the third empirical study in which participation in evaluation is facilitated in terms of effects specification supported by an effect map. Effects specification is applied as a technique to involve the participants in evaluation as part of design. To support the effects specification, an effect map was developed and applied. The design of the effect map was based on problems previously experienced with structuring the effects specification process.

The last contribution I would like to highlight concerns the facilitation of participation in evaluation and design, especially the role of the facilitator, or, should I say, facilitators. This is because in order to facilitate participation in evaluation, several different competencies are necessary, and these competencies can be difficult to obtain in one person. Apart from a person who maters PD and evaluation techniques and is capable of reopening the window of opportunities, the facilitator must also possess extensive knowledge about the HIS and the technical infrastructures and in-depth knowledge about the work practices. Additionally, it might be necessary to divide the facilitator role among several people because, in order to re-open the window of opportunity, it seems like a person from the outside is favourable. However, it is important to have a person who belongs to the group of participants and can act as a champion and/or change agent to facilitate participation in evaluation among a larger group of work system participants.

In order to sum up, I will provide a very brief and distilled answer to the research question. Participation in evaluation can be understood as similar to participation in design because formative evaluation is an integral part of the design process. I recommend that the design of healthcare work systems be approached as an ongoing and iterative design process in which formative evaluation is an integral part of the design process. Accordingly, participation in evaluation can be understood as healthcare work systems participants participating in a formative evaluation of the work system as part of an ongoing design process. The participants take part in a number of activities in relation to the formative evaluation process: specifying effects, generating hypotheses about which changes in the work system will lead to achieving the effects, suggesting interventions, designing effects measures, and reflecting about the appropriateness of the effects and interventions. These activities may with advantages be supported by an effect map.

The research has been carried out in accordance with the principles of engaged scholarship. For that reason, an effort has been made to communicate the research findings to both the practice community and the research community, through different communications channels. I will end this summary report by listing a number of implications derived from this study. In accordance with engaged scholarship, the implications concern both practice and research.

9.1 Implications

The suggested approach to organisational implementation, as well as the research finding, has a number of implications in relation both to future research and for the practice field concerned with the implementation of HIS.

9.1.1 Implications for practice

The research findings presented in the summary report, as well as in the research papers, entail a number of implications for the implementation of HIS.

The first implication is the need for working continuously and systematically with the improvement of healthcare work systems by use of formative effect evaluation. This implication entails a need for considering the institutional support of the ongoing improvement and design process. It also includes the need for people who have the abilities and competencies to facilitate participation and evaluation as part of continuously designing the HIS-reliant healthcare work systems.

The institutional support might entail a need for the hospitals and the region to consider the division of the local and regional quality units and IT departments. A suggestion could be to integrate or consolidate these departments to better address the ongoing design of HIS-reliant healthcare work systems. That might have been the rationale behind the regional quality and development/change department that already exists. In any case, it would be obvious to place the responsibility and support for such an ongoing design process in the quality and development/change department. However, it seems that there is a need for additional knowledge, competencies, and will to push through that kind of organisational change and restructuring.

The need for ongoing design also implies a need not only for considering how to organise and address the work on an institutional level, but also for taking into account how the actual work should be organised and managed. For example, to reflect on whether the project organisation, defined by being temporary, is suitable for supporting ongoing processes, or whether something else is needed. It might be that iterative and/or agile project management methods, to a certain extent, could support ongoing design. Additionally, there may be some practical challenges in managing ongoing processes, especially considering today's project and business case-based financial structures.

The findings presented in this thesis show that there is potential in applying participatory formative evaluation as a constructive form of evaluation aimed at creating improvements and enhancing organisational learning. This will, in certain cases, imply a break with the mindset of being able to predict, plan, and control projects, for example, by means of stable project goals. Furthermore, it entails a call for breaking with evaluation as merely a control technique. In return, formative evaluation incorporated as part of HIS implementation does have the potential to detect low or absent adoption and indentify barriers, as well as feasible interventions, to address the lack of change.

The work system perspective implies an explication of HIS understood as an integrated part of the clinical work and not just as a tool to be used or not. What might be the most radical implication for practice is the conceptualisation of HIS implementation as ongoing design, including participation in evaluation as part of design. This implies that the idea of maintenance disappears – a system is never finished, and running an HIS or a work system is never about maintenance, but is always improving to reach the optimal performance.

9.1.2 Implications for research

In relation to participatory design, the conceptualisation of HIS implementation as the ongoing design of healthcare work implies a need for supporting and facilitating participation in ongoing design processes. It also implies that PD is concerned not only with designing HIS, but with more explicitly designing healthcare work systems relying on HIS. Furthermore, it implies an expansion of the notion of design to cover more than design understood as an activity or a phase between analysis and development; rather, design ought to take place at all stages in a work system's and an HIS's lifecycle. A similar point has already been stated by a number of researchers, as reported in Section 4.3.

Understanding and approaching evaluation as part of design implies that PD also must be concerned with tools and techniques to facilitate participation in the evaluation of work systems, such as effects specification and effect maps. These tools and techniques may be different than the tools and techniques developed for supporting participation in the design of information systems, but they are not necessarily that different. However, further research into how to facilitate participation in evaluation, both in terms of tools and techniques, but also in terms of the facilitator role, is required in relation to the design of healthcare work systems.

The formative evaluation approach presented has implications for the field of evaluation in medical informatics. The participatory approach to formative evaluation implies a need to focus on how to involve the different groups of clinicians in evaluation activities. The combination of formative evaluation by use of effect specification, and a desire to be able to account for emergent and opportunity-based effects, calls for additional research into how to design and approach iterative and formative evaluation in order to account for emergent and opportunity-based changes.

The last implication I want to point out is particularly relevant in the design processes that entail significant changes in the HIS supporting the work system. In these situations, formative evaluation as part of designing healthcare work systems implies a need for addressing the conflict between the desire to test the HIS at early stages when it is easy to modify, and the need to evaluate the HIS as part of the work system, that is when it is sufficiently stable to the work system.

The research presented here provides a suggestion for conceptualising the design and implementation of HIS as the ongoing design of healthcare work systems. It also provides a suggestion for how to understand participation in evaluation as part of this ongoing design process. Furthermore, one example of how participation in evaluation can be approached as part of an ongoing design process of a healthcare work system has been presented. However, more research on how to approach participation in evaluation as part of the ongoing design of healthcare work systems, as well as other kinds of work systems, would be a natural continuation of the work presented in this thesis.

References

Alter, S. (1999a). "A general, yet useful theory of information systems." *Communications of the Association for Information Systems (CAIS),* 1(13).

Alter, S. (1999b). "The Siamese twin problem: a central issue ignored by dimensions of information system effectiveness." *Communications of the Association for Information Systems (CAIS),* 2(20).

Alter, S. (2002). "The work system method for understanding information systems and information systems research." *Communications of the Association for Information Systems (CAIS),* 9: 90-104.

Alter, S. (2003). "18 Reasons Why IT-Reliant Work Systems Should Replace "The IT Artifact" as the Core Subject Matter of the IS Field." *Communications of the Association for Information Systems (CAIS),* 12: 366-395.

Alter, S. (2004). "Making Work System Principles Visible and Usable in Systems Analysis and Design." *Proceedings of the tenth Americas Conference on Information Systems*: 1604-1611.

Alter, S. (2006). The work system method. Larkspur, CA, Work system Press.

Alter, S. (2007). "Could the Work System Method Embrace Systems Concepts More Fully?" *Information Resources Management Journal,* 20(2): 33-43.

Alter, S. (2008). "Defining information systems as work systems: implications for the IS field." *European Journal of Information Systems,* 17(5): 448-469.

Ammenwerth, E., Brender, J., Nykänen, P., Prokosch, H.-U., Rigby, M.&Talmon, J. (2004). "Visions and strategies to improve evaluation of health information systems: Reflections and lessons based on the HIS-EVAL workshop in Innsbruck." *International Journal of Medical Informatics,* 73(6): 479-491.

Andersen, N. E., Kensing, F., Lassen, M., Lundin, J., Mathiassen, L., Munk-Madsen, A.&Sørgaard, P. (1986). Professionel systemudvikling. Viby J, Teknisk forlag A/S.

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

Ash, J. S., Gorman, P. N., Lavelle, M., Payne, T. H., Massaro, T. A., Frantz, G. L.&Lyman, J. A. (2003). "A cross-site qualitative study of physician order entry." *Journal of the American Medical Informatics Association,* 10(2): 188-200.

Ashurst, C., Doherty, N. F.&Peppard, J. (2008). "Improving the impact of IT development projects: the benefits realization capability model." *European Journal of Information Systems,* 17: 352-370.

Avison, D., E., Lau, F., Myers, M., D.&Nielsen, P. A. (1999). "Action research." *Communications of the ACM,* 42(1): 94-97.

Azad, B.&King, N. (2008). "Enacting computer workaround practices within a medication dispensing system." *European Journal of Information Systems,* 17(3): 264-278.

Balka, E. (2006). "Inside the belly of the beast: the challenges and successes of a reformist participatory agenda." *Proceedings of the ninth conference on Participatory design: Expanding boundaries in design - Volume 1*, Trento, Italy.

Bannon, L. (1991). From Human Factors to Human Actors: The Role of Psychology and Human–Computer Interaction Studies in System Design. In J. Greenbaum and M. Kyng (eds.), Design at Work. Hillsdale, New Jersey, Lawrence Erlbaum Associates**:** 25-44.

Bansler, J., P. (1989). "Systems development research in Scandinavia: three theoretical schools." *Scandinavian Journal of Information Systems,* 1(9): 3-20.

Barki, H.&Hartwick, J. (1989). "Rethinking The Concept Of User Involvement." *MIS Quarterly,* 13(1): 53-63.

Barlach, A.&Simonsen, J. (2008). "Effect specifications as an Alternative to Use Cases." *31st Information Systems Research Seminar in Scandinavia, IRIS 31*, Åre, Sweden.

Barley, S. R. (1986). "Technology as an Occasion for Structuring: Evidence from Observations of CT Scanners and the Social Order of Radiology Departments." *Administrative Science Quarterly,* 31(1): 78-108.

Baskerville, R.&Myers, M., D. (2004). "Special Issue on Action Research in Rnformation Systems: Making IS Research Relevant to Rractice-foreword." *MIS Quarterly,* 28(3): 329.

Baskerville, R.&Stage, J. (1996). "Controlling Prototype Development Through Risk Analysis." *MIS Quarterly,* 20(4): 481-504.

Baskerville, R. L. (1999). "Tutorial: Investigating information systems with action research." *Communications of the Association for Information Systems (CAIS),* 2(19).

Baskerville, R. L.&Wood-Harper, A. T. (1996). "A critical perspective on action research as a method for information systems research." *Journal of Information Technology,* 11(3): 235-246.

Baskerville, R. L.&Wood-Harper, T. (1998). "Diversity in information systems action research methods." *European Journal of Information Systems,* 7(2): 90.

Bates, D. W., Teich, J. M., Lee, J., Seger, D., Kuperman, G. J., Ma'Luf, N., Boyle, D.&Leape, L. (1999). "The Impact of Computerized Physician Order Entry on Medication Error Prevention." *Journal of the American Medical Informatics Association,* 6(4): 313-321.

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

Berg, M. (2001). "Implementing information systems in health care organizations: myths and challenges." *International Journal of Medical Informatics,* 64(2-3): 143-156.

Berg, M., Langenberg, C., Berg, I. v. d.&Kwakkernaat, J. (1998). "Considerations for sociotechnical design: experiences with an electronic patient record in a clinical context." *International Journal of Medical Informatics,* 52(1-3): 243-251.

Berg, M., Aarts, J.&van der Lei, J. (2003). "ICT in Health Care: Sociotechnical Approaches." *Methods of Information in Medicine,* 42(4): 297-301.

Beyer, H.&Holtzblatt, K. (1998). Contextual design : Defining Customer-Centered Systems. San Fransisco, Morgan Kaufmann.

Beyer, H., Holtzblatt, K.&Baker, L. (2004). "An Agile Customer-Centered Method: Rapid Contextual Design." *4th Conference on Extreme Programming and Agile Methods,* Calgary, Canada.

Bhanoo, S. N. (2010). Denmark Leads the Way in Digital Care. *The New York Times*. New York.

Bjerknes, G.&Bratteteig, T. (1987). Florence in wonderland - systems development with nuses. In G. Bjerknes, P. Ehn and M. Kyng (eds.), Computers and democracy: A Scandinavian challenge. Aldershot, UK, Avebury.

Bjerknes, G.&Bratteteig, T. (1988). "The memoirs of two survivors: or the evaluation of a computer system for cooperative work." *Proceedings of the 1988 ACM conference on Computer-supported cooperative work*, Portland, Oregon, United States.

Bjerknes, G.&Bratteteig, T. (1995). "User Participation and Democracy: A Discussion of Scandinavian Research on System Development." *Scandinavian Journal of Information Systems,* 7(1): 73-98.

Boehm, B. (1986). A spiral model of software development and enhancement ACM Press.

Bossen, C. (2006). "Participation, power, critique: constructing a standard for electronic patient records." *Proceedings of the ninth conference on Participatory design: Expanding boundaries in design - Volume 1*, Trento, Italy.

Bourke, J. L., Bjeldbak-Olesen, I., Nielsen, P. M.&Munck, L. K. (2001). "Enstrenget medicinhandtering. På vej mod øget sikkerhed " *Ugeskrift for laegerU,* 163(39): 5356-60.

Bratteteig, T. (1994). User Participation in Redesign. In G. E. Bradley and H. W. Hendrick (eds.), Human factors in Organisational Design and Management - IV. Amsterdam, Elsevier Science**:** 387-392.

Breil, B., Semjonow, A.&Dugas, M. (2009). "HIS-based electronic documentation can significantly reduce the time from biopsy to final report for prostate tumours and supports quality management as well as clinical research." *BMC Medical Informatics and Decision Making,* 9(1).

Braa, K. (1995). "Priority workshops: springboard for user participation in redesign activities." *Proceedings of conference on Organizational computing systems*, Milpitas, California, United States.

Bygstad, B. (2005). Mutual Adaptation between Technology and Organisation in Iterative IS Development Projects. *Department of Computer Science, The Faculty of Engineering and Science*. Aalborg, Aalborg University. PhD.

Bødker, K., Kensing, F.&Simonsen, J. (2004). Participatory IT Design - Designing for businss and workplace realities, The MIT Press.

Bødker, K., Kensing, F.&Simonsen, J. (2008). Professionel it-forundersøgelse - grundlag for brugerdrevet innovation. Frederiksberg, Samfundslitteratur.

Bødker, S. (1996). "Creating conditions for participation: conflicts and resources in systems development." *Human-Computer Interaction,* 11(3): 215-236.

Christiansen, T. (2002). "Organization and financing of the Danish health care system." *Health Policy,* 59(2): 107-118.

Clegg, C., Axtell, C., Damodaran, L., Farbey, B., Hull, R., Lloyd-Jones, R., Nicholls, J., Sell, R.&Tomlinson, C. (1997). "Information technology: a study of performance and the role of human and organizational factors." *Ergonomics,* 40: 851-871.

Clegg, C. W. (2000). "Sociotechnical principles for system design." *Applied Ergonomics*, 31(5): 463-477.

Clemensen, J., Larsen, S. B., Kyng, M.&Kirkevold, M. (2007). "Participatory Design in Health Sciences: Using Cooperative Experimental Methods in Developing Health Services and Computer Technology." *Qualitative Health Research,* 17(1): 122-130.

Clement, A.&Besselaar, P. V. d. (1993a). "A retrospective look at PD projects." *Communications of the ACM,* 36(6): 29-37.

Clement, A.&Besselaar, P. V. d. (1993b). "A retrospective look at PD projects." *Commun. ACM,* 36(6): 29-37.

Coiera, E. (2007). "Putting the technical back into socio-technical systems research." *International Journal of Medical Informatics,* 76(Supplement 1): S98-S103.

Dahler-Larsen, P. (2008) Konsekvenser af indikatorer [Consequenses of indicators]. KREVI.

Del Beccaro, M. A., Jeffries, H. E., Eisenberg, M. A.&Harry, E. D. (2006). "Computerized Provider Order Entry Implementation: No Association With Increased Mortality Rates in an Intensive Care Unit." *Pediatrics,* 118(1): 290-295.

Dittrich, Y., Eriksen, S.&Hansson, C. (2002). "PD in the Wild; Evolving Practices of Design in Use." *Proceedings of the Participatory Design Conference*

Malmö, Sweeden.

Doherty, N., F. &King, M. (2005). "From technical to socio-technical change: tackling the human and organizational aspects of systems development projects." *European Journal of Information Systems,* 14(1): 1-5.

Doherty, N. F.&King, M. (2001). "An investigation of the factors affecting the successful treatment of organisational issues in systems development projects." *European Journal of Information Systems,* 10(3): 147-160.

Doherty, N. F.&King, M. (2003). "The Treatment of Organisational Issues in Systems Development Projects: The Implications for the Evaluation of Information Technology Investments." *Electronic Journal of Information Systems Evaluation,* 4(1).

Drazin, R.&de Ven, A. H. V. (1985). "Alternative Forms of Fit in Contingency Theory." *Administrative Science Quarterly,* 30(4): 514-539.

Earl, M. J. (1992). "Putting IT in its place: a polemic for the nineties." *Journal of Information Technology,* 7(2): 100-108.

Ehn, P. (1992). Scandinavian design: on participation and skill. In (eds.), Usability: turning technologies into tools, Oxford University Press, Inc.**:** 96-132.

Ehn, P.&Sjögren, D. (1991). From system descriptions to scripts for action. In (eds.), Design at work: cooperative design of computer systems, L. Erlbaum Associates Inc.**:** 241-268.

Farbey, B., Land , F.&Targett, D. (1999). "The moving staircase - Problems of appraisal and evaluation in a turbulent environment." *Information Technology & People,* 12(3): 238-252.

Fichman, R. G.&Kemerer, C. F. (1997). "The Assimilation of Software Process Innovations: An Organizational Learning Perspective." *Management Science,* 43(10): 1345-1363.

Floyd, C., Mehl, W.-M., Reisin, F.-M., Schmidt, G.&Wolf, G. (1989). "Out of scandinavia: alternative approaches to software design and system development." *Human-Computer Interaction,* 4(4): 253-350.

Flyvbjerg, B. (2006). "Five Misunderstandings About Case-Study Research." *Qualitative Inquiry,* 12(2): 219-245.

Gallivan, M. J.&Keil, M. (2003). "The user-developer communication process: a critical case study." *Information Systems Journal,* 13(1): 37-68.

Giaglis, G. (1999). "Focus issue on legacy information systems and business process engineering: on the integrate design and evaluation of business process and

information systems." *Communications of the Association for Information Systems (CAIS),* 2(5).

Glaser, B. G.&Strauss, A. L. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. New York, Aldine de Gruyter.

Granlien, M. F., Hertzum, M.&Gudmundsen, J. (2008). "The Gap between Actual and Mandated Use of an Electronic Medication Record Three Years after Deployment." *Stud Health Technol Inform,* 136: 419-24.

Granlien, M. S. (2008). "Refleksioner over brugerdreven innovation og tilhørende udfordringer." *Ledelse – brudflader og paradokser i ledelsesudfordringen,* København, Danmark.

Granlien, M. S.&Hertzum, M. (2009). "Implementing new ways of working: interventions and their effect on the use of an electronic medication record." *Proceedings of the ACM 2009 international conference on Supporting group work,* Sanibel Island, Florida, USA.

Granlien, M. S., Pries-Heje, J.&Baskerville, R. (2009). "Project Management Strategies for Prototyping Breakdowns." *Hawaiian International Conference on system Science,* Hawaii.

Greenbaum, J. (1993). "PD a personal statement." *Communications of the ACM,* 36(6): 47.

Greenbaum, J.&Kyng, M., Eds. (1992). Design at work: cooperative design of computer systems, L. Erlbaum Associates Inc.

Greenwood, D. J., Whyte, W. F.&Harkavy, I. (1993). "Participatory Action Research as a Process and as a Goal." *Human Relations,* 46(2): 175-192.

Grudin, J. (1993). Obstacles to Participatory Design in Large Product Development Organizations. In D. Schuler and A. Namioka (eds.), Participatory Design. Principles and Practices. Hillsdale New Jersey, Erlbaum Associates.

Hamilton, S.&Chervany, N. L. (1981). "Evaluating Information System Effectiveness - Part I: Comparing Evaluation Approaches." *MIS Quarterly,* 5(3): 55-69.

Hammer, M. (1990). "Reengineering Work: Don't Automate, Obliterate." *Harvard Business Review,*(July-August): 104-112.

Han, Y. Y., Carcillo, J. A., Venkataraman, S. T., Clark, R. S. B., Watson, R. S., Nguyen, T. C., Bayir, H.&Orr, R. A. (2005, December 1, 2005). "Unexpected Increased Mortality After Implementation of a Commercially Sold Computerized Physician Order Entry System." Retrieved 6, 116, from http://pediatrics.aappublications.org/cgi/content/abstract/116/6/1506

Hansen, H. F. (2005). "Choosing Evaluation Models: A Discussion on Evaluation Design." *Evaluation,* 11(4): 447-462.

Hedman, J.&Borell, A. (2005). "Broadening information systems evaluation through narratives." *Electronic Journal of Information Systems Evaluation,* 8(2): 115-122.

Heeks, R. (2003) Most e-Government-for-Development Projects Fail - How Can Risks be Reduced? IDPM i-Government Working Paper.

Heeks, R. (2006). "Health information systems: Failure, success and improvisation." *International Journal of Medical Informatics,* 75(2): 125-137.

Hertzum, M. (2002). "Organisational implementation: a complex but underrecognised aspect of information-system design." *Proceedings of the second Nordic conference on Human-computer interaction,* Aarhus, Denmark.

Hertzum, M.&Simonsen, J. (2004). "Evidence-based development: a viable approach?" *Proceedings of the third Nordic conference on Human-computer interaction*, Tampere, Finland.

Hertzum, M.&Simonsen, J. (2008). "Positive effects of electronic patient records on three clinical activities." *International Journal of Medical Informatics,* 77(12): 809-817.

Ives, B.&Olson, M., H. (1984). "User Involvement and MIS Success: A Review of Research." *Management Science,* 30(5): 586-603.

Jarvenpaa, S. L.&Ives, B. (1991). "Executive Involvement and Participation in the Management of Information Technology." *MIS Quarterly,* 15(2): 205.

Jespersen, P. K. (2007). New Public Management-reformen i det danske sygehusvæsen. In C. Greve (eds.), Offentlig ledelse og styring København, Jurist og økonomforbundets forlag.

Jones, M. R. (2003). ""Computers can land people on Mars, why can't they get them to work in a hospital?" Implementation of an Electronic Patient Record System in a UK Hospital." *Methods of Information in Medicine,* 48(5): 410-415.

Kanstrup, A. M.&Bertelsen, P. (2006). "Participatory IT-support." *Proceedings of the ninth conference on Participatory design: Expanding boundaries in design - Volume 1*, Trento, Italy.

Kaplan, B. (1995). "The Computer Prescription: Medical Computing, Public Policy, and Views of History." *Science, Technology, & Human Values,* 20(1): 5-38.

Kaplan, B. (2001). "Evaluating informatics applications--some alternative approaches: theory, social interactionism, and call for methodological pluralism." *International Journal of Medical Informatics,* 64(1): 39-56.

Kaplan, B.&Shaw, N. T. (2004). "Future directions in evaluation research: people, organizational, and social issues." *Methods of Information in Medicine,* 43(3): 215-31.

Kensing, F.&Blomberg, J. (1998). "Participatory Design: Issues and Concerns." *Computer Supported Cooperative Work (CSCW),* 7(3): 167-185.

Kensing, F.&Munk-Madsen, A. (1993). "PD: structure in the toolbox." *Communications of the ACM,* 36(6): 78-85.

Kensing, F., Sigurdardottir, H.&Stoop, A. (2007). "MUST - A Participatory Method for Designing Sustainable Health IT." *Proceedings of Medinfo 2007*, Brisbane, Australia.

Kensing, F., Simonsen, J.&Bødker, K. (1998). "MUST: A Method for Participatory Design." *Human-Computer Interaction,* 13(2): 167 - 198.

Kensing, F., Strand, D. L., Bansler, J., P.&Havn, E. (2004). "Empowerng Patients: PD in the Healthcare Field." *proceedings of the Participatory Design Conference - Volume 2*, Toronto, Canada.

Klecun, E.&Cornford, T. (2005). "A critical approach to evaluation." *European Journal of Information Systems,* 14(3): 229-243.

Klein, K. J.&Sorra, J. S. (1996). "The Challenge of Innovation Implementation." *The Academy of Management Review,* 21(4): 1055-1080.

Kold, J.&Pedersen, I. L. (2009). "Der er ikke noget "quick fix" [There is no "quick fix"]." *Ugeskrift for læger,* 117(8): 632.

Kumar, K. (1990). "Post implementation evaluation of computer-based information systems: current practices." *Communications of the ACM,* 33(2): 203-212.

Kvale, S. (2002). Interview - en introduktion til det kvalitative forskningsinterview, Hans Reitzels Forlag A/S.

Kyng, M. (1988). "Designing for a dollar a day." *Proceedings of the 1988 ACM conference on Computer-supported cooperative work*, Portland, Oregon, United States.

La Cour, V.&Hellstern-Hauerslev, C. (2007). "Evaluating the implementation and use of a computerized physician order entry system: a case study." *Studies in Health Technology and Informatics,* 130: 75-79.

Lai, V. S.&Mahapatra, R. K. (1997). "Exploring the research in information technology implementation." *Information & Management,* 32(4): 187-201.

Lanzara, G. F.&Mathiassen, L. (1985). "Mapping situations within a system development project." *Information & Management,* 8(1): 3-20.

Lehoux, P. (2006). The Problem of Health Technology. New York, NY, Routledge.

Leonard-Barton, D. (1988). "Implementation as mutual adaptation of technology and organization." *Research Policy,* 17(5): 251-267.

Leonard-Barton, D.&Sinha, D. K. (1993). "Developer-User Interaction and User Satisfaction in Internal Technology Transfer." *The Academy of Management Journal,* 36(5): 1125-1139.

Lorenzi, N. M.&Riley, R. T. (2000). "Managing change: an overview." *Journal of the American Medical Informatics Association,* 7(2): 116-124.

Lorenzi, N. M.&Riley, R. T. (2003). "Organizational ISSUES=change." *International Journal of Medical Informatics,* 69(2-3): 197-203.

Lorenzi, N. M., Riley, R. T., Blyth, A. J., Southon, G.&Dixon, B. J. (1997). "Antecedents of the people and organizational aspects of medical informatics: review of the literature." *Journal of the American Medical Informatics Association,* 4(2): 79-93.

Mabeck, H. (2008a). Elektronisk medicinerng i klinisk praksis [Electronic medication in clinical practice]. *Department of Development and planning, Danish Institute for Health Services Research*, Ålborg University. PhD.

Mabeck, H. (2008b). "Implementation of an electronic medication system and disregarded power of the record." *Studies in Health Technology and Informatics,* 136: 443-448.

Macredie, R. D.&Sandom, C. (1999). "IT-enabled change: evaluating an improvisational perspective." *European Journal of Information Systems,* 8: 247-259.

Magalhães, R. (2000). The Organisational Implementation of Information Systems: towards a new theory. *Department of management*. London, London School of Economics. PhD.

Markus, M. L. (2004). "Technochange management: using IT to drive organizational change." *Journal of Information Technology,* 19(1): 4-20.

Markus, M. L.&Benjamin, R. I. (1997). "The Magic Bullet Theory in IT-Enabled Transformation." *Sloan Management Review,* 38(2): 55-68.

Markus, M. L.&Mao, J.-Y. (2004). "Participation in Development and Implementation - Updating an old, tired concept for today's IS contexts." *Journal of the Association for Information Systems,* 5(11-12): 514-544.

Mathiassen, L.&Nielsen, P. M. (2008). "Engaged Scholarship in IS Research." *Scandinavian Journal of Information Systems,* 20(2): 3-20.

Maxwell, J. A. (1996). Qualitative Research Design - An Interactive Approach, Sage.

McDonald, C. J. (2006). "Computerization Can Create Safety Hazards: A Bar-Coding Near Miss." *Annals of Internal Medicine,* 144(7): 510-516.

McGowan, J. J., Cusack, C. M.&Poon, E. G. (2008). "Formative Evaluation: A Critical Component in EHR Implementation." *Journal of the American Medical Informatics Association,* 15(3): 297-301.

McKay, J.&Marshall, P. (2001). "The dual imperatives of action research." *Information Technology & People,* 14(1): 46-59.

Mekhjian, H. S., Kumar, R. R., Kuehn, L., Bentley, T. D., Teater, P., Thomas, A., Payne, B.&Ahmad, A. (2002). "Immediate Benefits Realized Following Implementation of Physician Order Entry at an Academic Medical Center." *Journal of the American Medical Informatics Association,* 9(5): 529-539.

Miles, M.&Huberman, M. (1994). Qualitative Data Analysis: An Expanded Sourcebook(2nd Edition).

Mumford, E. (1993). The Participation of users in Systems Design: An Account of the Origin, Evolution and Use of the ETHICS Method. In D. Schuler and A. Namioka (eds.), Participatory Design. Principles and Practices. Hillsdale New Jersey, Erlbaum Associates**:** 257-270.

Mumford, E. (2000). "A Socio-Technical Approach to Systems Design." *Requirements Engineering,* 5(2): 125-133.

Mumford, E. (2006). "The story of socio-technical design: reflections on its successes, failures and potential." *Information Systems Journal,* 16(4): 317-342.

Nahm, R.&Poston, I. (2000). "Measurement of the effects of an integrated, point-of-care computer system on quality of nursing documentation and patient satisfaction." *Computers in Nursing,* 18(5): 220-9.

Nissen, C. S. (2008). Det er lettere at pege fingre – end at vise vej. In P. Melander (eds.), Det fortrængte offentlige lederskab, DJØF forlag.

Nykänen, P.&Brender, J. (2008) Guidelines for Good Evaluation Practices in Health Informatics (GEP-HI). EFMI's WG on Evaluation.

Oates, B. (2006). Researching Information systems and Computing, Sage.

Oostveen, A.-M.&Besselaar, P. v. d. (2004). "From small scale to large scale user participation: a case study of participatory design in e-government systems." *Proceedings of the eighth conference on Participatory design: Artful integration: interweaving media, materials and practices - Volume 1,* Toronto, Ontario, Canada.

Orlikowski, W.&Iacono, C. S. (2001). "Research commentary: Desperately seeking "IT" in IT research - A call to theorizing the IT artifact." *Information Systems Research,* 12(2): 121-134.

Orlikowski, W. J.&Hofman, D., J. (1996). "An Improvisational Model of Change Management: The Case of Groupware Technologies." *Sloan Management Review,* 38(2): 11-21.

Pasmore, W. A. (1995). Social Science Transformed: The Socio-Technical Perspective. 48**:** 1-21.

Pekkola, S., Kaarilahti, N.&Pohjola, P. (2006). "Towards formalised end-user participation in information systems development process: bridging the gap between participatory design and ISD methodologies." *Proceedings of the ninth conference on Participatory design: Expanding boundaries in design - Volume 1,* Trento, Italy.

Pilemalm, S.&Timpka, T. (2008a). "Third generation participatory design in health informatics--Making user participation applicable to large-scale information system projects." *Journal of Biomedical Informatics,* 41(2): 327-339.

Pilemalm, S.&Timpka, T. (2008b). "Third generation participatory design in health informatics-Making user participation applicable to large-scale information system projects." *J. of Biomedical Informatics,* 41(2): 327-339.

Poissant, L., Pereira, J., Tamblyn, R.&Kawasumi, Y. (2005). "The Impact of Electronic Health Records on Time Efficiency of Physicians and Nurses: A Sys-

tematic Review." *Journal of the American Medical Informatics Association,* 12(5): 505-516.

M. o. H. a. Prevention (2008) Health care in Denmark

Protti, D.&Nøhr, C. (2002). "The EHR in Denmark: You Don't Have to be Big to be in Front." *ElectronicHealthcare,* 1(4): 42-46.

Rapoport, R. N. (1970). "Three Dilemmas in Action Research: With Special Reference to the Tavistock Experience." *Human Relations,* 23(6): 499-513.

Ratcliff, D. E. (1994) Analytic Induction as a Qualitative Research Method of Analysis. The University of Georgia.

Rigby, M. (2001). "Evaluation: 16 powerful reasons why not to do it - and 6 overriding imperatives." *Studies in Health Technology and Informatics,* 84(Pt 2): 1198-202.

Rigby, M. (2006). "Evaluation - The Cinderella Science of ICT in Health." *IMIA yearbook of Medical Informatics 2006,*(1): 114-120.

Robson, C. (2002). Real world research, Blackwell Publishing.

Rogers, E. M. (1995). Diffusion of Innovations. New York, The Free Press.

Sallas, B., Lane, S., Mathews, R., Watkins, T.&Wiley-Patton, S. (2007). "An Iterative Assessment Approach to Improve Technology Adoption and Implementation Decisions by Healthcare Managers." *Information Systems Management,* 24(1): 43-57.

Sanoff, H. (2007). "Special issue on participatory design." *Design Studies,* 28(3): 213-215.

Scacchi, W. (2004). Socio-Technical Design. In W. S. Bainbridge (eds.), The Encyclopedia of Human-Computer Interaction

Berkshire Publishing Group.

Schmidt, K.&Carstensen, P. (1990) Arbejdsanalyse - teori og praksis. Forskningscenter Risø.

Schuler, D.&Namioka, A. (1993). Participatory Design: Principles and Practices, L. Erlbaum Associates Inc.

Scott, J. T., Rundall, T. G., Vogt, T. M.&Hsu, J. (2005) "Kaiser Permanente's experience of implementing an electronic medical record: a qualitative study." *BMJ,* bmj.38638.497477.68, DOI 10.1136/bmj.38638.497477.68

SDSD (2008) National strategi for digitalisering af sundhedsvæsenet 2008-2012 [National strategy for digitalisation of the healthcare system 2008-2012]. Sammenhængende digital sundhed i Danmark.

Seddon, P., B. , Staples, S., Patnayakuni, R.&Bowtell, M. (1999). "Dimensions of information systems success." *Communications of the Association for Information Systems (CAIS),* 2(20).

Shamliyan, T., A. , Duval, S., Du, J.&Kane, R., L. (2008). "Just What the Doctor Ordered. Review of the Evidence of the Impact of Computerized Physician Order Entry System on Medication Errors." *Health Services Research,* 43(1p1): 32-53.

Shapiro, D. (2005). "Participatory design: the will to succeed." *Proceedings of the 4th decennial conference on Critical computing: between sense and sensibility*, Aarhus, Denmark.

Simonsen, J. (2009a). Design Studier - en vision for RUC's nye hovedområde. *Inagural lecture, November 11th, Roskilde University*. Roskilde.

Simonsen, J. (2009b). "The Role of Ethnography in the Design and Implementation of IT Systems." *Design Principles and Practices: An International Journal,,* 3(3): 253-264.

Simonsen, J.&Hertzum, M. (2005). "Evidence-Based IT Development: Toward a New Contract Model for EPR Projects." *Proceeding of 3rd Scandinavian conference on Health Informatics*, Virtual Centre for Health Informatics, Aalborg University, Denmark,.

Simonsen, J.&Hertzum, M. (2008). "Participatory Design and the Challenges of Large-Scale Systems: Extending the Iterative PD Approach." *Proceedings of the 10th anniversary conference on Participatory Design: Experiences and Challenges*, Bloomingto, Indiana, USA.

Sjöberg, C.&Timpka, T. (1998). "Participatory Design of Information Systems in Health Care." *Journal of the American Medical Informatics Association,* 5(2): 177-183.

Smith, P. (1995). "On the unintended consequences of publishing performance data in the public sector." *International Journal of Public Administration,* 18(2): 277 - 310.

Smithson, S.&Hirschheim, R. (1998). "Analysing information systems evaluation: Another look at an old problem." *European Journal of Information Systems,* 7(3): 158-174.

Southon, G. (1999). "IT, Change and evaluation: an overview of the role of evaluation in health services." *International Journal of Medical Informatics,* 56(1-3): 125-133.

Stake, R. (2000). Case Studies. In N. Denzin and Y. Lincoln (eds.), Handbook of Qualitative Research 2nd ed., Sage publications**:** 435-454.

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

Suchman, L. (2007). Human-machine reconfigurations: plans and situated actions, Cambridge University Press.

Sundhedsministeriet (1996) Handlingsplan for elektroniske patientjournaler

Sundhedsministeriet (2000) National strategi for IT i sygehusvæsenet 2000-2002

Sundhedsministeriet (2003) National IT-strategi for sundhedsvæsenet 2003-2007

Susman, G. I.&Evered, R. D. (1978). "An Assessment of the Scientific Merits of Action Research." *Administrative Science Quarterly,* 23(4): 582-603.

Talmon, J. (2006). "Evaluation and Implementation: A Call for Action." *IMIA yearbook of Medical Informatics 2006,* 1(1): 11-15.

Telestyrelsen, I. o. (2007) Effektmåling af offentlige it-projekter.

Tichy, L.&Bascom, T. (2008, March 2008). "The business end of IT project failure." Mortgage Banking Retrieved 13/10, 2009, from http://findarticles.com/p/articles/mi_hb5246/is_6_68/ai_n29421069/.

Trigg, R. H.&Anderson, S. I. (1996). "Introduction to This Special Issue on Current Perspectives on Participatory Design." *Human-Computer Interaction,* 11(3): 181-185.

Tyre, M. J.&Orlikowski, W. J. (1994). "Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations." *Organization Science,* 5(1): 98-118.

Törpel, B. (2005). "Participatory design: a multi-voiced effort." *Proceedings of the 4th decennial conference on Critical computing: between sense and sensibility*, Aarhus, Denmark.

Vallårda, S.&Krasnik, A. (2002). Sundhedstjeneste og sunedhedspolitik. København, Munksgaard.

Van de Ven, A. H. (2007). Engaged Scholarship. Oxford, Oxford University Press.

Wadsworth, Y. (1998). "What is Participatory Action Research?" *Action research international,* Paper 2.

Wagner, E., L. &Piccoli, G. (2007). "Moving beyond user participation to achieve successful IS design." *Communications of the ACM,* 50(12): 51-55.

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

Ward, J.&Elvin, R. (1999). "A new framework for managing IT-enabled business change." *Information Systems Journal,* 9(3): 197-221.

Ward, J., Taylor, P.&Bond, P. (1996). "Evaluation and realisation of IS/IT benefits: An empirical study of current practice." *European Journal of Information Systems,* 4(4): 12.

Wears, R.&Berg, M. (2005). "Computer technology and clinical work: still waiting for Godot." *Journal of the American Medical Informatics Association,* 293(10): 1261-1263.

Westbrook, J. I., Braithwaite, J., Georgiou, A., Ampt, A., Creswick, N., Coiera, E.&Iedema, R. (2007). "Multimethod Evaluation of Information and Communication Technologies in Health in the Context of Wicked Problems and Sociotechnical Theory." *Journal of the American Medical Informatics Association,* 14(6): 746-755.

Westbrook, J. I., Georgiou, A.&Dimos, A. (2006). "Computerised pathology test order entry reduces laboratory turnaround times and influences tests ordered by hospital clinicians: a controlled before and after study." *Journal of Clinical Pathology,* 59(5): 533-536.

Whyte, W. F. (1989). "Participatory Action Research: "Through Practice to Science in Social Research"." *American Behavioral Scientist,* 32(5): 513.

Yin, R. K. (1981). "The Case Study as a Serious Research Strategy." *Science Communication,* 3(1): 97-114.

Yin, R. K. (1994). Case Study Research - Design and Methods, Sage publications.

Yin, R. K. (2003). Case Study Research - Design and Methods, Sage publications.

Aarts, J., Doorewaard, H.&Berg, M. (2004). "Understanding implementation: the case of a computerized physician order entry system in a large Dutch university medical center." *Journal of the American Medical Informatics Association,* 11(3): 207-216.

PART FOUR: RESEARCH PAPERS

Paper I
Granlien, M. F., & Simonsen, J. (2007). "Challenges for IT-supported shared care: A qualitative analyses of two shared care initiatives for diabetes treatment in Denmark". International Journal of Integrated Care, 7.

Paper II
Bødker, K., & Granlien, M. S. (2008). "Participation and Representation: a Discussion Based upon a Case Study in the Danish Healthcare Sector." in Simonsen, J., Robertson, T., & Hakken, D. (red.): PDC 2008 Experiences and Challenges (s. 190-193). Indiana University: Association for Computing Machinery (ACM).

Paper III
Granlien, M. S., Pries-Heje, J., & Baskerville, R. (2009). "Project Management Strategies for Prototyping Breakdowns." Proceedings of the Annual Hawaii International Conference on System Sciences.

Paper IV
Granlien, M., Hertzum, M. "Longstanding Barriers to Organisational implementation of an Electronic Medication Record." Under review for International Journal of Healthcare Technology and Management.

Paper V
Granlien, M. S., & Hertzum, M. (2009). "Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record." in: Proceedings of the GROUP 2009 Conference on Supporting Group Work (s. 321-330). ACM Press.

Paper VI
Granlien, M.S. (2009). "Facilitating Participation in Formative Evaluation Supported by Effect Map", in Molka-Danielsen, J. (ed.) Selected Papers of the 32nd Information Systems Research Seminar in Scandinavia - Inclusive Design, Tapir Academic Press, Trondheim, pp 73-88.

Challenges for IT-supported shared care: a qualitative analyses of two shared care initiatives for diabetes treatment in Denmark

Maren Sander Granlien

Roskilde University, Denmark
maren@ruc.dk

Jesper Simonsen

Roskilde University, Denmark
simonsen@ruc.dk

Abstract. Purpose: To investigate the circumstances as to why it is so difficult in the primary care sector to implement IT based infrastructures supporting shared care. The qualitative analysis includes two separate case studies of IT-supported shared care implemented in two different regions of Denmark throughout 2005. The study comprises 21 interviews and 35 hours of observations. The data were analysed through a coding process that led to the emergence of 3 main challenges impeding the organisational implementation of IT-supported shared care. The two cases faced the same challenges that led to the same problem: The secondary care sector quickly adopted the system while the primary sector was far more sceptical towards using it. In both cases, we observe a discrepancy of needs satisfied, especially with regard to the primary care sector and its general practitioners which hinder bridging the primary sector (general practitioners) and the secondary sector (hospitals and outpatient clinics). Especially the needs associated with the primary sector were not being satisfied. We discovered three main challenges related to bridging the gap between the two sectors: 1) Poor integration with the general practitioners' existing IT systems; 2) low compatibility with general practitioners' work ethic; 3) and discrepancy between the number of diabetes patients and the related need for shared care. We conclude that development of IT-supported shared care must recognise the underlying and significant differences between the primary and secondary care sectors: If IT-supported shared care does not meet the needs of the general practitioners as well as the needs of the secondary care sector the initiative will fail.

1. Introduction

During the past decade in Denmark, electronic information technologies (IT), representing infrastructures that support integrated and long-term medical care across hospitals and professional boundaries, have been the subject of extensive investments and multiple implementation efforts. Recently, a greater interest and focus have evolved around bridging not only institutional and professional boundaries within the secondary care sector (hospitals and outpatient clinics) but also between the secondary and primary care sector (represented by general practitioners). Such initiatives for integrated care are labelled under the banner of supporting 'shared care' [1]: Establishing coherent treatment of the patient through close coordination and cooperation across care sector boundaries. The recent initiatives in establishing technological infrastructures to support shared care have experienced new and unforeseen challenges that are rooted in the different natures of the two sectors. This article describes two recent initiatives in Denmark that aim at supporting shared care for diabetes treatment. This article also identifies some major challenges for the development and organisational implementation of shared care systems.

The two shared care initiatives took place during 2005 in two different regions of Denmark. There are a total of 5 regions in all in Denmark. Both cases focus on the treatment of diabetes. Though there were differences between the two cases' development strategies, both cases faced the same problem: The secondary care sector quickly adopted the system while the primary sector was far more sceptical in using the system. In both cases similar challenges that lead to a rejection of the system by the primary sector and – hence – to a failure of the shared care initiatives as such, can be identified.

In this article we investigate the circumstances of the two shared care initiatives and *identify the main challenges constraining the development of technological infrastructures supporting shared care in the primary care sector.* There is very little qualitative research exploring the practical barriers to the adoption of such systems in the primary care sector [2]. Based on qualitative and comparative analyses of both cases, we identify and elaborate on three major challenges and conclude that the common denominator present in both initiatives has been the diabetes treatment seen from the perspective of the secondary sector, as opposed to the perspective of the general practitioner.

In the following, related work as well as our research method is presented. We then briefly introduce diabetes, diabetes treatment, and the shared care policy in Denmark. This is followed by the main part of the article describing the two case studies. First, these studies are introduced and the development process for each case is presented. Then the three challenges constraining the development of the shared care infrastructure are unfolded: 1) Poor integration of the shared care systems; 2) low compatibility with general practitioners' work ethic; 3) and discrepancy between the number of diabetes patients and the related need for shared care. Finally, a conclusion is drawn.

2. Related work

Shared care initiatives in general are expected not only to improve communication and coordination [1] in particular through electronic referral and discharge letters [3] but also to provide higher quality and efficiency by bridging the health sector divide [4] and thereby offer more coherent health services [5].

Earlier studies of integrated care across sector boundaries can be divided into three groups: Studies concerning data *exchange*; studies dealing with the *integration* of data (on condition of data exchange); and studies concerning *shared* or *integrated care* (on condition of data integration). Most studies use a quantitative research approach. Studies related to the first two groups typically focus on the technical problems with and possibilities for data exchange and integration. This includes investigating exchange standards, such as the Electronic Data Interchange For Administration, Commerce, and Transport (EDIFACT) [6] and the Clinical Document Architecture (CDA) [7, 8]. Or it includes addressing security issues regarding data storage and access rights [9-11], e.g. by means of smart cards [4,12,13]. Exchanging and integrating data are a prerequisite for supporting shared care [9,10]: Shared care is more than just sharing data. Hickman et al. define shared care as "the joint participation of general practitioners and hospital consultants in the planning and delivery of care for patients with a chronic condition, informed by an enhanced information exchange over and above routine discharge and referral letters" [14:447-8]. In our study the aim of both initiatives were to support shared or integrated care. The IT systems ended up though supporting primarily data exchange and data integration.

An example of a study dealing with data exchange and integration is Branger et al. [6], who studied the replacement of paper-based records with Electronic Data Interchange (EDI) between primary and secondary care. The EDI messages could be integrated into the medical record by choosing where to integrate each data from the EDI message into the medical record. Branger et al. found a higher frequency of communication and found that 75% of the EDI data was integrated. A follow up study on Branger et al.'s study showed that the volume of electronic messages remained the same but there was a decrease in integrating the messages into the respective fields in their medical record. One explanation for this was that the messages decreased the overview of the record [15]. Müller et al. [7] investigated how the CDA standard can be use to exchange data between hospitals an general practitioners. They found CDA to be a promising method for enhanced electronic data exchange, though they also found that there still were issues to be resolved such as technical infrastructure and organizational frameworks.

The analysis of the Danish initiatives in this article focuses on the development of technologically supported infrastructural arrangements, i.e. the organisational implementation of IT-supported shared or integrated care [16]. Both initiatives were aiming at supporting collaboration and joint participation in the treatment of the patient by means of using a shared IT system and by *sharing* clinical data recorded by the general practitioner as well as by clinical staff at the outpatient clinics.

A number of reviews and investigations have found positive effects on patient care due to increased cross-section collaboration [3,17,18]. Most of the studies, that revolve around investigating infrastructural arrangements that support integrated care

in diabetes (with or without IT), focus on the medical outcome for the patients. None of them have provided evidence of the effect of integrated care [5,18]. Smith et al. [19,20] found significant improvements in diabetes care delivery, but no improvements in the biomedical outcome. Naji [21] evaluated the effectiveness and efficiency of IT-supported shared care for diabetes patients and found that the IT-supported shared care was at least as effective as conventional hospital clinic care. Naji [21] gives the possible explanation that the general practitioners involved in the experiment were particularly interested in the treatment of diabetes.

In the literature concerning shared care and integrated care we have not found any studies concerning the users role in adopting technological infrastructures supporting shared care. Short et al. [2] have conducted a qualitative study of the general practitioners' barriers to the adoption of an IT system that supports decisions made during their consultations. They identify challenges that correspond to the challenges that we find with relation to the adoption of IT-supported shared care. Short et al. [2] identify constraining challenges such as 'time pressure' (it can be hard to find time to incorporate using yet another new IT system in a 10 minute consultation); 'infrequent use'; and for some of the general practitioners, 'limited skills and confidence in IT' was also an issue.

3. Case study

The two cases presented in this article have been analysed by means of qualitative research methods [22]. The empirical work took place throughout 2005 and comprises 4 interviews with physicians and 2 interviews with nurses (from the outpatients clinics); 7 interviews with general practitioners; 3 interviews with developers from the IT-companies (one with a project manager from company-1 and 2 interviews with two different project managers from company-2) and another 2 interviews with representatives from each of the two regions (the developer companies are in the following referred to as company-1 and company-2). The interviews were semi-structured and lasted around 45-75 minutes. Most interviews were recorded and later transcribed. The interviews were supplemented by 35 hours of observation, where the use of the systems on the outpatients clinics was observed. Additional time was spent observing the general practitioners in their daily work when only using their own medical record system. We also observed introduction courses of the systems from both cases and conducted document analyses of a number of relevant documents, including requirement specifications, information material, user manuals, etc.

Interview transcripts and other field notes from the interviews and observations were analysed using a coding process inspired by the theoretic sampling technique known from grounded theory [22,23]: The empirical material was coded into categories through a repeating process of comparison and evaluation. The content of the interviews was organised as interesting and meaningful statements. These were grouped and categorised by designating the classifications into low level categories [23 pp. 45ff]. Examples of the categories were: Purpose of the shared care systems; use of the computer; organisational implementation; work flows; and communication

across sectors. The categories were then grouped into themes identifying the challenges.

An example on a statement from the 'purpose of the shared care systems' category, which shows the imbalance in the need for shared care, follows here:

> From my point of view, system 2 is made by people who don't think we do anything else but treat diabetes patients and therefore have one hour for each patient (GP4).

Another example from 'communication across sectors' that shows that the communication works fine for the general practitioner and that there is no need for such a system, follows here:

> It is not always them [the doctors at the outpatients clinic] that mention the cholesterol numbers, but I get them when they send me the letter of discharge. So I don't need to go into a database to see it (GP6).

This quote also indicates that the system does not provide the general practitioner with other information than he already gets in the present organisation from the referral and discharge letters.

The data from the two cases were analysed separately and later compared. The results were combined with document analysis and 3 succeeding interviews with the developers and representatives from the two areas. Our findings have been reported on and on several occasions discussed with management, clinicians, and other informants from the cases.

4. Diabetes

Diabetes is a rapidly growing (epidemic) chronic disease. In Denmark (with approximately 5 million inhabitants), the number of diabetics is estimated to be about 2-300,000 and this number is rising with 10-20,000 each year. People with diabetes have a problem controlling their blood sugar either because of insulin resistance (type 2 diabetes) or a lack of insulin production (type 1 diabetes). The aim of the patients is to keep their level of blood sugar as stable as possible, which can be controlled through a healthy diet and exercise together with proper medication. Diabetes results in an increased risk of a number of complications such as cardiovascular diseases, arteriosclerosis, reduced sight, etc. These complications can be postponed or avoided with an appropriate regulation of the patient's blood sugar.

In Denmark, people with diabetes are most of the time treated by their general practitioner, which typically means that they have to attend a regular consultation with their general practitioner every 3 months and attend a more thorough check-up once a year. The general practitioner functions as a gatekeeper between the primary and the secondary care sector, and the vast majority of diabetic patients enter the health care system by means of consulting their general practitioner. When a patient consults the general practitioner, the general practitioner evaluates the need for referring the patient to the secondary sector, which in Denmark and in the case of diabetes, is an outpatient clinic. Outpatient clinics are located at the hospital as part of the diabetes medical ward. The staff at the clinic includes diabetologists, endocrinologists, chiropodists, dieticians, and diabetes nurses. Diabetes patients are for the most part treated solely by their general practitioner. If complications arise, such as unsta-

ble blood sugar or severe non compliance, the patient is referred to the outpatient clinic. The outpatient clinic will normally continue to see the patient every 3 months for a period of 1-2 years or until the patient's condition is stabilized. When this has happened the patient is referred back to the general practitioner who then takes over from here. Only a few patients are treated solely by the outpatient clinic, and they typically represent severe cases of type 1 diabetes.

5. Shared care

Shared or integrated care denotes care where "the patient is shared between individuals or teams who are part of separate organizations or where substantial organisational boundaries exist" [1, p. 8]. The application area for shared care has typically been related to chronic diseases – as for example diabetes. Shared care is in this respect defined as "the joint participation of general practitioners and hospital consultants in the planned delivery of care for patients with a chronic condition" [14, pp. 447f]. Initiatives in order to IT-support shared care with regard to diabetes patients have recently been taken in Denmark [16,18,24,25] as well as abroad [20,26-28].
Shared care, and IT-supported shared care, are generally articulated as positive and necessary in order to improve coordination and cooperation across care sector boundaries:

> "Shared care is one approach to improving care at the interface [between the primary and secondary care sector] by minimising the apparent fragmentation of service" [5, p. 34].

In Denmark IT-supported shared care is articulated as a general solution to the increasing problem of chronic diseases [29]. IT-supported shared care is a central part of the national IT strategy [30]. It is an area of action with regards to the current health reform in Denmark [31]. It is part of the action plan with regards to the national initiatives concerning diabetes [32-34]. It also has high priority with regards to national quality assurance initiatives [35,36]. The Association of County Councils (now referred to as the Danish Regions), which is responsible for the secondary care sector, anticipates great improvements in the health care sector due to the future development of technological infrastructures by means of IT-supported shared [37-39]:

> The general practitioners are complaining that they do not know what we [the secondary care sector] tell the patients. If they could get access to the patient records they would always be able to see what happens [38,p. 27].

Shared care as the 'solution' to chronic diseases is also articulated within the community of physicians and general practitioners:

> The road to raise the quality of patient trajectories in Danish hospitals is through an increased coordination, continuity, communication, and interdisciplinarity [40:1560].
>
> By all means the so-called shared care between general practitioners and hospitals seems to be the way forward for many patients with serious chronic diseases [25:322].

Shared care has become a positive value-laden 'buzz-word', a commonly referred to means for achieving an improvement, and a label denoting a number of different strategies, action plans, and initiatives. In this article, the main actors of the analysis are representatives from the primary and secondary care sector. However a key actor influencing the stress towards initiating the development of technological infrastruc-

tures in terms of IT-supported shared care, is a grey eminence in the form of various national institutions such as the Ministry of Health, National Board of Health, and others, who establish and articulate the political pressure for action through national strategies, action plans, etc. [30-34, 37-39].

6. The two cases

We have investigated two different cases of shared care initiatives (in the following referred to as case-1 and case-2), both of which took place in two geographically different regions in Denmark (which we refer to as area-1 and area-2). The cases involved two different web-based IT systems specifically aiming at supporting shared care (system-1 and system-2 respectively).

Case-1 concerns a system that originally was developed during the period 1992-94 by a biochemist and a chief physician at the largest outpatient clinic in area-1. In the beginning it was only meant to record 'hardcore' biochemical data relevant to diabetes, such as blood sugar levels, etc. Later in 1997 an endocrinologist came to the outpatient clinic and took part in the development, and at the same time a young student of informatics was also drawn into the project. The latter started an IT company on the basis of porting system-1 to a web-based system [41]. In 2000 the old version of system-1 was replaced by this web-based version of system-1 at the outpatient clinic, and the aim was to implement it in all outpatient clinics throughout area-1. In 2004, a steering committee was established with representatives from the central IT-unit (a unit responsibility for the secondary care sector within area-1), with representatives from the IT company, and three representatives that were general practitioners. They all had the task of developing and promoting a 'light' version of system-1 specifically intended for the general practitioner. 'Light' means that the system basically was identical to system-1 used by the outpatient clinics but with reduced functionality. A requirement specification for the light version of system-1 was devised and in 2005 the first light version was ready to be tested [see figure 1].

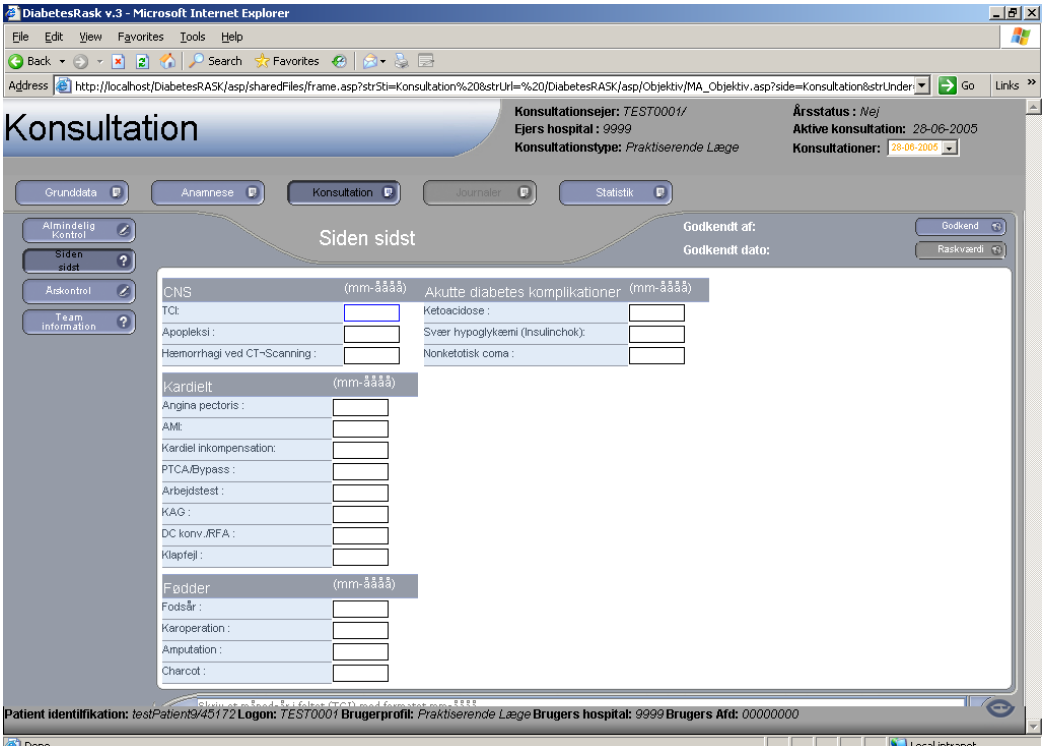

Figure 1 Screen dump System -1-

The test however revealed unsatisfactory results and the roll-out to the general practitioners was postponed indefinitely. In 2006 however, the system was modified according to some of the test results and the roll-out plan was re-established. In 2006 system-1 was accepted by all of area-1's outpatient clinics. Some outpatient clinics are still in the process of implementing system-1 but the majority of outpatient clinics now routinely use the system. System-1 is however still not in use by any of the general practitioners. From October 2006 until March 2007, system-1 has been tested but only 3 out of 10 general practitioners have managed to use the system during the test period due to technical problems. So there is yet no real valid result from the use of system-1 on the part of the general practitioners.

In case-2 the initiative for the new system was taken by the county diabetic committee in area-2 consisting of representatives from the management level at the hospitals and at related outpatient clinics dealing with diabetes in area-2, three so-called Diabetes Practice Consultants (described further below), as well as patients with diabetes. There was no existing system (as in case-1), rather the starting point was finding an answer to the demands for shared care initiatives given by the National Board of Health, as pointed out above. The diabetic committee contacted a large IT-company, that for some time had been developing a new IT system (system-2) supporting the treatment of diabetes, and they then started collaborating. It was decided early on that system-2, which is intended to be sold both nationally and internationally, should be web-based and use the same data in both the primary and secondary care sectors to promote information exchange [See figure 2].

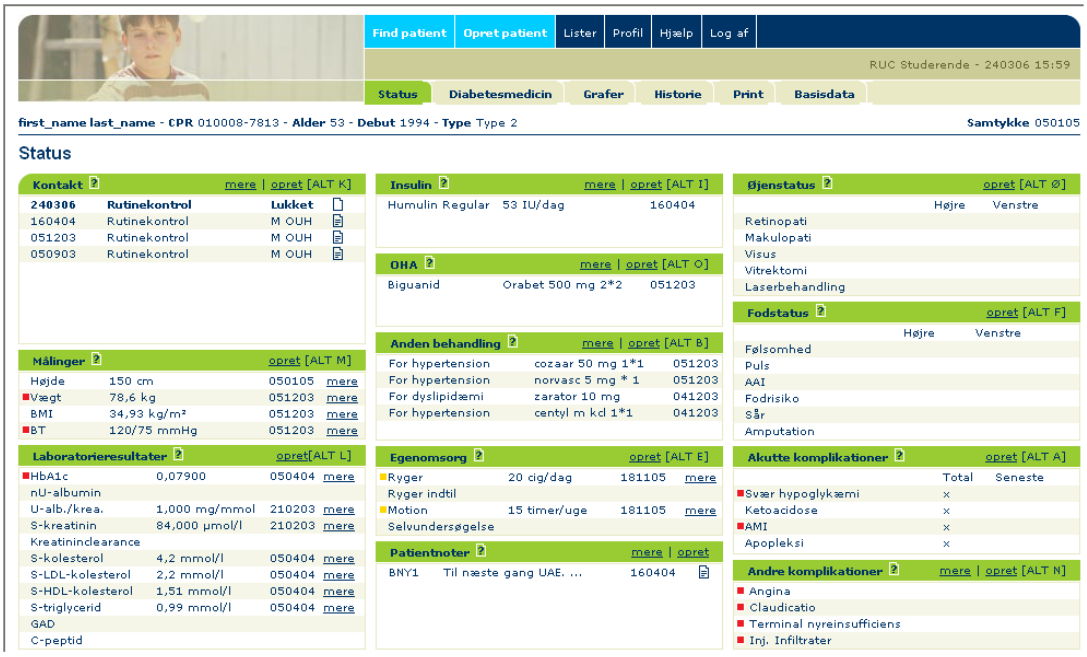

Figure 2 Screen dump system -2-

System-2 was also meant to be used during the actual consultation (and not e.g. after the consultation), to avoid double registration of data and to support the involvement of the patient.

The implementation at area-2's outpatient clinics started in spring 2003 and within a few months, system-2 was used by all the outpatient clinics in that area. The introduction of system-2 to the general practitioners began in 2004 and was accompanied by a comprehensive effort to encourage the general practitioners in using the system. All general practitioners were invited to a half-day introduction course which was mandatory for getting a password to system-2. A year after more that 80% of the area's general practitioners had participated in the course. The general practitioners were also assured a special bonus when reporting the results from the patients' yearly control with system-2. In 2006 most general practitioners in the area had access to system-2 but only few used it. A survey made by the committee in 2006 found that only about 15% of the general practitioners used system-2 on a regular basis. At the end of 2006 the number of regular users among the general practitioners was about 30% of those who had been registered as users[20]. So even though system-2 was rapidly adopted by the outpatient clinics, less than 25% of the general practitioners had adopted the system 2 years after the intensive introduction.

[20] Regular users includes already registered users who have logged into the system one or more times during one week. This means that only general practitioners that have been registered and have a password count as users. General practitioners who have not attended an introduction course which is a precondition to get registered, are not in the statistics. 5-10% of the GPs still need to register.

7. The development processes

The development processes of the infrastructural arrangements in both cases differ in some respect but also share some decisive similarities.

The cases differ with respect to the overall development approach, which in case-1 can be characterised as bottom-up and in case-2 as top-down. In case-1 the initiative for system-1 (both in its original version as well as in the light version offered to the general practitioners) came from the end-users, in terms of the outpatient clinics' chief physicians. Chief physicians from the involved outpatient clinics independently established a steering committee and managed the development process with a relatively small budget during a multi-annual period involving different versions of system-1 [41, 42]. The development process in case-2 arose from a top-down approach with a central committee established by the management of the secondary care sector [43]. The development process was relatively short, aiming at system-2 in its current version. The budget was tenfold larger than in case-1 and included funding from the pharmaceutical industry.

Both cases share however a more determining characteristic of the development approach from the secondary sector to the primary sector. This can be phrased as 'inside-out': inside, from the hospitals and their outpatient clinics seen as the core of the care sector, and out, to the general practitioners seen as satellites surrounding the care sector. We can identify three conditions that have contributed to the circumstances resulting in this inside-out approach: *Firstly*, the articulation of the overall need for IT-supported shared care from a national level, including the ministry of health and national board of health, is primarily placing pressure on the secondary sector in order to take action. *Secondly*, the organisational structure of the secondary care sector simplifies the management of the development process. The secondary sector is organised as a traditional hierarchical bureaucracy. Management can decide that hospitals and outpatient clinics in their area must adopt and use the system. General practitioners constitute a much looser form of network of independently run private practices. General practitioners can be motivated to accept the system but there is no formal authority that can decide that they *must* do it. The development process can thus in the secondary sector be characterised as a "primary authority innovation-decision process" and in the primary sector as a "collective and optional innovation-decision process" [44]. Collective because the purpose of the system will be lost if not the majority of the general practitioners accept the system. *Thirdly*, the manner in which general practitioners are organised, with regard to diabetes issues, promotes the secondary sector's interests and needs. In order to support the collaboration between the primary and secondary care sectors in Denmark, a number of general practitioners participate in a network of Practice Consultants[21] [45]. Among these, some are appointed the function of diabetes practice consultants: They have a special interest in and knowledge about diabetes; they are paid a special fee for participating in the network; their responsibility with regards to further the overall integration of dia-

[21] Nationwide there are more than 300 practice consultants covering almost all medical specialties. A practice consultant is hired on an hourly basis working from 5 to 30 hours a month on improving the cooperation between the general practitioners and the hospitals, e.g. establishing common treatment guidelines.

betes care entails an epidemiological interest closely related to their colleagues at the outpatient clinics. The diabetes practice consultants thus represent a perspective that might reflect the secondary sector rather than the primary sector. But the diabetes practice consultants also represent an expert group of the general practitioners (who otherwise do not have any organized representation), which becomes especially important when facing diabetes related initiatives from the secondary sector. In both cases the diabetes practice consultants were chosen to be members of the steering committees, and thus making them primary informants for the developing IT companies when testing the systems.

In case-2 the practice consultant was not viewed as a "true" representative for the general practitioners but a representative from the county due to his strong involvement and association with the steering committee.

> I don't know how many who use it [the system] as such. That uses it daily to everything. That they [the people behind the system] don't want to tell. When I talk to him [the practice consultant] he says that there are many but how many he won't tell. (GP6)

The inside-out approach has implied that the development processes in both cases are grounded in the secondary care sector and therefore the focus has been primarily on the secondary care sector's interests, wishes, and demands.

8. Challenges for IT-supported shared care

In the two cases, we can observe a discrepancy of needs satisfied, especially with regard to the primary care sector and its general practitioners. Even though case-1 can be characterized as bottom-up and case-2 as top-down, both cases share an inside-out approach due to the fact that both initiatives originated from the outpatient clinics and the primary sector was involved afterwards. This implied that the general practitioners did not obtain an equal amount of influence on the development processes. The results were threefold in both cases. First, the shared care systems were weakly integrated with the general practitioners' existing IT systems. Secondly, using the system in some ways contradicts the general practitioners' work ethic in terms of values and views on patients that can in turn influence their work practices. Lastly, the shared care solutions do not recognise the varying number of diabetes patients at the outpatient clinics (many diabetes patients and only diabetes patients) and at the general practitioners (few diabetes patients among many other patients). These three results that challenged the development of IT-supported shared care are described in more detail below.

8.1 Poor integration with the general practitioners' existing IT systems

Virtually all Danish general practitioners use IT to record their clinical notes in electronic patient records and to send and receive clinical electronic messages [46,47]. There are in total 19 different electronic patient record systems available on the Danish market. The general practitioner's investment in his electronic patient record system is considerable: He has to finance the investment out of his own budget; the ven-

dor typically offers only a short introduction to the system, leaving the general practitioner responsible for the majority of tasks involved in implementing the system and integrating it with the work organization and work practices in his clinic. His electronic patient record system constitutes a very important tool for his clinic as *the* single documentation tool in use. The general practitioner's investment, considerations, and work involved bring about a kind of devotion to the system that might be compared to that of the taxi driver and his car.

The general practitioners were in favour of an integrated solution and they were in general concerned with the prospect of having yet another new IT system for each shared care initiative that might be made for each chronic disease. They suggested developing a shared care system that would use the data recorded in their electronic patient record systems:

> I was quite insisting on this matter, but it was technically not possible to do this at this point in time. I am of the opinion that a [shared care system] should have been developed where the application should be within our computers (GP6).
>
> If it [shared care system] was on my computer then it could get most of the data [from my electronic patient record system]. But there should be a little piece of code that did this [automatically] (GP7).
>
> It has to ease our workday. It should not be something that we have to spend extra time on (GP3).

In both cases however it was noted that integrating a shared care system with 19 different electronic patient record systems, and thus maintaining such an integration along with new updates and versions of each of these 19 systems, would be insurmountable as well as very costly. The result was therefore a decision to develop web-based shared care systems, which were to be used as independent systems in addition to the general practitioners' existing patient record systems. In order to meet the general practitioners' concerns regarding having to record data twice, both in the shared care system as well as in their patient record system, some integration was considered in both cases. Data recorded in the shared care systems are returned to the general practitioner as an EDIFACT. This EDIFACT can then be imported by the patient record systems. With this type of low-tech integration it is claimed that no data has to be recorded twice due to the shared care systems. In principle this is true, but the solution is a poor one, as seen from the general practitioner's view: The EDIFACT message is stored in the general practitioner's system as a special note for the patient in question. This means that the data is added to the patient record as an unstructured text note. Since the data will not be an integral part of the system's structured patient record database, it might easily become problematic to maintain a general view of the patient record. This observation correlates with the study by Branger et al. [6], reported on above in the section on Related Work. In order to meet this problem in case-1, a guide was made instructing the general practitioner on how to write program scripts in order to convert EDIFACT messages from the shared care system to data records in the patient record system. At the time this study was completed, the EDIFACT solution and associated guide only covered 6 of the 19 systems, and we have not been able to identify any general practitioner that has overcome this immense and tedious task. If one wants to oblige both the needs of the primary and sec-

ondary sector the integration could have been done more smoothly though it could end up being very costly.

To sum up, a technical challenge was solved by giving up developing a solution that would integrate the shared care systems with the general practitioners' 19 different electronic patient systems. Instead a web-based system was developed where the general practitioner had to use it along with his own patient system. Data integration by means of EDIFACT was never really taken seriously, which left it up to the general practitioner himself to program this integration. The result is a shared care system that is not integrated with the general practitioner's own patient system and which results in redundant data recording and a lack of information overview with regards to the diabetes patient he is consulting.

8.2 Low compatibility with the general practitioners' work ethic

The general practitioners' work ethic, in terms of their perspectives on patients and their interaction with patients, influence their work practices. We see their work ethic as underlying their work practices.

The shared care systems in both cases were developed as real-time systems to be used during the consultation with the patient and to support the workflow of this consultation. Our observations show that the systems were used in this way in the outpatient clinics. The shared care systems constitute the outpatient clinic's most important system and since all their patients are diabetics the clinicians used it in a routine manner as the primary tool supporting the consultation. In an outpatient clinic in area-2, the physician turned the screen so the patient could see it and used the system throughout the consultation referring to figures, etc., appearing on the screen. In an outpatient clinic in area-1 a nurse was operating the system during the physician's consultation with the patient.

None of the general practitioners expressed a wish to use the shared care system in a similar manner. On the contrary, they said they prefer using the system after the patient has left in order to be physically and mentally present during the consultation, not to mention the lack of time as well during the consultation. Only a relatively few of the general practitioners' patients are diabetics and the primary tool is the practitioners patient record system. This is usually used infrequently during the consultation for ad-hoc queries and recordings. General practitioners generally regard the time communicating face-to-face with the patient as the most important quality of the consultation [48]. The concept of 'quality-time' during the consultation (face-to-face communication) was brought up several times during our interviews with the general practitioners, and many general practitioners are reluctant to use the computer at all during the consultation.

> I would rather use the time – and I might sound a little self-righteous now – but I prefer using my time with the patient and then use the computer either before or after [the consultation]. That's what I do generally (GP5).

> I won't sit with my back to the patient [facing the computer]. I believe that's rude … it is not the job of a physician to sit and act like a computer nerd (GP4).

> GP: I have to obtain maximum presence. Interviewer: So using a system like this [shared care system]… GP: Then I would kind of disappear … the patient would feel that … "Hey – doc-

> tor, it's me that's ill… doctor, I am sitting over here … shouldn't you look in my throat?". It [the shared care system] does not comply with my way of being a doctor (GP4).

Even when the general practitioner experiences that the shared care system could give support during the consultation he is still reluctant to use it:

> Most often I wait until the patient has left [the consultation]. Then I have recorded it [the data during the consultation] on a little piece of paper. It is a little annoying when sometimes I do not remember to write everything down [which becomes apparent when using the shared care system after the consultation]. But that's the cost of doing it my way (GP5).

It seems like it contradicts with the general practitioners' work ethic to use the computer as an integrated part of his consultation with the patient. He would rather use the computer as a tool before, at the end, or after the consultation. It is a challenge requiring the general practitioner to use the shared care system and do the accompanying extra work as part of the consultation – as the system is intended for – in order to support the treatment procedure. Changing the general practitioners' work ethic, as part of making them adopt the shared care system and workflow as intended, might be a protracted process [44].

8.3 Discrepancy between the number of diabetes patients and the related need for shared care

There is a conspicuous difference in the number of diabetes patients treated and the related need for IT-supported share care with regards to the outpatient clinics and the general practitioners respectively.

The outpatient clinics only treat diabetes patients. A patient must be referred to the outpatient clinic by the general practitioner and the outpatient clinic's initial information about the patient thus stems from this referral. The outpatient clinic's physicians are experts in diabetes, and epidemiology and research obligations are part of their responsibility and daily work. With regards to research, monitoring diabetes from an epidemiological perspective, and as means to improve the overall quality of diabetes treatment, the outpatient clinics have a strong interest in systematic and thorough data recordings. The outpatient clinics are willing to invest time and resources in achieving a more elaborated data recording. In order to have more accurate recordings of the number of diagnosed diabetes patients, and in turn how the chronic disorder develops, it requires in general that data is captured regularly by the general practitioners. It also requires the general practitioner to record data beyond the observations, values, and deviations that he has to consider making an intervention upon.

> Here in the general practises we are very busy so we cannot record everything that's normal. We document the discrepancies. But at the hospitals they use "tons of time" documenting everything that's normal – because they have to do that. And they don't have to think about how much time the secretaries use, they can talk and talk for hours. And then everything is documented. We do not have the staff for doing that. It is the discrepancies and the important issues [that we record]. And then of course the medicine (GP4).

To the general practitioner, diabetes patients only constitute a minor part of their overall number of patients. Only one out of 20 patients meeting the general practitioner suffers from diabetes [47]. The general practitioners interviewed had between 10 and 60 diabetes patients, out of which only 1 to 15 are referred to an outpatient

clinic. Usually the general practitioner manages to keep his diabetes patients well regulated. Thus the general practitioner rarely makes a referral to the outpatient clinic. General practitioners do not experience mutual dependencies or needs for increased cooperation requiring special IT-supported shared care with the outpatient clinics.

> I would say that shared care with regards to diabetes: There is not much 'shared' in this because if they are referred to an outpatient clinic then they take care of them and then you [the general practitioner] should not interfere with this (GP6).

> Either I take care of my diabetes patients or the outpatient clinic does. [Most often] I manage them myself and then there are some cases where they are hard to manage. They are then referred to the outpatient clinic and they will take care of the big annual check-up (GP4).

The low number of diabetes patients and even lower number of referrals to the outpatient clinics, seen from the general practitioner's point of view, entails that he does not experience any particular need for a shared care system. On the contrary, the general practitioner is generally dependent on using his own patient record system. Being satisfied with his patient record system and not seeing any particular benefits from using the shared care system seriously challenges convincing the general practitioner on spending resources and time on this solution [49]. Some of the general practitioners expressed a wish for extended functionality in their patient record system supporting diabetes treatment. For example they withed the system was capable of drawing list of patients with certain characteristics to be able to localize those with high blood pressure or blood sugar and then compare the values of their patients with the values of other doctors' patients to monitor their quality and level of treatment. But the wish was more of a "nice to have" than a "need to have" wish and some of the needs would nonetheless (according to the developers) not be fulfilled with the shared care system.

In summary, there are very different needs for shared care support in the secondary and primary sector and the difference is revealed by the varying number of diabetes patients treated: The outpatient clinics are a kind of 'factory' treating many diabetes patients (and only diabetes patients). They are specialized in diabetes and their obligations with regard to research and epidemiological monitoring encourage systematic, thorough, and sustained data recordings. The general practitioners treat relatively few diabetes patients. Their obligation is a 'general' treatment where discrepancies from the norms are in focus. Only few of the general practitioners' diabetes patients are subject to a referral to the outpatient clinic and the general practitioners did not experience any special needs for increased cooperation as part the referral.

9. Conclusion

The two cases presented in this article represent some of the first serious initiatives for IT-supported shared care for diabetes treatment in Denmark. The cases are different with regards to the development processes: Case-1 has a year long history with several versions of system-1, a system developed bottom-up and managed by the chief physicians from the involved outpatient clinics. Case-2 represents a more prestigious large scale effort initiated and managed top-down and involving large funding and a multinational IT company. However, we observe that both cases result in an inside-out approach, where the initiatives for developing infrastructures originate from the secondary care sector: The result is a primary focus on the secondary care sector's interests, needs, and demands. This is partly due to the national articulation justifying IT-supported shared care as an aim in itself and partly due to the inherent problems of representing the general practitioners.

Both cases resulted in a situation where the secondary care sector quickly adopted the system while the primary sector was far more sceptical towards using it. Why it is so difficult to implement IT based infrastructures supporting shared care in the primary care sector? Our study has identified three relevant challenges that contribute to the answer to this question:

- Shared care solutions need to be integrated with the general practitioners' existing IT systems – otherwise the general practitioner is confronted with redundant data recording and will experience a lack of information overview with regards to the diabetes patient he is consulting.
- Shared care solutions should recognize that both the work practice and the work ethic differ within the primary and secondary sector. A workflow embedded in a shared care system might work fine as an integral part of the consultation in the secondary sector and at the same time it might contradict with the general practitioner's routine and treatment procedure.
- Shared care solutions must take into account the discrepancy between the number of treated diabetes patients and the related need for shared care within the two sectors. The secondary sector's specialization and related need for systematic, thorough, and sustained data recordings does not comply with the primary sector's momentary, transient, and 'general' treatment procedure, where recognizing deviances from the norm are in focus and where a variety of illnesses are treated and not just one specific illness.

Everybody can agree with the idea that quality improvement, closer cooperation, and information exchange are issues that both health care sectors should strive for – it is hard to disagree on these matters. But when these intentions are operationalized we must recognise that the underlying and significant differences between the primary and secondary care sectors have a huge impact on how it should be done – differently - in the two sectors. The latter is characterised by high specialisation, epidemiological perspective, research obligations, a homogeneous patient group and related care treatments, and routine technology use. The former is characterised by a generalist perspective, personally knowing your patients, 10-15 minutes per consultation, het-

erogeneity in the patient group and their care needs, and IT as a disruptive factor in the consultation. In addition to these differences related to treatment, needs, and technology usage, the general practitioners have to perceive the significant usefulness and be exceptionally motivated in order to embrace new technological infrastructures (due to their optional innovation-decision process [44]). The lesson from both cases is that the development of technological infrastructures not meeting the needs of the general practitioners as well as the needs of the secondary sector will fail. It will in the end result in an IT-supported shared care system that looses its value due to general practitioners' neglect to properly use the system.

Acknowledgement

We would like to thank Sine Marie Øelund, M.Sc, and Louise Baunsgaard Koch, M.Sc, who together with Maren Fich Granlien have conducted the empirical data that formed the basis for this study. They also took part in analysing the data and in forming the main conclusions from the study as part of their joint master thesis.

References

Pritchard P, Hughes J. Shared care: the future imperative? London: Royal Society of Medicine Press, Nuffield Provincial Hospitals Trust; 1995.

Short D, Frischer M, Bashford J. Barriers to adoption of computerised decision support systems in general practice consultations: a qualitative study of general practitioner's perspectives. International journal of medical informatics 2004 May;73(4):357-62.

Hampson JP, Roberts, RI, Morgan DA. Shared care: a review of the literature. Family Practice 1996 Jun;13(3):264-79.

Pringel M. Improving quality: Bridging the care sector divide. International Journal for quality in Health Care 2003 Dec;15(6):457-62.

Kvamme OJ, Olesen F, Samuelsson M. Improving the interface between primary and secondary care: a statement from the European Working party on quality in family practice. Quality Health Care 2001 Mar;10(1):33-9.

Branger PJ, van't Hooft A, van der Wouten JC, Moorman PW, van Bemmel JH. Shared care for diabetes: supporting communication between primary and secondary care. International Journal of Medical Informatics 1999 Feb-Mar;53(2-3):133-42.

Müller M, Ückert F, Bürkle T, Prokosch HU. Cross-institutional data exchange using the clinical document architecture (CDA). International journal of Medical informatics 2005 Mar;74(2-4):245-56.

Heitmann KU, Schweiger R, Dudeck J. Discharge and referral data exchance using global standards – the SCIPHOX project in Germany. International Journal of Medical Informatics 2003 Jul;70(2-3):195-203.

Blobel B. Trustworthiness in distributed electronic healthcare records - Basis for shared care. In: Proceedings of the 17th Annual Computer Security Applications Conference; 2001 Dec 10-4; Washington, DC: IEEE Computer Society; 2001.p. 433-41.

Van der Haak M, Mludek V, Wolff AC, Bulzebruck H, Oetzel D, Zierhut D, et al. Networking in shared care – first steps towards a shared electronic patient record for cancer patients. Methods of information in medicine 2002;41(5):419-25.

Takeda H, Matsumura Y, Kuwata S, Nakano H, Shanmai J, Qiyan Z, et al. An assessment of PKI and networked electronic patient record system: lessons learned from real patient data exchange at the platform of OCHIS (Osaka Community Healthcare Information System). International journal of medical informatics 2004 Mar 31;73(3):311-6.

Blobel B, Pharow P, Spiegel V, Engel K, Engelbrecht R. Securing interoperability between chip card based medical information systems and health networks, International Journal of Medical Informatics 2001 Dec;64(2-3):401-15.

Kühnel E, Klepser G, Engelbrecht R. Smart cards and their opportunities for controlling health information systems. International Journal of Bio-Medical Computing 1994 Feb;35 Suppl:153-7.

Hickman M, Drummond N, Grimshaw J. A taxonomy of shared care for chronic disease. Journal of Public Health Medicone 1994 Dec;16(4):447-54.

Moorman, P Branger P, van der Kam, W, van der Lei, J. Electronic messaging between primary and secondary care: a four year case report. Journal of the American information association 2001 Jul-Aug;8(4):372-8.

Bansler J, Havn E, Kensing F. IT-support for shared care. In: Ole K. Hejlesen OK, Nøhr C (editors). SHI 2005 proceedings. 3rd Scandinavian conference on health informatics; 2005 Aug 25-26; Aalborg. Aalborg: Virtual Centre for Health Informatics, Aalborg University; 2005. p. 9.

Llewellyn-Jones R, Baikie K, Smithers H, Cohen J, Snowdon J, Tennant C. Multifaceted shared care intervention for late life depression in residential care: randomised controlled trial. British Medical Journal 1999 Sep 11;319(7211):676-82.

Rubak S, Mainz J, Rubak J. "Shared care" – et integreret samarbejde om patientforløb på tværs af sektorgrænserne [Shared Care - an integrated cross-sectorial co-operation about patient care pathway].Ugeskrift for læger 2002;164(45):5256-61. [in Danish].

Smith SM, O'Leary MO, Bury G, Shannon W, Tynan A, Staines A, et al. A qualitative investigation of the views and health beliefs of patients with Type 2 diabetes following the introduction of a diabetes shared care service. Diabetes Medicine 2003 Oct;20(10):853-7.

Smith S, Bury G, O'Leary M, Shannon W, Tynan A, Staines A et al. The North Dublin randomized controlled trial of structured diabetes shared care. Family Practice 2004 Feb;21(1):39-45.

Naji S. Integrated care for diabetes: clinical, psychosocial, and economic evaluation. British Medical Journal 1994 May 7;308:1208-1212.

Straus A, Corbin J. Basics of qualitative research. London: Sage Publications; 1990.

Glaser BG, Strauss AL. The discovery of grounded theory: strategies for qualitative research. New York: Aldine de Gruyter; 1967.

Dahler-Eriksen K. Tværsektorielt samarbejde om behandling af Type 1 diabetes[Cross sectorial cooperation regarding the treatment of Type 1 diabetes] [PhD thesis]. Århus: Århus Universitet; 1999. [in Danish].

Winding K.. Delekontrol af diabetes – en succes i Vejle Amt [Shared control of diabetes –a succes in the county of Vejle]. Ugeskrift for Læger 2005;167(3):320-1. [in Danish].

Greenhalg PM. Shared Care for Diabetes - a systematic review. London; Royal College of general practitioners; 1994. (Occasional Paper 67).

Overland J, Mira M, Yue D. Diabetes management: shared care or shared neglect. Diabetes Research and Clinical Practices 1999 May;44(2):123-8.

Sowden A, Sheldon T, Alberti G. Shared care in diabetes. British Medical Journal 1995 Jan 21;310(6973):142-3.

Jørgensen, S J., editor. Kronisk sygdom. Patient, sundhedsvæsen og samfund. [Chronical diseases. Patient, healthcare system and society]. Sundhedstyrelsen: København; 2005. [in Danish].

Indenrigs- og sunhedsministeriet [Ministry of the Interior and Health]. National IT-strategi for sundhedsvæsenet 2003-2007.[National IT strategy for the Danish health care service 2003-2007] [homepage on the Internet]. c2003. Available from: URL: http://www.sst.dk/upload/nat_itstrategi03_07.pdf. [in Danish].

Indenrigs- og sundhedsministeriet [Ministry of the Interior and Health]. Sundhedsreformen [Health reform][homepage on the Internet]. c2005. Available from: URL: http://im.dk/publikationer/komreform_politiske_aft/html/indhold.htm (cited 2005 Nov 11). [in Danish].

Sundhedsministeriet.[Ministry of Health]. Handlingsplan om diabetes. [Action plan for diabetes]. [S.l.]: Indenrigs- og sundhedsministeriet; 2003. [in Danish].

Sundhedsstyrelsen. **[**National Board of Health**].** Diabetesindsatsen i amterne og H:S : Status marts/april 2005 [Diabetes in the counties an H:S : status March/April 2005] [homepage on the Internet]. c2005. Available from: URL: http://www.sst.dk/upload/planlaegning_og_behandling/planer_indsatser/diabetes/status_diabetesindsats_130505.pdf [cited 2005 Nov 18]. [in Danish].

Sundhedsstyrelsen**. [**National Board of Health**].** Diabetes [homepage on the Internet]. c2006. Available from URL: http://www.sst.dk/Planlaegning_og_behandling/Planer_Indsatser/Diabetes.aspx [cited 2006 May 2]. [in Danish].

Det Centrale Kvalitets- og Informatikudvalg for almen praksis. Samarbejdsaftale mellem PLO og SFU om kvalitetsudvikling i almen praksis [Cooperation between PLO and SFU about quality in general practice]. [S.l.]: Det Centrale Kvalitets- og Informatikudvalg for almen praksis; 2006. [in Danish].

Det Almenmedicinske Kvalitetsudviklingsprojekt. Afsluttende rapport Del 2 DAK-D Patientforløbet [Final report part 2 DAK-D: The patient pathway]. [S.l.]: Det Almenmedicinske Kvalitetsudviklingsprojekt; 2005. [in Danish].

Samuel J. editor. Samarbejde i snitfladerne mellem, amt, kommune og praksissektor.[Cooperation at the interface between, county, municipality and the practice sector]. [København]: Amtsrådsforeningen [Association of County Councils]; 2003. (Notat Amtsrådsforeningen, Dokumentnr.: 341197). Available from: URL: http://www.arf.dk/NR/rdonlyres/ej655q2lwfyori3b44hgc7srbz3m24jsr2nlpwfhwdnmx2to42fa34wknlyticeeqabv57hroirul2fznyrtajglqkg/SamarbejdeISnitfladerne_341197.pdf. [in Danish].

Højlund EM, Jørgensen O., editors. Sammenhæng i søgelyset: fremtidens sundhedsvæsen til debat.[Looking for continuity: debate about the future healthcare sector] København: Sundhedsfagligt Forum, Amtsrådsforeningen; 2004. (Debatoplæg). Available from: URL: http://www.arf.dk/NR/rdonlyres/estvqhno6po6i2hmvahttmweuaj74oiovhxl26dyxgsvplwtm4sksmmt5llqnakx2vpyjrvpwkfpnkfkrsut7suiw7b/SammenhaengISoegelyset.pdf. [in Danish].

Højlund EM, Jørgensen O., editors. Sammenhæng i søgelyset: Hovedindtryk fra sundhedsfagligt Forum, Amtsrådsforeningen; 2004 [Looking for continuity: Main input from a healthcare forum 2004]. København: Sundhedsfagligt Forum; 2004. Available from: URL: http://www.arf.dk/NR/rdonlyres/exkiiplkll24mwslggowoo5i5muevynolniimrwtm3zp7cuwh4fx2gmphg7mslmcvhz2jcvo27vb7owr23iaftdntwb/HovedindtrykFraSundhedsfagligtForum2004.pdf. [in Danish].

Weimar A. Shared care: et bedre forløb for patienten [Shared care: a better pathway for the patient]. Ugeskrift for læger 2002;164(11):1560-4. [in Danish].

Danholt P, Bødker K. Implementing a Diabetes EPR in Copenhagen Hospital Corporation. In: Ole K. Hejlesen OK, Nøhr C (editors). SHI 2005 proceedings. 3rd Scandinavian conference on health informatics; 2005 Aug 25-26; Aalborg. Aalborg: Virtual Centre for Health Informatics, Aalborg University; 2005. p. 19.

Granlien MF, Øelund SM, Koch LB. En undersøgelse af pilot-implementering af IT-understøttet shared care i Roskilde Amt [An investigation of a pilot-implementation of IT supported shared care in the county of Roskilde]. In: Ole K. Hejlesen OK, Nøhr C., editors. SHI 2005 proceedings. 3rd Scandinavian conference on health informatics; 2005 Aug 25-26; Aalborg. Aalborg: Virtual Centre for Health Informatics, Aalborg University; 2005. p. 30. [in Danish].

Bassett B, Hangaard J, Hansen C, Henriksen E, Vagner H. Diabetesbehandling – den fynske model [Diabetes treatment – the Funen model]. Månedsskrift for praktisk lægegerning januar 2006;84:33-46. [in Danish].

Rogers ME. Diffusion of Innovations. 4th. ed. New York: The Free Press; 1995.

Anthonsen B, Grinsted P, Rubak JM. Praksiskonsulentordningen PKO: Håndbog for praksiskonsulenter og praksiskoordinatorer [The practice consultant arrangement: Handbook for practice consultants and practice coordinators] [online]; 2004. Available from: URL: http://dsam.dk/flx/kvalitetsudvikling/praksiskonsulentordning/haandbog_for_pko/ . [in Danish].

Protti D, Johansen I. Further Lessons from Denmark About Computer Systems in Physician Offices. Electronic Healthcare 2003;2(2):36-43.

Protti D, Wright G, Treweek S. Johansen I.. Primary care computing in England and Scotland: a comparison with Denmark. Informatics in Primary Care 2006; 4: 93-9.

Gannik D, Saaby J. Kvalitet i almen praksis: Praktiserende lægers syn på fagets essens, vilkår og udvikling i Viborg Amt. [Quality in general practice: the general practitioners view on the essens of the proffession, terms and development in the county of Viborg]. Odense: Lægekredsforeningen for Viborg Amt; 2004. [in Danish].

Vedsted P, Olesen F, Hollnagel H, Bro F, Kamper-Jørgensen F. Almen lægepraksis i Danmark [General practice in Denmark]. København: Tidsskrift for praktisk lægegerning og forskningsenheden for almen praksis i Århus; 2005. (Report). [in Danish].

Lorenzi NM, Riley RT. Managing Change: An Overview. *Journal of the American Medical Information Association,*2000, Mar-Apr;7(2):116-24.

PART FOUR: RESEARCH PAPERS

Paper I
Granlien, M. F., & Simonsen, J. (2007). “Challenges for IT-supported shared care: A qualitative analyses of two shared care initiatives for diabetes treatment in Denmark”. International Journal of Integrated Care, 7.

Paper II
Bødker, K., & Granlien, M. S. (2008). “Participation and Representation: a Discussion Based upon a Case Study in the Danish Healthcare Sector.” in Simonsen, J., Robertson, T., & Hakken, D. (red.): PDC 2008 Experiences and Challenges (s. 190-193). Indiana University: Association for Computing Machinery (ACM).

Paper III
Granlien, M. S., Pries-Heje, J., & Baskerville, R. (2009). “Project Management Strategies for Prototyping Breakdowns.” Proceedings of the Annual Hawaii International Conference on System Sciences.

Paper IV
Granlien, M., Hertzum, M. “Longstanding Barriers to Organisational implementation of an Electronic Medication Record.” Under review for International Journal of Healthcare Technology and Management.

Paper V
Granlien, M. S., & Hertzum, M. (2009). “Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record.” in: Proceedings of the GROUP 2009 Conference on Supporting Group Work (s. 321-330). ACM Press.

Paper VI
Granlien, M.S. (2009). "Facilitating Participation in Formative Evaluation Supported by Effect Map", in Molka-Danielsen, J. (ed.) Selected Papers of the 32nd Information Systems Research Seminar in Scandinavia - Inclusive Design, Tapir Academic Press, Trondheim, pp 73-88.

Participation and Representation - a Discussion Based upon a Case Study in the Danish Healthcare Sector

Keld Bødker
Roskilde University
keldb@ruc.dk,

Maren Fich Granlien
Roskilde University
maren@ruc.dk

Abstract. The Scandinavian approach and the Participatory Design community has come a long way in terms of raising attention to include future users in the design and development of new technologies and in relation to making PD approaches applicable in real life projects. Based upon a case study of a - in many ways - successful project in the Danish healthcare sector we discuss issues in relation to participation and representation in projects with diversified user groups.

1. Introduction

Over the past two decades the Scandinavian Approach and Participatory Design has come a long way in making participatory approaches applicable in practice, i.e. in real life projects in for example business settings. There is, of course, still a viable debate in relation to dealing with problems in the design and use of information technology as witnessed for example by Dan Shapiro's call for for Participatory Design to "consider claiming an engagement in the development of large scale systems, and more particularly an engagement with the procurement and development of systems in the public sector...." (Shapiro, 2005, p. 32).

In this paper we want to discuss issues in relation to participation and representation based upon findings from a case study of a project in the Danish healthcare sector. The healthcare domain has emerged as an important area for Scandinavian IS

researchers and for PD - from our point of view due to the relevance of issues involved in designing it support for communication and interaction among actors crossing professional, organizational and institutional boundaries.

Chronic diseases, like diabetes, are affecting growing numbers of patients in western countries. When treatment involves several providers - such as hospital departments, outpatient clinics, general practitioners and homecare providers - issues like continuity of care and coordination become central. In many ways the project on it-support for diabetes treatment in a Danish region is a succesfull one. It is well integrated with related activities at the organizational and institutional level (Bassett et al, 2006), and the system is technically quite well designed. However, the uptake and use of the system by the primary healthcare providers is at odds with the intentions. In this short paper we will discuss this issue in terms of how to engage with practitioners from this domain in a project based in the secondary sector.

2. SharedDiabetes

As part of a long-term research effort in relation to it-support of diabetes treatment (Bødker, 2006; Danholt&Bødker, 2005; Danholt et al., 2004), we have followed the implementation of a system for supporting shared care of diabetes (Granlien&Simonsen, 2007). The system - SharedDiabetes[22] - was developed and implemented in the central part of one of the five Danish regions and is now being spread to the rest of the region.

In order to understand the project, a simple introduction to diabetes treatment is needed: When a suspicion for diabetes with a patient is discovered - in a hospital or the general practitioner's practice - the patient is referred to the diabetes outpatient clinic to have the diabetes diagnosed properly. Here the patient upon diagnosis receives initial treatment with the goal of becoming *well regulated,* i.e. achieve a stable situation by a combination of medication, a changed diet and physical exercise. In the outpatient clinic the patient is treated by a multi-disciplinary group of specialists: diabetes doctors and nurses, dieticians, ophthalmologists (eye specialists), and podiatrists (feet specialists). When the patient is well regulated, typically within less than a year, the patient is discharged to his/her general practitioner (GP).

This is the workflow for type II diabetes - by far the most widespread (type I patients are treated in the hospitals). Upon discharge, type II patients are seen by their GP on a regular basis, every three months and a more thorough control every 12 months. In relation to the yearly control, the GP refers the patient to see an eye specialist and a foot clinic. Late complications of diabetes (of which some are related to sensibility in feet and changes to the eyes, hence the yearly checks at the eye specialist and the foot clinic) are serious to the individual patient and costly to deal with for the healthcare system. Effective care and the patient's active participation are central to reduce the late complications, and thereby improve the quality of life for the patients and lower the costs for society.

[22] a pseudonym.

2.1 The Case Study, its Methods and Initial Findings

The empirical investigation took place throughout 2005/06 and comprised a series of interviews, observations and document analyses, see table 1. Interviews were semi-structured and lasted 45-75 minutes. They were recorded and later transcribed (later in this paper referred to as GP1, etc.). Observations at an outpatient clinic were carried out over three days - in total approximately 15 hours of observation documented by field notes. Interview transcripts and field notes from the observations were analyzed using a coding process inspired by the theoretic sampling technique known from grounded theory (Glauser&Strauss, 1967).

Table 1. Empirical activities in Region A

	Interview	**Observation**	**Training session**	**Documents**
General practitioners	3	-	3	*
Outpatient clinics	2	3	-	
System developers	2	-	1	*
Region	1	-	1	-

SharedDiabetes was developed in response to an action plan for diabetes from the Danish National Board of Health in 1994 (Bassett et al, 2006). Establishing a regional diabetes committee was the first result of the action plan. A variety of initiatives such as restructuring the diabetes outpatient clinics to reflect a team oriented care, hiring a diabetes nurse and diabetes practice coordinators at the regional level to improve the communication between the various care providers, and establishing schools for newly diagnosed diabetics were later launched to fulfill the action plan. After a number of the initiatives had been carried out, a need for an it system that could help monitor and support the treatment as well as provide a means for quality assurance was identified.

The project involved representatives from the various stakeholder groups, e.g. diabetes doctors and nurses from the outpatient clinics and the diabetes practice coordinators, i.e. general practitioners with a special interest in diabetes. Compromises had to be made in many areas during the design of the system. The specialists at the outpatient clinics requested extensive data versus the general practitioners' wish for simplicity, ease of use and a minimal use of time. As part of the implementation the general practitioners were given three hours of training before getting a password to the system. In return of an additional remuneration they are expected to use the system for reporting the yearly status.

SharedDiabetes is used by all outpatient clinics, a substantial part of the GPs, and has recently been made accessible to patients in the region through the Danish National Public Healthcare Portal. SharedDiabetes is a web-based system for registration of data relevant for the treatment of patients with diabetes such as: HbA1c, blood pressure, weight, medication, status for eye and heart etc. The system is being

promoted as a system for supporting shared care. SharedDiabetes can be accessed through an Internet browser and requires a manual login, or it can be setup to be accessed via the general practitioners patient administration system/electronic patient record (EPR) system through an integrated link. The system is integrated with the hospitals' laboratory system, which means that results of the patients' tests occur in the system automatically. The integration with the general practitioners' electronic patient record systems is done by text messages (edifact) from SharedDiabetes. At the time of our investigation the outpatient clinics did not have an electronic patient record and used SharedDiabetes as their main system for diabetic patients together with the hospital patient administration system. For that reason we do not know about the integration, or the planned integration, with a potential full EPR system.

The system is designed for use *during* the consultation to facilitate involvement of the patient (to help the patient become active in his/her own treatment) and with a fine-grained level of data. This is how we observed the system being used at the outpatient clinics. The general practitioners we interviewed never used the system during a consultation, but preferred to consult the system before the consultation and register data afterwards. Most of them preferred to use their own system, and others said they hardly ever used any system during consultation. They prefer to be "present" and not hiding behind the screen during the consultation.

> "I would rather use the time – and I might sound a little self-righteous now – but I prefer using my time with the patient and then use the computer either before or after [the consultation]. That's what I do generally" (GP2).
>
> "I won't sit with my back to the patient [facing the computer]. I believe that's rude … it is not the job of a physician to sit and act like a computer nerd" (GP1).

Many of the general practitioners in our study did not feel the need for shared care – especially not if shared means shared between the general practitioner and the outpatient clinics. Less than 5 % of their consultations regard diabetes (Vedsted et al., 2004), which means that they typically have 50 patients or less with diabetes and only one fourth of them is also being treated by the outpatient clinic. Even if the patients are shared with the outpatient clinic, the general practitioners do not feel the need for a shared record or a shared treatment.

> "Either I take care of my diabetes patients or the outpatient clinic does. [Most often] I manage them myself and then there are some cases where they are hard to manage. They are then referred to the outpatient clinic and they will take care of the extended yearly control" (GP2).

When the patients are being treated by the outpatient clinic the general practitioner does not interfere with the treatment and vice versa. The general practitioners would gladly share and exchange data with the outpatient clinics, but they all preferred to use their own system and then have some kind of data transfer module.

> "I was quite insisting on this matter, but it was technically not possible to do this at this point in time. I am of the opinion that a [shared care system] should have been developed where the application should be within our computers" (GP3).
>
> "If it [shared care system] was on my computer then it could get most of the data [from my electronic patient record system]. But there should be a little piece of code that did this [automatically]" (GP3).

The general practitioners would prefer a solution with a system much more integrated with their own record systems. The general practitioners were all very positive about their own system, they all found an opportunity to show us the excellence of *their* system.

3. Discussion

The project was well integrated with the regional activities of diabetes treatment, as evidenced by (Bassett et al, 2006) and our interviews; the system is actually quite well designed; and a leading medical doctor from the regional University Hospital has claimed remarkable results in terms of significantly less late complications from diabetes to the shared care initiatives. However, findings from the study also point to a number of challenges for it supported shared care, especially related to GPs' use of SharedDiabetes. Some of these challenges are related to structural issues, and some are related to the insufficient involvement of key actors.

3.1 Structural problems and lack of attention to general practitioners' practice

A large part of the structural problems comes down to the fact that GPs as well as other care providers in the primary healtcare sector are private businesses, while diabetes outpatient clinics are part of public hospitals. In Denmark virtually all GPs have electronic patient records, and there are more than 20 different EPR systems in use in GP's clinics. Currently the Danish regions owning the public hospitals are developing and implementing full-scale hospital EPR systems, but when the SharedDiabetes project started, and when the system was first implemented in the region, there was no EPR system at the region's hospitals. For that reason SharedDiabetes was designed for use as the main system for diabetes patients.

The GPs, however, have their own EPR system as their main system. This means that the use of SharedDiabetes in GP's clinics is on top of their EPR system involving extra work and overhead. When seeing a diabetes patient the GP has to log into SharedDiabetes by opening a browser window, check data from previous consultations, register the relevant data from the current consultation, and then return to the EPR system. This extra work was actually acknowledged as part of the project: the services to be performed by GPs were regulated and included in the financial agreements between the GPs and the region. However, in the daily use the lacking integration causes frustrations, as illustrated by the quotes above, for example "I was quite insisting on this matter, but it was technically not possible to do this at this point in time. I am of the opinion that a [shared care system] should have been developed where the application should be within our computers" (GP3). As noted by the GP, achieving a tight, or *seamless,* integration between SharedDiabetes and his EPR system requires a vast amount of resources. Given the project's software architecture decisions this would involve all the 20+ providers of EPR systems for GPs.

In general the GPs find that SharedDiabetes does not support their way of working. The GPs we interviewed never used the system during a consultation, but preferred to consult the system before and register the data after the consultation.

Due to the fact that the information input to SharedDiabetes is not integrated with the GPs' electronic records, and the fine level of granularity of data requested by the doctors at the outpatient clinics, using the system becomes tedious extra work in the GP clinic. This is reinforced by the low frequency of diabetes patients in general practice. Less than 5% of a GP´s consultations regard diabetes (Vedsted et al., 2005), which means that s/he typically has 50 patients or less with diabetes to be seen once every three months, or three patients weekly. This means that using the system never becomes routine, the GP always has to use extra attention - for example to locate a specific field.

3.2 Participation of diversified user groups

Our findings resemble experience from other studies of the uptake of clinical information systems, for example Short et al. (2005). The implication of the findings is that by not attending to the GPs' professional practice regarding use of computers in their consultations, risks are high that GPs will only use a shared care system to an extent fulfilling the minimal requirements in agreements between the region and GPs. From this, one could hypothesize that a small number of GPs would use the system as intended. We have not been able to test this hypothesis, as we have only been able to obtain data on the number of GPs having followed a course on SharedDiabetes and hence obtained a password to the system (more than 50% of GP clinics six month after launch (Bassett et al., 2006)).

How can we end in a situation like this in a project with all the best intentions? It is our claim that for a variety of reasons, the project operated with a *specialist mindframe*. The situation was seen from the regional diabetes committee's point of view. Here we have the experts (doctors and nurses from the outpatient clinics), and actors from this domain are the dominating actors in the project. They work full time with diabetes, and they are allocated to the project as part of their job. The GPs involved in the project were primarily the diabetes practice consultants, who are only paid a few hours monthly. This means that general practice is represented by physicians with a special interest in diabetes who work part time for the region with improving the collaboration between diabetes outpatient clinics and general practice. Hereby they can easily "get carried away" by their joint interest in diabetes treatment, and thus become less representative of GP clinics and clinical practice.

And what does representation of GP clinics mean, anyway? This is actually quite a tricky question. GPs and other care providers are private businesses without any organizational structure, for example a trade organization, from which individuals can represent all GPs. In the matters of contract negotiations between the GPs and the regional and national healthcare organization, a formal structure has been established. However, this only covers the contractual and financial agreements, not questions about the design of it systems to be used in the GPs' clinics. The question of representation is strongly linked to time and economic issues. Whereas the people from the regional outpatient clinics are allocated to the project as part of their full

time job, GPs who take part only do it out of their personal interest and with a limited amount of paid hours.

So where PD approaches in 'stable' or classic organizational settings have elaborated guidelines for user participation and representation, for example to include users with knowledge of the work domains in question, who enjoy professional respect from their colleagues, and who have time available for the project (NN et al., 2004), PD needs to develop guidelines for participation and representation in projects with more diversified user groups.

Relating to Gärtner and Wagner's classic distinction between three arenas for PD (Gärtner&Wagner, 1996) - the individual project, the company and the national level - we see that the complexitites of this project in part can be attributed to an increased structural complexity at the "company" level. We do not only have a strong power base with the actors at the regional level, also actors from the primary healthcare sector do not have a structure of representation enabling the involved actors to speak on behalf of their colleagues, while still others actors are not involved at all.

4. Conclusion

From a case study of the implementation of a shared care system for diabetes treatment in the Danish healthcare system, we have identified challenges for the PD community to address issues of participation and representation of user groups in projects with diversified user groups. These groups are not weak in the classic sense, actually they are quite outspoken, however, the challenge is to create opportunities and room for the involvement of actors with different institutional and economical orientations than a project's dominating actors.

Acknowledgements

We would like to thank Sine Marie Øelund and Louise Baunsgaard Koch who together with the second author have conducted the empirical study that formed the empirical basis for this paper.

References

Bassett, B.., et al., *Diabetesbehandling - den fynske model.* Månedsskrift for praktisk lægegerning, 2006 84(1): p. 33-46.

Bødker, K. Shared Care in Diabetes? In Proceedings of the 4th Scandinavian Conference on Health Informatics, SHI 2006, 24-25. August 2006, Virtual Centre for Health Informatics, Aalborg University, Denmark, p. 23-24.

Bødker, K., F. Kensing and J. Simonsen. Participatory IT Design: Designing for Business and Workplace Realities, MIT Press, Cambridge, Massachusetts, 2004.

Danholt, P. and K. Bødker. Implementing a DiabetesEPR in Copenhagen Hospital Corporation. In O. Hejlesen and C. Nøhr (eds.): SHI2005 Proceedings. 3rd Scandinavian Conference on Health Informatics, August 25-25, 2005, Aalborg University, Denmark, pp. 19-23.

Danholt, Peter, Keld Bødker, Morten Hertzum and Jesper Simonsen: Healthcare IT and Patient Empowerment: The Case of Diabetes Treatment, in A. Bond, A. Clement, F. de Cindio, D. Schuler, and P. van den Besselaar (eds.): *Artful Integration: Interweaving Media, Materials and Prac*tices. Proceedings of the eight Participatory Design Conference 2004, CPSR, Palo Alto, 2004, Volume II, pp. 80-83.

Glaser, B. and A. Strauss, *The discovery of grounded theory: strategies for qualitative research*. 1967, New York: Aldine de Gruyter.

Granlien, M. F. and J. Simonsen: "Challenges for IT-supported shared care: a qualitative analyses of two shared care initiatives for diabetes treatment in Denmark", *International Journal of Integrated Care*, 2007, Vol. 7, pp. 1–13.

Gärtner, J and I. Wagner. Mapping actors and Agendas: Political Frameworks of Systems Design and Participation. *Human-Computer Interaction*, Vol. 11, no. 3 (1996), pp. 187-214.

Shapiro, D: Participatory Design: The will to succeed. In Bertelsen et al. (Eds.) *Proc. Fourth Decennial Aarhus Conference, Critical Computing - Between Sense and Sensibility*, ACM Press, New York, 2005, pp. 29-38.

Short, D., M. Frischer, and J. Bashford, *Barriers to the adoption of computerised decision support systems in general practice consultations: a qualitative study of GPs' perspectives.* International Journal of Medical Informatics, 2004, 73(4), pp. 357-362.

Vedsted P, Olesen F, Hollnagel H, Bro F, Kamper-Jørgensen F. Almen lægepraksis i Danmark [General practice in Denmark]. København: Tidsskrift for praktisk lægegerning og forskningsenheden for almen praksis i Århus; 2005.

PART FOUR: RESEARCH PAPERS

Paper I
Granlien, M. F., & Simonsen, J. (2007). “Challenges for IT-supported shared care: A qualitative analyses of two shared care initiatives for diabetes treatment in Denmark”. International Journal of Integrated Care, 7.

Paper II
Bødker, K., & Granlien, M. S. (2008). “Participation and Representation: a Discussion Based upon a Case Study in the Danish Healthcare Sector.” in Simonsen, J., Robertson, T., & Hakken, D. (red.): PDC 2008 Experiences and Challenges (s. 190-193). Indiana University: Association for Computing Machinery (ACM).

Paper III
Granlien, M. S., Pries-Heje, J., & Baskerville, R. (2009). “Project Management Strategies for Prototyping Breakdowns.” Proceedings of the Annual Hawaii International Conference on System Sciences.

Paper IV
Granlien, M., Hertzum, M. “Longstanding Barriers to Organisational implementation of an Electronic Medication Record.” Under review for International Journal of Healthcare Technology and Management.

Paper V
Granlien, M. S., & Hertzum, M. (2009). “Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record.” in: Proceedings of the GROUP 2009 Conference on Supporting Group Work (s. 321-330). ACM Press.

Paper VI
Granlien, M.S. (2009). "Facilitating Participation in Formative Evaluation Supported by Effect Map", in Molka-Danielsen, J. (ed.) Selected Papers of the 32nd Information Systems Research Seminar in Scandinavia - Inclusive Design, Tapir Academic Press, Trondheim, pp 73-88.

Project management strategies for prototyping breakdowns

Maren Sander Granlien

Roskilde University, Denmark
maren@ruc.dk

Jan Pries-Heje

Roskilde University, Denmark
janph@ruc.dk

Richard Baskerville

Georgia State University
baskerville@acm.org

Abstract. Prototyping is often presented as a universal solution to many intractable information systems project problems. Prototyping is known to offer at least three advantages (1) provide users with a concrete understanding, (2) eliminate the confusion, (3) cope with uncertainty. On the other hand, managing the explorative and iterative aspects of prototyping projects is not a trivial task. We examine the managerial challenges in a small scale prototyping project in the Danish healthcare sector where a prototype breakdown and project escalation occurs. From this study we derive a framework of strategies for coping with escalation in troubled prototyping projects; the framework is based on project management triangle theory and is useful when considering how to manage prototype breakdown and escalation. All strategies were applied in the project case at different points in time. The strategies led to partial recovery of the project but not until several coping strategies had been tried.

1. Introduction

It is almost trivial to find how many IS projects are failing by not meeting the requirements or how they exceed the original schedule and budget by far. These kinds of projects are also termed “runaway projects”, which can be defined as projects that

fail to meet two or all of the following three criteria: completed on time, completed within budget, and produced the desired functionality. However projects can be more or less of a failure, meaning their degree of 'runawayness' can be placed on a continuum [1]. The underlying behavior of runaway projects is characterized by Keil et al. [2:631] as "escalating of commitment to a failing course of action". Escalation occurs when projects on a failing course are continued instead of discarded or redirected. Escalation can be defined "as continued commitment to a previously chosen course of action in spite of negative feedback concerning the viability of that course of action" [2:634]. When escalation is recognized the project manager or any other decision maker can take action to de-escalate the project by either ending it or redirecting it; for example by redefining the project or by reducing the scope. Generally escalation is perceived as something negative but in some cases escalation behavior can be economically prudent, when associated benefits are underestimated and/or adaptations during the project can lead to an increased project outcome [3].

One of the most difficult decisions for a project manager is to terminate a project before the project goal has been reached; consequently "projects are often allowed to continue for too long before appropriate management action is taken" [4:299]. Often the level of *sunken cost* (the amounts of resources already spend on the project) is given as an explanation for this behavior. Thus Conlon and Garland [5] suggest that the *completion effect* (the higher the degree of project completion, the more willing the project manager is to allocate resources to the project and let it continue) influence the escalation commitment of the project managers [6].

It can be difficult to gauge the degree of project completion because it can be difficult to determine the goal upon which to measure the project completion due to the volatility in the scope of software projects [5]. The estimation of project completion becomes even more difficult when dealing with iterative projects such as prototyping projects where you may only have a precise goal for the next iteration, and much weaker and sketchy goals for the following iterations.

1.1 Prototyping

The prototyping method is characterized by a high degree of iteration and user involvement in the development process as well as building and evaluating prototypes [7].

A prototype is a preliminary version of an information system that models selected aspects of a planned system. Prototypes offer solutions to many difficult systems development problems. Because prototypes are tentative, these provide a mechanism for improving the effectiveness of analysis and design in volatile or dynamic situations. When used as a participative approach to development of systems, prototyping involves construction and use of prototypes in collaboration with the prospective users. The use of prototypes can shortcut communications problems that arise in requirements definition [8-10] by integrating users directly into the design process [11-13]. Because of this feature, it is most appropriate in settings where organizational technology learning and user interaction effectiveness are important. Prototyping is effective because it provides meaningful social interaction between

developers and users [14]. Indeed, prototyping is even seen as a key mechanism for organizational change in heavily computerized organizations [15].

There are at least four different kinds of prototypes. A mock-up prototype models physical aspects of the final system. Mock-ups are non-executing versions of systems built with cardboard boxes, wood or plastic, perhaps even with people simulating the computer operations [12, 16].

A throw-away prototype is perhaps the most common category of prototype. It actualizes requirements as specified as an executable system. It is often described as an operational or "running" requirements specification. Throw-away prototypes include user interface prototypes that have limited functionality but embody the human interfaces.

A quick and dirty prototype is an early implementation without prior analysis and design. By revising it until the users are satisfied, it can evolve into the final system. A design-driven prototype used for technical experiments, e.g. with a platform or communication technology. Where design-driven prototypes are for a pre-finalization "test-drive", they may implement a design that is very close to the complete final system. However, for efficiency purposes, the final system is developed traditionally.

Finally an evolutionary prototype is a modifiable, running model of part of a system. It is incrementally developed into a final version, which is then used as the production system. Evolutionary prototypes are a form that underlies many release-oriented software products.

Prototyping is a highly explorative, experimental and evolutionary approach to system development, and is one approach to solve the common problem of fluctuating and conflicting requirements [11].

Development experts tout systematic use of prototypes as solutions to many of the problems that arise from extensive use of specifications. Prototypes provide users with a concrete understanding of the proposed computer system. They eliminate the confusion and potential for misunderstanding that originate from the interpretation of abstract specifications, and replace this with meaningful and direct communication between systems developers and users [17]. Not surprisingly, prototyping is frequently a prominent, perhaps optional component of larger system development approaches. Prototyping is a development method specially suited for exploring and eliciting the requirements for a new system.

There are acknowledged limits to the usefulness of prototyping. Prototypes usually operate inefficiently, [18], large prototypes are often impractical [19], prototypes can create the unrealistic expectations [20], users may not sincerely engage until a significant part of the system has been prototyped [13].

Thus project management of projects using prototyping is difficult because it is dependent on iterative activities. The basic management functions of planning and control are complicated because plans are supposed to change with each cycle, and control is hampered by lack of meaningful progress measurement coupled with the uncontrolled dependence on user cooperation. [21]

1.2 Research Question: From prototype iterations to coping

Originally our research was a study of prototyping and use of iterations in the development of a health care system. However, the study failed because the planned use of prototyping failed which turned our attention to the limits of prototyping. Our working research question changed and then became: Why did the iterative and experimental development process not work out as planned?

This research question led our attention towards the problems and difficulties of managing prototyping projects mentioned above. The project was at various points in time clearly on a failing course but was *not* abandoned. Accordingly the project manager enacted what could be called 'escalation of commitment'. But looking at the data we realized that the project manager, at the same time as she was enacting escalation behavior, at various points in time also tried to cope with the problems in many other ways. She redirected the failing project with a view to achieving as happy an ending as possible, trying out different strategies to cope with the escalation underlying the runaway project. A careful analysis of our data using analytical induction techniques [22] revealed that these coping strategies could be characterized by the project management triangle or "iron triangle" [23]. As explained by this triangle, any human undertaking – like prototyping – will have to be performed with scope, time and cost as constraints; a definition very close to the three characteristics that define runaway projects. We show an example of the project management triangle in Figure 1.

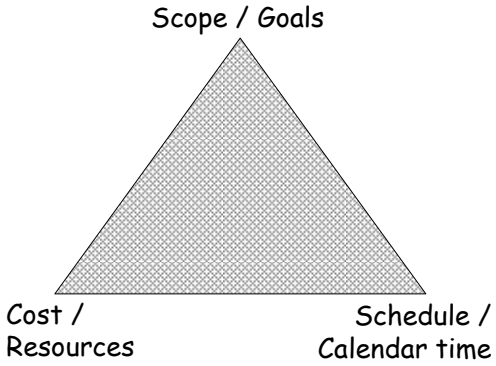

Figure 1: The "Iron Triangle"

Scope refers to the proportions of the project that could be the quality of the application, the anticipated effects it is to obtain, and the functionality as well. Scope is particularly problematic for iterative projects because these can be vague and shifting. It makes coping behaviour particularly "normal" in prototyping projects because one of the project constraints is expected to be changing. Time refers to the planning of the project and how much time is set aside to the different activities and how much calendar time the project is to stretch over. Cost refers to the amount of resources spent which in most cases would be man hours and can usually be converted to a monetary value. Often these three constraints are drawn as a triangle, where each side

represents a constraint. The relationship between the constraints is then that one side of the triangle cannot be changed without influencing the others.

Consequently we changed our research question one more time to the final question: *What coping strategies are used when managing problematic prototyping projects and prototyping breakdowns?* By answering this question, we help explain the behaviour of actors in prototyping failure settings (while not directly explaining the causes of prototyping failures).

	Accepting	Changing	Ending
Timing problem	TA	TC	TE
Resource problem	RA	RC	RE
Scoping problem	SA	SC	SE

Figure 2: The nine coping strategies

Using this research question, our data analysis concluded that the coping strategies we saw enacted in the health care system prototyping case all could be related to one of the constraints in the iron triangle. Furthermore we saw three types of coping behavior for each of the three constraints: (1) Accepting, (2) Changing, and (3) Ending. Together this can be shown as a 3-by-3 matrix as in Figure 2 resulting in nine coping strategies. The coping strategies in Figure 2 are named by a two letter abbreviation, the first letter refers to the constraint and the second letter to the coping behavior. E.g. a resource problem coped with by changing a course of action is named RC.

A timing problem arises when the time frame is not suitable to reach the originally planned (and desired) goal of the project. It can be coped with by *accepting* the deadline and the possible goal that may be achievable within the time frame (TA). This coping strategy is shown in Figure 3.

Figure 3: The TA coping strategy

The timing problem can also be handled by *changing* the schedule, adding new activities to the plan and continue with the same originally planned goal (TC). This coping strategy is shown in Figure 4.

Figure 4: The TC coping strategy

Or we can deal with the timing problem by stopping the project; meaning that we terminate and end the project (TE), for example because we realise that it is not reasonable to apply either of the other two coping behaviours. This is shown in figure 5.

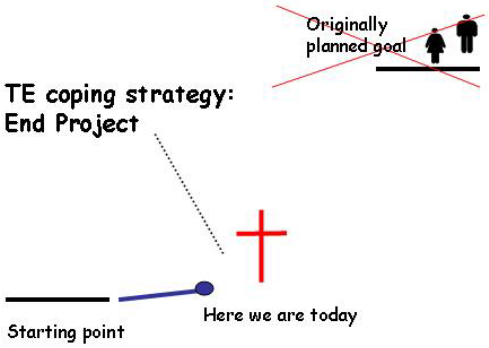

Figure 5: The TE coping strategy

A resource problem occurs when the allocated resources are not sufficient to reach the desired goal and effects. Again we have three coping behaviours possible. We can accept the goal that we now realise can be achieved with the resources given (RA). Alternatively we can change the course of action by adding resources in order to aim for an unchanged goal (RC). Finally we can instead end the project (RE).

A scoping problem is when the originally desired scope con not be reached or when the goal becomes less or non-desired. The cause could be market forces, competitor actions, etc. But it can also be internal forces that make the originally desired

goal obsolete. Top management may for example launch a new strategy and the originally planned goal may have been closely linked to the old one. Again, this type of problem can be coped with in three different ways. First, by holding on to the original goal – accepting it no matter how obsolete it is (SA). Second, by changing to a new scope (SC), or third, by ending the project (SE).

2. Research method

To answer the research question we undertook a case study in the Danish healthcare sector. Yin [24] describes the case study method as "an empirical enquiry that: investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" [24:13]. This approach was ideal for studying the prototyping phenomenon in a context where breakdowns in relation to expectations from prototyping took place.

In order to secure multiple sources of evidence, various types of data were collected from various sources. We made participatory observations at four full-day workshops where prototypes were developed and discussed. The workshops were documented by field notes and one of them videotaped. One author was actively taking part in workshop facilitation. Second, direct observation was applied through the use of the forms in the healthcare environment before and during a pilot test. A total of 61 hours of observations were made, including evening and night shifts. Third, one author participated in weekly status meeting during the 8 weeks that the pilot testing took. Fourth, as an evaluation after the pilot test, one author conducted eight interviews with key actors in the case setting using an evaluation questionnaire as well as attending the evaluation workshop where the preliminary evaluation was presented. Finally, a semi-structured interview lasting 80 minutes with the project manager was conducted.

The observational data were supported by various documents from the project: official project reports, PowerPoint slides from the workshops, specifications documents, and log books from the healthcare wards during the pilot test, to the joint evaluation report form the vendor and the region.

All these data were transcribed and summarized. For analysis we used analytic induction [22] which can be described as a systematic examination of similarities between various social phenomena in order to develop concepts or ideas. Materially, we used analytic induction to search for those similarities, and to identify the nine broad categories of coping strategies (shown in Figure 2) as an answer to our research question.

3. Case: A health care prototyping project

In 2006 an existing Electronic Patient Record (EPR) system in one region of Denmark consisted of a patient administration system, a medication administration module, a laboratory module for viewing laboratory results, an x-ray module for ordering and viewing x-rays, and a module for showing the notes to the records.

It was decided to add a new Clinical Monitoring (C-M) module to the EPR system. The new module should replace various paper forms used for monitoring vital values related to specific areas (i.e. diabetes, stroke, asthma) with similar electronic forms. The purpose of the forms (and thus also the C-M module) was to monitor clinical information of the patients.

The scope of the project was first, to create consensus about the possibilities and constraints in using the old paper based system, and second, to specify and configure the desired expansions of the functionality of C-M.

To achieve this scope a participatory quick and dirty prototyping strategy was chosen. A series of configuration and prototyping workshops with participation from the hospital, the healthcare region and the vendor was planned. Further, to test the new functionality of the C-M system, a pilot test was planned and conducted on three clinical wards.

A project group was formed with involvement of a doctor and 1-2 nurses from three different hospital wards. The project group met for three workshops. The tool behind the application was chosen based on its configurability and ability to serve as a prototyping tool.

The plan was for prototyping to take place during the three workshops. The vendor was responsible for providing the prototype tool and the person that could (further) configure and develop the prototype as part of the workshop.

3.1 Prototype Break down

However, both at the first and the second workshop the prototype application tool was not ready. Instead MS Word documents and later PowerPoint mock ups were used. Participants complained that it was difficult to relate to the very long (up to 40 A4-pages) and technical documents. Thus, it was decided to add another workshop into the project plan.

The vendor had not assigned enough resources to the project – they were in need of both developer and configurator resources; resulting in the missing prototype. Not until after the second workshop were project participants granted access to a very "raw" prototype. And it was not until after the 3rd workshop that the vendor assigned an inexperienced configurator to the project. This configurator was new to the system and not able to configure on-the-spot during the workshop as planned.

The plan called for iterative prototyping and participative development. Due to the missing prototype the participants had no possibility for trying and testing the electronic forms thereby getting an impression of how they would work. Due to the obvious shortage of vendor development resources it was decided early in the process to cancel one of the forms. Later, two other forms were suspended. This is an example of the SC coping strategy (Scoping problem coped with by changing scope). In the next section we will give a complete analysis of where and when which coping strategies were used.

The doctors were very determined to focus on and improve the graphical presentation of the data though it was at the expense of some of the more basic data collection functionality (that could have especially helped the nurses who collected the da-

ta). Thus tensions between the goals of different users began to fundamentally affect possibilities for obtaining the overall effects.

After the workshops a pilot test period was planned. The pilot test was to take place in real hospital setting. As time for the pilot testing was coming closer it was realized that two of the remaining five forms would not be ready. Therefore it was decided to extend the pilot test period from four weeks to eight weeks.

Due to problems with backup the pilot test starting date was postponed two days. This had huge unintended consequences. Notice that work plans in the hospitals are normally planned 6-10 weeks in advance. The personnel trained in the application were scheduled to be working the first days of the test period so they could train their colleagues both on day shifts and night shifts. Thus the two day delay caused many of the future users of the system to be untrained in the new system until weeks after the start of the pilot test.

As described a series of events, mainly started by lack of resources in the vendor organization, lead to the breakdown. In such complex settings it can be difficult to point out the exact cause that initiates the breakdown. However, the coping behaviour by the participants in response is more observable.

4. Case analysis

In this section we analyze the case using the framework presented in figure 1. Later in the section we will analyze the prototyping project from an escalation perspective.

We will use the first letter in each column and row to specify where we place something in the framework. For example TA refers to a Timing problem, the Accepting coping strategy. As explained earlier the three project constraints are interdependent so if you change one it will affect the others. For example, if there is a scoping problem handled by accepting the “old” scope (SA) in most cases it may also influence cost/resources and calendar-time/schedule. But analytically we have chosen to label the strategies related to the problem that appeared most dominant or occurred first and gave rise to the other problems in that particular situation.

Prototyping was a reasonable method to choose within the case setting in order to obtain the knowledge requested and needed in the project. Traditional all-in-one implementations and traditional functionality driven projects involve too much focus on the technology itself and tend to neglect the organizational circumstances [25]. Since a main purpose of the case project was to identify organizational consequences, such as changes in work patterns and division of labor, prototyping was a suitable approach.

The first obvious prototype breakdown happened when the prototype was in fact missing in the first workshop. This breakdown caused the users to obtain no concrete understanding of the application leading to troubles in their contributing to the specifications. The breakdown manifested itself at the second workshop when the analyst explained about two different structures in the application and asked the clinicians to choose the one they preferred. The clinicians were then obviously confused and uncertain about the consequences of their choice. If they had been able to experience

the implications of the two structures in a prototype they most certainly would have had a better understanding of the consequences of their choice.

4.1 Coping strategies in use

Creating a better overview was one of the main effects specified in the beginning. In order to judge whether the electronic forms created a better overview than before, the physicians wanted to see a prototype of the graphical overview. This could not be established in the prototype in the beginning because it took a lot more time than expected and development resources were lacking. Instead a vast amount of time was spent on making PowerPoint mock-ups of the graphs. This can be characterized as a Scoping problem where the coping strategy were accepting (SA) and consequently introducing new activities to aim for the same goal.

In the early part of the project – around the first workshop - there was a great amount of uncertainty about how the electronic forms would influence the workflow and how they would work. This was difficult to predict also because they had short time where they could test the running prototype before the pilot test. It did not ease the uncertainty that one of the remaining 4 forms was not ready until weeks after the pilot test was started. As a consequence the pilot test phase was extended by 4 weeks. This is an example of a Timing problem and a changing strategy (TC).

The planned effect of one of the forms was to support the medication of children by gathering data from other systems. It was soon realized that it would take too long time and too many resources to include that in the prototype. So as a result the integration to other systems was left out. Later this form was also cancelled since without integration, it did not provide any effect. This was clearly a Scoping problem handled with a Changing coping strategy (SC)

The prototype was meant to support the design specification in order to experiment with which design could possibly lead to the desired effects of use. The missing prototype resulted in uncertainty about whether the desired effects could be obtained. During the first three workshops this situation were accepted. So here we have a Timing problem handled with Accepting (TA). However, at the third workshop it was decided to add an extra workshop focusing on the desired effects and how they could be supported. So the Timing problem persisted and was later dealt with by a Changing strategy (TC).

The anticipated effects of the application could not be assessed in the beginning of the project due to the missing prototype. Later it was obvious that the expected effects could not be obtained when the electronic form associated with the effects was cancelled. So here is an example of a Scoping problem handled by a strategy of changing (SC).

The cost had been underestimated. At project start both the region and the vendor estimated to spend 400 man-hours each but ended with spending respectively 1032 and 1250 hours. The region had no problems in spending the extra amount of time – resulting in a Resource changing coping strategy (RC). The vendor however could not deliver the resources needed in the beginning of the project to build and configure the prototype. Consequently the first three workshops were spend doing traditional specification on paper, a resource problem with an accepting strategy (RA).

However later in the project the vendor provided extra resources (RC) when a developer and a configurator were assigned to the project.

Lack of resources in the beginning of the project seems to be more critical in a prototyping project. What also seemed to be the case in this project was that the vendor was bound by another iron triangle because they had just got a large contract in one of the other Danish regions. Accordingly they were not able to deliver the resources at the time needed for this project.

Despite all the prototype breakdown challenges, the project continued. During the six month project period the project manager used many different coping strategies in order to keep the project alive. It is difficult to gauge whether that was a reasonable and sound decision. Like other knowledge based projects, measuring objectives and progress is difficult, and the iterative nature of prototyping worsens measurement by putting everything in motion. Retrospectively the project manager regrets that the project was not stopped or postponed after the second workshop. At that time it was obvious that the vendor did not have the resources and the project period would need to be vastly extended in order to achieve the anticipated effects. The result was both, a Resource, Timing and a Scope problem which should have been coped with by terminating the project – an ending strategy (RE, TE and SE).

But stopping the project is also not a clearly correct decision. Looking back more than a year later, the project was not a dismal failure. In fact the application has been used on one of the wards since it was made available 18 months ago and is still in use on the ward (as of June 2008). The ward mainly uses one form but the electronic form has given them a better overview to spot trends faster because they can compile data from more than 24 hours at a time, which was the limit for the old paper forms. Further the electronic forms are never lost which has resulted in better accessibility and better patient safety. But all in all we can place the project in the lower end of the failure continuum; not a complete failure, but one with some limited success after a period of time.

4.2 Prototyping and escalation

Retrospectively the project obviously was an escalation of a runaway project. The project clearly exceeded the original budget by requiring almost 300% more man-hours than expected and the time schedule was exceeded by 15-20%. It is more difficult to determine how much of the desired functionality the project failed to deliver, since part of the purpose of this (and probably prototyping projects in general) was to specify the essential functionality. But obviously only four electronic forms were delivered, a little less than the 60 % of the 7 forms that originally were the goal to deliver and test. Ultimately only one form was used on one ward. But the purpose of the project was twofold. The purpose of the project was not only to build and test the forms, it was also to experiment and investigate the constraints and possibilities in shifting from paper to electronic forms and to explore the changes in work practice. And the latter purpose can be said to be fulfilled in any situation except those in which the project has been terminated.

It is reasonable to ask why the project was not deescalated and terminated now that it quite clearly was on a failing course. One explanation could be that the escala-

tion was not recognized. Escalations imply that the project manager must be *aware* of the unconstructive project progress, which can be very difficult when managing prototype projects.

In the prototyping literature it is well recognized that it is difficult to assess and report accurately on project completion, since the iterative, explorative, and experimental aspects of prototyping projects can make it even more difficult to assess the degree of project completion, even though the length and the scope of the project is limited [21]. This seems especially to be the case when the project has an experimental character.

Another explanation can be the rising level of sunk costs after a number of coping strategies. The more money already spend on a project, the more difficult it is to terminate it. The completion effect may also have been present, believing that the project is closer to completion that actually is the case. Again the nature of prototype projects makes it difficult to asses how far the projects are from completion – and what is the goal that completion can be measured upon - the experimental purpose or the building and testing of the electronic forms.

While the three project constraints are interdependent, the related coping strategies are not only interdependent, but interactive. At the beginning of the project, the participants attempted to persevere with goals and timing despite resource limitations. They coped with TA-RA-SA behaviour. As this broke down, the strategy TC-RA-SA emerged. When this strategy began failing, resources were added and scope was reduced and coping behaviour became TA_2-RC-SC (where TA_2 is an attempt to achieve the "previously revised timing" by changing resources and scope). New coping strategies depend on previous behaviours and interact with each other in emergent ways.

5. Discussion and implications

Prototyping is often presented as an ideal solution because of its value as a communications vehicle. Considered reasons for prototyping failure or breakdown tend to be technical: the project scale or complexity is too large for available resources. In the case at hand we had several examples of prototyping breakdown and failure. For example the prototype was not developed quickly enough in the early stages of the project, and in the later stages it is only partly functional. Figure 6 illustrates the process that the project followed.

The events that start the process include (1) the decision to prototype, which was taken of a meeting between the region and the vendor two months prior to the first workshop and (2) the initiation of a prototyping project. In our example, the eleven person project group began a series of meetings to guide the prototype development. The first meeting (2) provided the prototype initiation.

The crucial event in this process is the failure or breakdown of the prototype (event 3). This kind of event includes conditions where the prototype cannot be built in time, or doesn't operate. In our case, the prototype did not materialize because there were no developer resources to build it. As a result, project advancement slips (event 4). Prototyping failure and slipping project advancement has two impacts. The

obvious impact is that a non-operational prototype cannot be reviewed, discussed, corrected, and fixed to move to the next iteration. The second impact is on communications. Because the artifact is not available to facilitate communications among the project team, the social "good" that proceeds from experiencing the prototype not only does not progress, but appears to regress. The absence of the prototype is not a neutral event in terms of the impact on communications, especially between developers/configurator and users. The missing prototype leads to a high degree of uncertainty and confusion as well as misunderstanding between users and developers. Tensions grew between different groups of users. The delay of the prototype also affected the management of the project where it initiated multiple forms of coping strategies or behaviors as we have shown in Figure 2 and exemplified in our case analysis.

Coping strategies are meant to have an impact on any problem conditions that existed going into the prototyping project, be it a Timing, a Resource or a Scoping problem. Rather than having a neutral effect on these problem conditions, failure in prototyping exacerbates each condition. For example, in our case, the IT group was a separate vendor organization. There was substantial insulation between the using organization and the IT organization. This distance increased as the prototype failed, and the assigned project manager recognized the project was doomed. By ignoring the failure setting, she allowed the doomed project to continue; although later speculating that the Ending coping strategy would have been better.

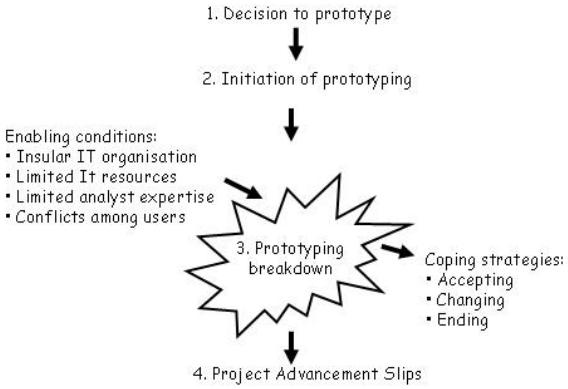

Figure 6: Coping strategies in context

There are other examples of unintended consequences of coping behaviors. Because system development resources were limited, the developer narrowed the scope of the prototyping project and determined how this scope should be narrowed without consulting the users. The analyst in this case did not have the necessary technical expertise to construct a prototype without the developer. Following the prototype failure, the analysts retreated to artificial prototypes (PowerPoint depictions) and began building traditional specification-based designs. Conflicts between user groups also escalated. These were latent and deep-seated conflicts, such as the professional tensions between physicians and nurses. In the presence of the prototyping failure, these

conflicts materialized as the missing prototype heightened doubts and ambiguity over the system's impacts on the worklife of the various professional groups.

The coping strategies framework helps explain the strategic behaviour of people in a prototyping failure situation. While it does not explain the failures themselves, future research is needed to investigate whether the presence of these strategies provides indicators of failures. The research above is grounded on previous work in software engineering. Another direction for future research could elaborate the sociology reflected in these coping behaviours. Like other participative approaches prototyping is a setting where professional cultures clash and fields of practice struggle with power, temporality, and other social values. More work is needed to elaborate the theoretical basis of the framework.

The framework developed and discussed in this paper could be a useful tool for project managers facing prototyping breakdown and project escalation. The framework offers a way to consider more systematically what to do; how to manage and cope with the breakdown of prototyping in system development projects. The framework can help to recognize the different coping behaviour earlier and provide a possible warning indicator of project escalation. If coping involves large changes, it may indicate an imprudent response. The degree to which it can be used to decide whether to stop a project is unclear. Future practical work is needed to see if the framework is useful in choosing and planning suitable coping strategies for redirection of projects.

6. Conclusion

Prototyping is often presented as a universal solution to many intractable information systems project problems. Prototyping is known to offer at least three advantages (1) provide users with a concrete understanding, (2) eliminate the confusion, (3) cope with uncertainty. A possible consequence of the breakdown of prototyping is the direct reversal of these advantages. Thus broken prototyping projects may be evidenced by (1) user misunderstandings, (2) confusion over the process and the product, and (3) rising uncertainty. Direct management of these factors can help recover from prototyping breakdown.

Based on an analysis of a prototyping project case from the health-care sector we derived a 3-by-3 framework of coping strategies for managing prototyping breakdowns; the framework was based on the theory of the iron triangle for project management. We found all the coping strategies to be applied in the project case at different points in time. The strategies led to a partial recovery of the project but the recovery emerged not from a single strategy, but from an interdependent and interactive process of using several coping strategies in a sequence.

References

[1] R. Mahaney, C. and A. Lederer, L. , "Runaway information systems projects and escalating commitment," in *Proceedings of the 1999 ACM SIGCPR conference on Computer personnel research*, New Orleans, Louisiana, United States: ACM, 1999.

[2] M. Keil, J. Mann, and A. Rai, "Why Software Projects Escalate: An Empirical Analysis and Test of Four Theoretical Models." *MIS Quarterly*, vol. 24, 2000, pp. 631-664.

[3] M. Keil and J. Flatto, "Information systems project escalation: a reinterpretation based on options theory," *Accounting, Management and Information Technologies*, vol. 9, pp. 115-139, 1999.

[4] M. Keil, B. C. Y. Tan, K.-K. Wei, T. Saarinen, V. Tuunainen, and A. Wassenaar, "A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects." *MIS Quarterly*, vol. 24, 2000, pp. 299-325.

[5] D. E. Conlon and H. Garland, "The Role of Project Completion Information in Resource Allocation Decisions." *Academy of Management*, vol. 36, 1993, pp. 402-413.

[6] H. Garland and D. E. Conlon, "Too Close to Quit: The Role of Project Completion in Maintaining Commitment." *Journal of Applied Social Psychology*, vol. 28, 1998, pp. 2025-2048.

[7] R. Vonk, Prototyping: The effective use of CASE Technology: Prentice Hall, 1990.

[8] B. Boar, Application Prototyping: A Requirements Definition Strategy for the 80's. New York: J. Wiley, 1984.

[9] R. Mason and T. Carey, "Prototyping interactive information systems", *Communications of The ACM*, 26, 1983, pp. 347-354.

[10] J. D. Naumann and A. M. Jenkins, "Prototyping: The New Paradigm for Systems Development", *MIS Quarterly*, vol. 36, 1982, pp. 29-44.

[11] R. Budde, K. Kautz, and H. Züllighoven, Prototyping: An Approach to Evolutionary System Development.Springer Verlag, 1991.

[12] P. Ehn, Work-Oriented Design of Computer Artifacts, 2 ed. Stockholm: Arbetslivscentrum, 1988.

[13] K. Grønbæk, "Supporting active user involvement in prototyping." *Scandinavian Journal of Information Systems*, vol. 2, 1990, pp. 3-24.

[14] P. Beck, J. J. Jiang, and G. Klein, "Prototyping mediators to project performance: Learning and interaction," *The Journal of Systems and Software*, vol. 79, 2006, p. 1025.

[15] J. Porra, "Colonial systems," *Information Systems Research*, vol. 10, Mar, 1999, pp. 38-70.

[16] C. Snyder, Paper Prototyping: The Fast and Easy Way to Design and Refine User Interfaces. New York, 2003.

[17] T. Moynihan, "Coping with requirements-uncertainty: The theories-of-action of experienced IS/software project managers," *The Journal of Systems and Software*, vol. 53, pp. 99-109, Aug 31, 2000.

[18] K. Lantz, E., "The prototyping methodology," Prentice-Hall, Inc., 1986, p. 191.

[19] M. Alavi, "As Assessment of The Prototyping Approach to Information Systems Development," *Communications of The ACM*, vol. 27, 1984, pp. 556-563.

[20] J. Iivari and M. Karjalainen, "Impact of Prototyping on User Information Satisfaction During The IS Specification Phase," *Information & Management*, vol. 17, 1989, pp. 31-45.

[21] R. Baskerville and J. Stage, "Controlling Prototype Development Through Risk Analysis," *MIS Quarterly*, vol. 20, 1996, pp. 481-504.

[22] M. B. Miles and A. M. Huberman, Qualitative Data Analysis: A Sourcebook of New Methods. Newbury Park, CA: Sage, 1984.

[23] R. Atkinson, "Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria.," *International Journal of Project Management*, vol. 17, 1999, pp. 337-342.
[24] R. K. Yin, Case Study Research - Design and Methods, 2 ed. vol. 5: Saga publications, 1994.
[25] R. Fichman, G. and S. Moses, A. , "An Incremental Process for Software Implementation," *Sloan Management Review*, vol. 40, 1999, p. 14.

PART FOUR: RESEARCH PAPERS

Paper I
Granlien, M. F., & Simonsen, J. (2007). “Challenges for IT-supported shared care: A qualitative analyses of two shared care initiatives for diabetes treatment in Denmark”. International Journal of Integrated Care, 7.

Paper II
Bødker, K., & Granlien, M. S. (2008). “Participation and Representation: a Discussion Based upon a Case Study in the Danish Healthcare Sector.” in Simonsen, J., Robertson, T., & Hakken, D. (red.): PDC 2008 Experiences and Challenges (s. 190-193). Indiana University: Association for Computing Machinery (ACM).

Paper III
Granlien, M. S., Pries-Heje, J., & Baskerville, R. (2009). “Project Management Strategies for Prototyping Breakdowns.” Proceedings of the Annual Hawaii International Conference on System Sciences.

Paper IV
Granlien, M., Hertzum, M. “Longstanding Barriers to Organisational implementation of an Electronic Medication Record.” Under review for International Journal of Healthcare Technology and Management.

Paper V
Granlien, M. S., & Hertzum, M. (2009). “Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record.” in: Proceedings of the GROUP 2009 Conference on Supporting Group Work (s. 321-330). ACM Press.

Paper VI
Granlien, M.S. (2009). "Facilitating Participation in Formative Evaluation Supported by Effect Map", in Molka-Danielsen, J. (ed.) Selected Papers of the 32nd Information Systems Research Seminar in Scandinavia - Inclusive Design, Tapir Academic Press, Trondheim, pp 73-88.

Longstanding Barriers to Organisational Implementation of an Electronic Medication Record

Maren Sander Granlien
Roskilde University, Denmark
maren@ruc.dk

Morten Hertzum
Roskilde University, Denmark
mhz@ruc.dk

Abstract. The aim of this study is to assess the perception and organizational implementation of an electronic medication record (EMR) 2-4 years after deployment. We investigate mid-and-lower-level managers' perception of (a) the adoption of the EMR and the work procedures associated with its use and (b) possible barriers toward adopting the EMR and work procedures, including the managers' perception of the usefulness and ease of use of the EMR. The investigation consists of a questionnaire survey send to EMR managers in one Danish healthcare region elaborated by interviews. The EMR is generally perceived as useful, yet respondents state that adoption of the EMR and related procedures is far from obtained. Eleven categories of barrier are identified with uncertainty about what the barriers concretely are, as the prime barrier although respondents are formally responsible for the adoption. It is apparent that time alone has not led to consistent adoption of the EMR.

1. Introduction

To improve the quality and efficiency of healthcare many hospitals are involved in extensive efforts to substitute electronic patient records for paper records. Like the technical specification and implementation of such technologies, the process of their organizational implementation is complex and crucial to success (Berg 1999; Lorenzi and Riley 2000; Markus 2004; Heeks 2006). According to technology-acceptance research (Davis 1989; Venkatesh et al. 2003) people's adoption of a technological

system depends to a considerable extent on their perception of its usefulness and ease of use, even when adoption is mandated. This emphasizes that organizational adoption of systems is a two-stage process involving a formal, organizational decision to adopt followed by actual adoption of the system by users (Gallivan 2001). Actual adoption may lag behind the formal decision temporally or it may remain partial, either because only some of the intended users adopt the system, because only parts of the system are adopted, or because adopted parts are used less or differently than intended (Fichman and Kemerer 1999). In studies of healthcare, reasons for such lags include that intended users perceive systems as decreasing the quality of records (Alapetite et al. 2009), increasing the time to enter medication orders (Ash et al. 2003), requiring clinicians to compromise their values and ethics to make the system work (Scott et al. 2005), and presenting knowledge barriers (Sobol et al. 1999). Brender et al. (2006) conclude that there is no small set of issues sufficient to ensure the success of healthcare systems; rather, success depends on a host of interdependent issues, including people, organizational, and social issues (Kaplan and Shaw 2004).

In this study we analyse the adoption of an electronic medication record (EMR) at the ten hospitals (2525 in-patient beds) in one of Denmark's five healthcare regions. The region started deployment of the EMR in 2003 and finished deployment in early 2006. The EMR is now used on all in-patient wards in the region for all medical specialties, except anaesthesia and acute medical receiving wards, to help ensure that the right medication is given to the right patients at the right time. To serve this purpose the EMR consists of facilities for recording and maintaining an overview of the ordering, dispensing, and administration of medication. While ordering is the physicians' responsibility, medication is dispensed and administered by nurses. Thus, the EMR is used by both physicians and nurses, and it is central to the coordination between physicians and nurses. In total, approximately 10000 physicians, nurses, health care assistants, secretaries, physiotherapists, and medical social workers use the EMR, and several work procedures involving the EMR are mandated in the region's standard operating procedures for medication. Patients' diagnoses, lab tests, treatments, and other non-medication information are not documented in the EMR but in other electronic and paper records.

The aim of this study is to investigate mid-and-lower-level managers' perception of (a) the extent to which their clinical staff has adopted the EMR and the mandated work procedures associated with it and (b) possible barriers toward adopting the EMR and work procedures, including the managers' perception of the usefulness and ease of use of the EMR. We target managers at the mid and lower levels because these managers, contrary to end-users, can answer on behalf of the entire unit for which they are responsible and because uncertainty in the managers' answers will itself be interesting as the managers are formally responsible for their staff's compliance with mandated work procedures. The study consists of a questionnaire survey and case interviews after the EMR has been in operation for between 1.5 and 4 years at the region's hospitals. Thus, clinicians have gained considerable experience with the EMR, and work practices involving the system have had time to stabilize.

Our interest in how widely the EMR has been adopted and incorporated in work practices is motivated by a belief that "for a technological innovation to be truly val-

uable, it must be incorporated within the adopting organization's operational and/or managerial work system" (Zmud and Apple 1992). The mandated work procedures partly prescribe how the EMR is to be incorporated in clinicians' work, making adoption of these procedures an integral part of the implementation and adoption of the EMR. We therefore define a barrier to the adoption of the EMR as any factor perceived (by respondents) to hinder or impede clinicians in using the EMR according to the procedures. Such an inclusive definition of barrier is in line with previous studies (e.g., (Cabana et al. 1999; Sobol et al. 1999)). We further emphasize that barriers are perceived and thereby part of respondents' reasoning about the extent to which they consider it meaningful and practicable to work according to the procedures.

Considerable research exists on barriers and facilitators to the implementation of guidelines and innovations among physicians at hospitals (Grimshaw et al. 2001; Landry and Sibbald 2002) and in general practice (Wensing et al. 1998; Grol et al. 2005) as well as among nurses (Colon-Emeric et al. 2007; Davies et al. 2008). A review of studies of barriers to guideline adherence among physicians identifies seven kinds of barrier divided into three groups: knowledge barriers, comprising lack of awareness and lack of familiarity; attitude barriers, comprising lack of agreement, lack of outcome expectancy, lack of self-efficacy, and lack of motivation; and behaviour barriers, comprising external factors (Cabana et al. 1999). The external factors include lack of time, which is identified as an important barrier in many studies. Sobol et al. (1999) specifically address barriers to the adoption of information technology in healthcare and group them into barriers relating to knowledge, approval, design, and implementation.

2. Method

The data for the study were collected by means of a questionnaire survey and follow-up case interviews. Approval for the survey and interviews was obtained from the region's director of hospitals and from the management board in the region's quality and development department.

2.1 Questionnaire survey

The questionnaire was administered with the online survey tool SurveyXact®. An email requesting participation was sent to all function managers, department managers, ward managers, and EMR coordinators at the hospitals in the region, a total of 430 people. Participation in the survey was anonymous and after issuing two reminders we received 232 responses (94 physicians, 129 nurses, 9 others), for a response rate of 54%. While this response rate is moderate, it is similar to the response rates of other medical mail surveys (Asch et al. 1997).

The questions in the survey concerned the adoption of the EMR and associated work procedures. Respondents were asked to what extent different parts of the EMR were used and to what extent different work procedures were followed. The response categories for these questions were *Always*, *Very often*, *Often*, *Rarely*, *Very Rarely*, *Never*, and *Don't know*. Participants were also asked to indicate their agreement to a

number of statements about the usefulness and ease of use of the system. The response categories for these questions were *Agree completely*, *Agree somewhat*, *Either*, *Disagree somewhat*, and *Disagree completely*. In addition to these fixed-response questions participants were asked to describe, in free text, perceived barriers to using the facilities of the EMR and complying with the work procedures. The questionnaire comprised 59 questions in total (including 6 questions on training not analysed in this paper).

Respondents provided 522 free-text comments about barriers to the adoption of the EMR and associated work procedures. Through a collaborative process of affinity diagramming (Beyer and Holtzblatt 1998) these comments were analysed and categorized by the first author and a staff member from the region who had a clinical background and thorough knowledge of the EMR. To assess the reliability of the resulting 11 categories, the second author independently assigned each comment to one of the categories. The Kappa value for the level of agreement between the two categorizations of the comments was 0.72, which according to Landis and Koch (Landis and Koch 1977) corresponds to substantial agreement. Disagreements were resolved through discussion and a consensus was reached.

2.2 Case interviews

To elaborate on the identified barriers in the questionnaire we interviewed the chief physician and the head nurse at a paediatric ward (in the following referred to as ward P) and the chief physician and deputy head nurse at a medical ward on another hospital (referred to as ward M). The two wards were selected because they were known as wards that had worked proactively with the implementation of the EMR. A project manager in the implementation unit of the region helped in selecting the wards. The purpose of the interviews was to get a deeper understanding of the barriers to adoption of the EMR, initiatives and interventions to overcome these barriers, experiences from the process, and effects anticipated from adopting the EMR.

The interviews were semi-structured by an interview guide, which took its starting point in the barriers expressed in the survey. This was possible because the interviews were conducted after the survey data had been analysed. The two interviewees at ward P were interviewed together, while the two at ward M were interviewed individually. Each interview lasted 40-60 minutes and was audio recorded, transcribed, and analysed with the qualitative analysis software Atlas.ti. Passages in the text were coded with the barriers from the survey and with codes indicating specific issues, initiatives, and interventions at the wards.

For both wards, we also conducted a telephone interview with a member of the regional implementation team responsible for the implementation of the EMR at the ward. These two interviews were semi-structured and documented by notes.

3. Survey results

Figure 1 shows respondents' perception of the extent to which the main facilities of the EMR are used at the wards of the hospitals in the region. Though the EMR was

designed to support clinicians' work, none of the facilities are reported to be used always or very often by more than two thirds of the wards. Four facilities are used always or very often by 56-67% of wards (items 1, 2, 7, 8). The other four facilities are used always or very often by only 3-37% of wards. This partial adoption of the EMR facilities is particularly noteworthy for the three facilities, the use of which is mandated in the region's standard operating procedures for medication (items 2, 7, 8). For example, though it is mandated for the nurses to use the dispensing/administration facility when medication is administered to patients, respondents indicate that only 53% of wards always do so. The extent to which one EMR facility is used at a ward weakly indicates that the other facilities are used to a similar extent in that the average pair-wise Spearman correlation between EMR facilities is 0.30 (SD = 0.15), $p < 0.05$ for 24 of the 28 pairs of correlation.

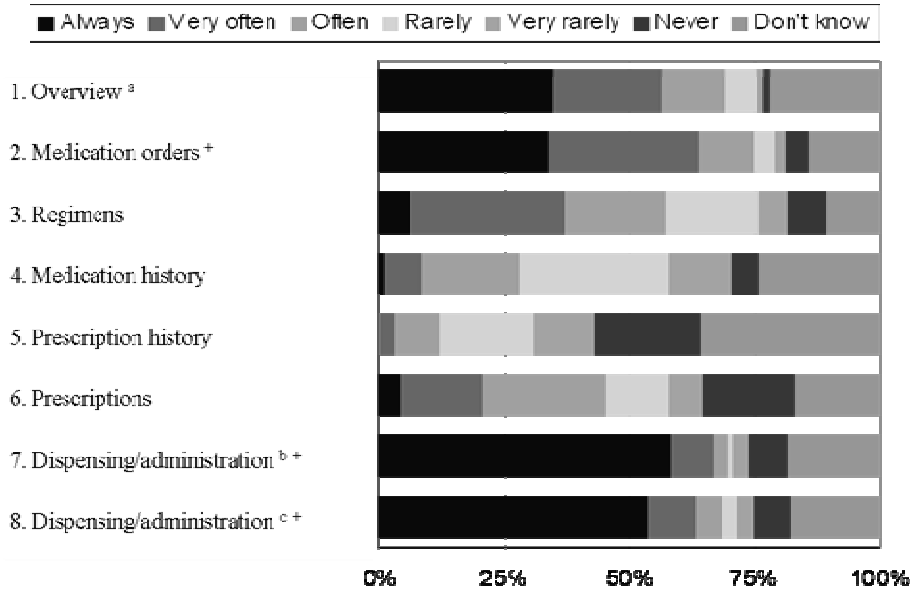

Figure 1. Perceived use of EMR facilities, N = 232 respondents
Notes: a Overview of ordered medication and its dispensing/administration. b When medication is dispensed. c When medication is administered. + The use of the facility is mandated.

Figure 2 shows respondents' perception of the extent to which work procedures involving the EMR are followed. Apart from the use of standard medication orders all these work procedures are mandated in the region's standard operating procedures for medication. However, respondents perceive that none of the work procedures are followed always or very often by more than 48% of wards and that four of the nine work procedures are followed always or very often by only 13-28% of wards (items 5, 7, 8, 9). It is, for example, mandated to set the medication status when a patient is transferred from one ward to another but according to respondents only 15% of wards always do so and an additional 13% do it very often (item 5). The extent to which one work procedure is followed at a ward weakly indicates that the other work procedures are followed to a similar extent in that the average pair-wise Spearman

correlation between work procedures is 0.29 (*SD* = 0.22), $p < 0.05$ for 25 of the 36 pairs of correlation.

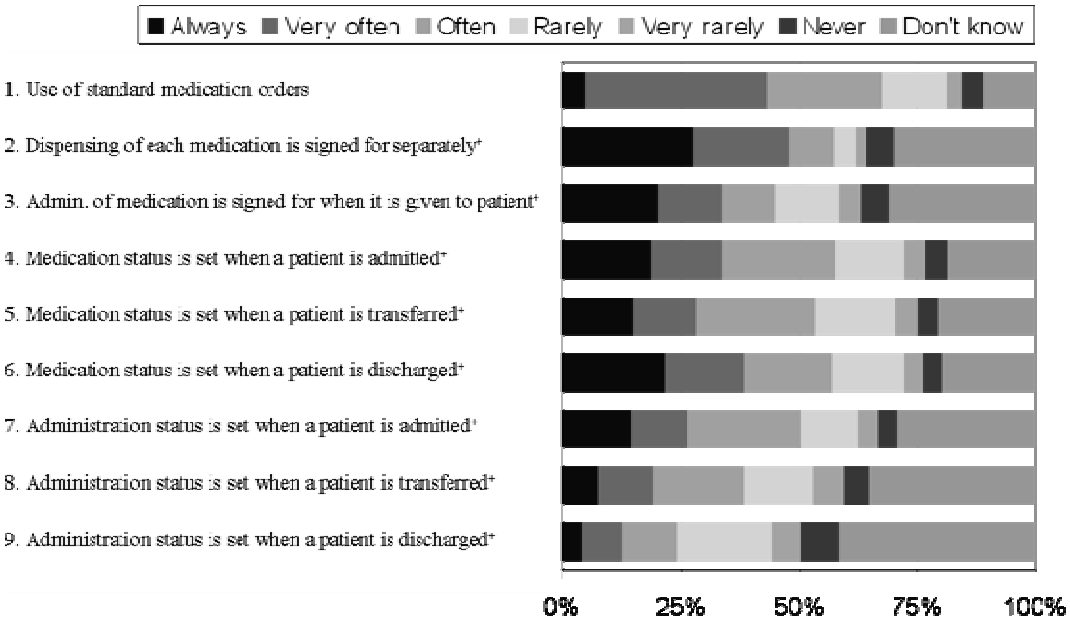

Figure 2: Perceived compliance with work procedures, N = 232 respondents
Note: + The work procedure is mandated.

Respondents were also asked to indicate the overall extent to which the standard operating procedures for medication were followed. Table 1 shows that though answers to this question correlated significantly with answers to six of the nine questions about the extent to which specified work procedures were followed the correlations were weak, suggesting limited awareness of the content of the standard operating procedures. Furthermore, many respondents lacked knowledge of the extent to which specified work procedures were followed, as indicated by the high percentages of *Don't know* answers. Averaged over the nine work procedures in Figure 2, 26% of respondents gave *Don't know* answers. The percentage of respondents uncertain about the extent to which system facilities were used was slightly lower, but still averaged 20% *Don't know* answers across the eight EMR facilities in Figure 1.

Table 1: Work procedures, N = 232 respondents

Work procedures	Mandated	Compliance assessment [a]
1. Use of standard medication orders	No	0.07
2. Dispensing of each medication is signed for separately	Yes	0.14 *
3. Administration of medication is signed for when it is given to patient	Yes	0.15 *
4. Medication status is set when a patient is admitted	Yes	0.32 ***
5. Medication status is set when a patient is transferred	Yes	0.27 ***
6. Medication status is set when a patient is discharged	Yes	0.38 ***
7. Administration status is set when a patient is admitted	Yes	0.22 **
8. Administration status is set when a patient is transferred	Yes	0.10
9. Administration status is set when a patient is discharged	Yes	0.09

[a] Spearman correlation between extent to which work procedure is followed and question 'Standard operating procedures for medication are followed', * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 3 shows respondents' perception of the usefulness and ease of use of the EMR. Below, we collapse *Agree completely* and *Agree somewhat* answers into a combined percentage of agreeing answers. Regarding perceived usefulness, 64-73% of respondents agree that the EMR provides a good overview of the different parts of the medication process (items 1, 2, 3). The three remaining items about perceived usefulness concern the quality of the medication process and yield slightly less positive results. Notably, the median response for the item concerning whether the right medication is ordered is neutral, that is neither agreement nor disagreement (item 4). Several respondents comment that the EMR has not reduced the number of medication errors but merely changed the types of medication error. Regarding perceived ease of use, the results show a difference between physicians and nurses. Medication ordering, which is the physicians' responsibility, is perceived as simple by only 36% of the 94 physicians among respondents (item 7) and as too time consuming by 76% of them (item 10). Conversely, dispensing and administration of medication, which is the nurses' responsibility, is perceived as simple by 65-66% of the 129 nurses among respondents (items 8, 9) and as too time consuming by 41-43% of them (items 11, 12). For both simplicity and time consumption nurses rate their parts of the medication process more positively than physicians rate theirs.

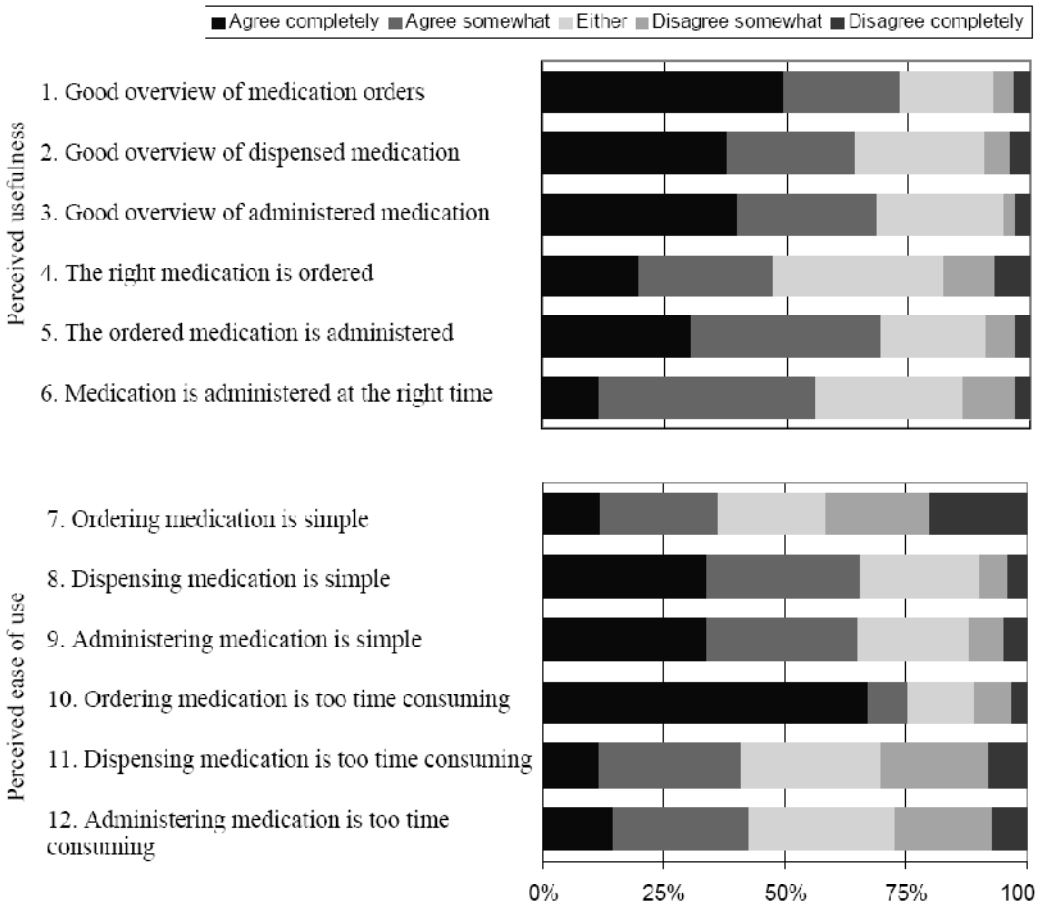

Figure 3: Perception of the EMR and the work procedures involved in using it.
Note: For items 1-6, all respondents are included, N = 232; for items 7 and 10, only the physicians among respondents are included, N = 94; and for items 8, 9, 11, and 12, only the nurses among respondents are included, N = 129.

Table II shows the eleven categories of barrier mentioned by respondents in their 522 free-text comments (each respondent had the opportunity to make multiple comments). Notably, the category most frequently mentioned is uncertainty about what constitutes the barriers to using the different EMR facilities and following the associated work procedures. Time, the second-most-frequently-mentioned category of barrier, refers mainly to technical issues such as slow response times and inferior system design making it time consuming to use the EMR. In some cases, however, time refers to social issues. This is, for example, the case when insufficient computer skills and lack of training are the reasons why system use takes a lot of time Additional categories related to social issues include lack of knowledge, information, and training (e.g., “Unaware of the facility”) and barriers resulting from non-compliance with work procedures earlier in the medication process (e.g., “Medication orders are incomplete” making it difficult for nurses to record the medication when they subsequently dispense/administer it). Collectively the categories that mainly refer to social

issues (categories 1, 3, 6, 7, 9) account for 52% of the comments. In addition to time, the categories mainly about technical issues include inadequate support for certain work areas (e.g., difficulties handling infusion medicine in the EMR because the frequent adjustments of the infusion rate are cumbersome) and poor usability and overview (e.g., "Difficult to get an overview due to an illogical composition of the interface").

Table 2: The eleven categories of barrier, N = 522 comments

Category	Number of comments	
1. Don't know: stating that barriers exist but not knowing what they are	132	(25%)
2. Time: the system being too slow and time consuming to use	85	(16%)
3. Lack of knowledge, information, and training	60	(11%)
4. Inadequate support of certain work areas	55	(11%)
5. Poor usability and overview	50	(10%)
6. Non-compliance with work procedures earlier in the medication process	42	(8%)
7. Cumbersome work procedures	20	(4%)
8. Inadequate hardware	19	(4%)
9. General operating procedures experienced as in conflict with EMR	9	(2%)
10. Requests for extension or revision of EMR functionality	7	(1%)
11. Other	43	(8%)

4. Case-interview analysis

At ward P the EMR was deployed in May 2005, after all staff had received half a day of training in its use and been offered an optional course in basic IT skills. The ward management appointed a person to receive extra training and follow the adoption process to identify needs for adjusting work practices. A member of the implementation team points out that ward P has shown extraordinary commitment toward the EMR and undertaken various initiatives to ensure consistent use of it. Ward M deployed the EMR in October 2005 after the staff had received training similar to that at ward P. Also, an EMR coordinator was appointed to support the clinicians and ward management in dealing with any problems that emerged when the clinicians started to use the EMR. Though the clinicians at wards M and P have learned to use the EMR, they still experience barriers that make it difficult to use the system as mandated. Other barriers have, however, been overcome through organizational initiatives or by establishing workarounds.

As in the survey, time appears a prime barrier to the consistent use of the EMR according to procedures: "It takes too long. You have to open and close so many windows." Thus, one reason for the perceived slowness of the EMR is that its use involves many operations that are merely navigational. Another reason mentioned by

the interviewees is that the computers and network are slow. As a consequence the nurses at ward M have given up bringing portable computers to the patients' bedside to record the administration of medication in real time. Instead, they record the administration of medication either before of after they have administered it to the patients at the ward. This practice is contrary to procedures but considered necessary to avoid delay and frustration. At ward P, they found that they spent too much time logging in to the computers. To minimize this problem, the nurses have established a practice of marking a computer with their name at the beginning of their shift and thereby claiming this computer for the duration of their shift. This way they circumvent repeatedly logging in and starting over on a new computer. Contrary to the other interviewees, the chief physician at ward M thinks unrealistic expectations about the time savings to be achieved with the EMR is a larger barrier than the actual time needed to use the system.

The most frequent problem relating to non-compliance with procedures earlier in the medication process is that nurses cannot record the dispensing and administration of medication in the EMR if the physician has not ordered it properly. For example, if the physician initially orders the medication orally but forgets to later order it through the EMR, then the nurses cannot document the administration of the medication in the EMR, as prescribed in the procedures. To alleviate such problems, the nurses at ward M have been enabled to make 24-hour orders of selected drugs such as light painkillers. This way the nurses can complete some of the physicians' incomplete medication orders and thereby also provide the basis for recording their own dispensing and administration of medication according to procedures. As the head nurse states: "It is a fact, that if the nurses do it, it gets done", implying that the physicians do not always do everything the way they ought to do it.

In the survey, lack of knowledge, information, and training appeared as a prime barrier. The interviewees remark that though new staff completes the half day of EMR training, they cannot remember much of it when they get back to the ward. All interviewees emphasize the importance of the more informal and ad hoc training that is hardly perceived as training but often consists simply of explaining or showing a colleague how something can be done. In getting clinicians to adopt procedures, it also seems effective to supplement explanations of how to do things with explanations of why it is important: "If you explain the reason to them, they are more motivated to do it. People need to be able to make sense of it, if they are to spend time doing it." The chief physician at ward M argues that proper use of the EMR is a matter of good habits, and he sees it as part of his responsibility to instil good habits in the clinicians at his ward. He makes an effort to enforce knowledge and adoption of the EMR in the course of his daily activities.

A possible barrier to the adoption of procedures could be disagreement as to whether the procedures are sensible. It is, therefore, worth noting that all four interviewees were in support of the procedures associated with the EMR. When specifically asked whether they found the procedures sensible, the interviewees gave answers such as "I find it very sensible to gather the documentation in the EMR – all in one place" and "It is, as a matter of fact, the best way to do it." In the interviewees' experience, changes in procedures and work practices have resolved issues that would otherwise have been barriers to the use of the EMR. The head nurse of ward P

adds that though a lot can be accomplished by adjusting work practices it may take considerable time to make such adjustments: “When you introduce a new technology then people have to learn new ways of working. That is not something you do from one day to the next.” While it is well known that it takes time to change habits, it is notable that this utterance is made after ward P has been using the EMR for two years, implying that learning new ways of working may take considerable time.

5. Discussion

5.1 Barriers to adoption

Respondents find that the EMR provides a good overview of medication orders, dispensed medication, and administered medication. They are also positive, though less so, about the quality of the medication process. Yet, there is a considerable gap between mandated and actual adoption of the EMR and associated work procedures. This gap persists 18-48 months after deployment in spite of training, information programmes, efforts to speed up the EMR, and improvements to the design of its user interface. In a survey of Norwegian hospitals, Lærum et al. (2001) report the related finding that physicians used electronic medical records for far fewer tasks than the systems supported. Though it is unclear whether use of the systems they surveyed was mandated, this suggests that substantial under-use of systems is not uncommon. The respondents in our survey are the managers formally responsible for their units’ consistent use of the EMR and compliance with associated work procedures. Hence, respondents ought to know the extent to which the EMR and work procedures are adopted, the barriers that impede consistent adoption, and how to address these barriers. There is, however, considerable uncertainty among respondents about the actual level of adoption and the concrete character of the barriers, complicating directed efforts to address the barriers. Stating that barriers exist but not knowing what they are is the barrier most frequently mentioned by respondents. While this barrier reflects a lack of knowledge, the lacking kind of knowledge is not included in common definitions of knowledge barriers, which focus on lack of knowledge about the system or procedure being introduced (Cabana et al. 1999; Sobol et al. 1999).

The barriers mentioned by respondents are about evenly divided between barriers that mainly refer to social issues and barriers that mainly refer to technical issues. This emphasizes the need for a socio-technical approach, which involves mutual adjustment of organizational and technical issues (Leonard-Barton 1988; Berg 1999). For example, barriers relating to time persist in spite of several efforts to speed up the EMR and provide extra training, emphasizing that this barrier has to be addressed in a more targeted, effective, and systematic manner to achieve adoption. At ward P, they have successfully lowered the time spent logging on to the EMR by adopting a practice where each nurse claims a computer for her or his entire shift. This reduces flexibility by giving each nurse access to the EMR from one rather than all computers, but it is considered a workaround that improves the usability of the EMR. Examples like this illustrate that pragmatic social, as opposed to technical, solutions are frequently employed to overcome barriers.

As a planned effect of the EMR, the associated work procedures have shifted work from nurses to physicians. Physicians have to specify medication orders in more detail, while nurses are relieved of work – though some nurses consider it a barrier to their work that physicians still make some incomplete medication orders. This might explain why the physicians among respondents perceive the ease of use of the EMR more negatively than the nurses, a difference also reported by Lium et al. (2006). Thus, while physicians and nurses are highly interdependent in their use of the EMR, they have reasons to perceive its usefulness and ease of use from different perspectives. A result of this is barriers specific to either physicians or nurses.

A further barrier may arise from the simultaneous presence of several interrelated records, of which the EMR is only one. For years hospitals have been and will continue to be in a transitional state where some records have become electronic and others have not. A possible consequence of this transitional state is a disintegration of information, as stated by one survey respondent in a free-text comment:

> Nothing has been achieved, except that data are now recorded in [the EMR]. Medication is no longer in the patient record; that is, the unified overview of medication and symptoms is lost, which is a clinical disaster.

This quote captures an adoption barrier that is easily dismissed as merely transitional, but such transitional states have become an almost permanent characteristic of work in many complex domains. As a consequence, the alignment of systems appears to be a key concern in achieving acceptance and adoption of individual systems.

5.2 Procedure and guideline compliance

Best practices, procedures, and other kinds of clinical practice guidelines are central to healthcare because they compile current knowledge, provide a structuring of important work activities, support the coordination of multidisciplinary work, and improve the quality of care. Often, improvement in clinical practice is equated with the implementation of guidelines (Grol et al. 2005), but in spite of their advantages guidelines also have limitations. Specifically, guidelines may under-recognize the complexity of clinical practice and thereby entail a risk of encouraging clinicians to apply recommendations rigidly even in situations where deviation is preferable (Hurwitz 1999).

Respondents perceived the EMR as useful, and the interviewees at wards M and P explicitly stated that they considered the mandated work procedures reasonable. This makes the gap between procedures and practice more notable. The magnitude of the gap suggests, however, that there may be good practical reasons for not complying fully with the mandated procedures. For example, the nurses at ward M have given up documenting the administration of medication in real time, as prescribed in the procedures, because the wireless network is too unstable and the EMR too slow to enable that the administration of medication is documented at the bedside on a portable computer. The head nurse describes that the nurses continually balance compliance with procedures against what is practically feasible in the situation to get their work done. This situated use of procedures is consistent with Suchman's finding that "plans are resources for situated action, but do not in any strong sense determine its course" (Suchman 1987:p.52). Suchman's analysis shows that plans are underspeci-

fied and depend on users to match the plans to the practicalities of the situation and thereby make competent use of the plans.

If barriers such as an EMR that is too slow prevent clinicians from following procedures and, at the same time, getting their work done, then the conditions for following the procedures are not present. This suggests that management may either have failed to take effective action against barriers or to adjust procedures so they support clinicians rather than present unattainable ideals. In the survey, lack of managerial support was not mentioned as a barrier to adoption. While this is contrary to previous studies (e.g., (Carroll et al. 1997; Hommelstad and Ruland 2004)), it should be remembered that the survey respondents and interviewees were managers. Lack of managerial support may have surfaced as a barrier to adoption if the survey had targeted clinicians in general.

5.3 Windows of opportunity

Partial adoption of mandated technologies is often seen as lags in the adoption process, suggesting that given more time adoption will occur (e.g., (Gallivan 2001)). Similarly, studies performed shortly after a technology has been introduced often account for partial adoption by emphasizing that insufficient time has passed for users to gain experience with the system and for new work practices to stabilize (e.g., (La Cour and Hellstern-Hauerslev 2007)). The EMR was deployed 18-48 months ago, yet no system facility and no mandated work procedure is fully adopted by all wards. The persistence of this adoption gap suggests that it may be misconstrued to expect that a long period of use will gradually lead to more complete adoption. Rather than gradual, the adoption process may be discontinuous and characterized by a relatively brief period for exploring and developing new work practices, which thereafter tend to stick (Tyre and Orlikowski 1994; Huysman et al. 2003).

Tyre and Orlikowski (1994) argue that adaptation is most likely to occur immediately after deployment than any time later. For adaptation to occur some time after deployment a disruptive event is generally necessary, and it has to be actively exploited. In explaining the brevity of this window of opportunity, Tyre and Orlikowski provide four reasons: First, the pressure of production discourages people from spending time and resources on adaptation. Second, habitual patterns of use constrain practice because they tend to congeal without much exploration of alternative patterns of use. Third, adjustment of expectations to fit experience reduces or completely removes the perceived need for adaptation. Fourth, erosion of team membership and enthusiasm entails that the teams responsible for adaptation lose momentum or dissolve before adaptation is accomplished. All four reasons seem relevant to an understanding of the use of the EMR. For example, the forums of coordinators and super users disintegrated soon after deployment, and they were not replaced by another forum for driving the adoption process.

If the exploration of new systems and the accompanying adaptation of work practices are confined to a brief window of opportunity, after which routinization takes over, then periodic interventions become a key element of organizational implementation. Periodic interventions are necessary to open new windows of opportunity for modifying work practices and technology. Abstaining from such interventions entails

considerable risk of only partially capturing the benefit of deploying a system (Markus 2004).

5.4 Limitations

Four limitations should be remembered in interpreting the results of this study. First, the response rate of the survey is moderate. While respondents were evenly distributed across the region's hospitals, non-respondents may differ from respondents in their perception of the EMR. The absolute number of wards at which EMR facilities and work procedures are not consistently used is, however, substantial among the respondents alone; non-respondents cannot subtract from but only add to this number. Second, survey respondents and case interviewees were managers at mid and lower levels. A management position may involve increased focus on procedures and less exposure to the practicalities of using the EMR in accordance with procedures in the day-to-day treatment of patients. Third, we do not assess the appropriateness of the mandated work procedures. No respondent has, however, criticized the mandated work procedures, except by commenting that they were cumbersome. Fourth, the EMR cannot be dissociated from the network, the hardware, and the other applications used along with it. Respondents' perception of the EMR incorporates their frustrations over, for example, slow network connections and this, in turn, affects how they use the EMR. Thus, the limited adoption of the EMR and work procedures cannot, based on this study, be attributed to the clinicians, the EMR, or any other single cause.

5.5 Implications for practice

The EMR survey has three implications for the region's hospitals. Keeping the above-mentioned limitations in mind, we feel that these implications are also more broadly applicable.

First, the managers formally responsible for the adoption of systems and work procedures may often be insufficiently aware of the actual level of adoption and the concrete barriers to adoption. This makes it more likely that limited adoption will go unnoticed and more difficult to address barriers in an effective manner. Practitioners should consider possible steps to support managers in working systematically with organizational implementation. It appears that support in realizing the issue and assuming responsibility for it may be under-recognized first steps.

Second, the gap between actual and intended use may be large. Various barriers and practical reasons may obstruct users' adoption of a system, even if they perceive the system as useful and agree that consistent use is in principle a good idea. Supporting clinicians in making the transition to a new system requires considerably more than providing a useful system, mandated procedures, and training.

Third, the window of opportunity during which clinicians explore a new system and adapt their ways of working appears to be brief. We suggest a sustained focus on organizational implementation with periodic interventions to open new windows of opportunity. Interventions should target selected barriers and be accompanied by activities to monitor whether the interventions have the intended effect. Grimshaw et

al. (Grimshaw et al. 2001) report that the most effective interventions are one-on-one coaching of clinicians during work, feedback on performance, and parallel application of multiple interventions.

6. Conclusion

EMR systems are an important element in hospitals' shift toward electronic patient records. In one of the five healthcare regions in Denmark, managers at the mid and lower levels perceive that the main EMR facilities are used always or very often by 3-67% of the hospital wards and that the mandated work procedures associated with the EMR are followed always or very often by 13-48% of wards. These findings are not a result of limited experience with the EMR but the state of affairs after using it for at least 1.5 years. The EMR is fully diffused at the organizational level, but at the level of clinicians the adoption of the EMR and its incorporation into clinicians' work practices are far from the goals that motivated the acquisition of the EMR.

Respondents to our survey find that the EMR provides a good overview of the medication process. They are slightly less positive about the quality of the process, and they display a division between physicians and nurses in their perception of whether the process is simple and whether it is too time consuming. Apart from differences between nurses and physicians, a number of adoption barriers are mentioned by respondents as reasons for the gap between actual and mandated use. These barriers include the EMR being too slow and time consuming to use, lack of knowledge, information, and training, and inadequate support of certain work areas. The prime barrier appears, however, to be uncertainty about what the barriers concretely are. This suggests a need for interventions at the managerial level to heighten managers' awareness of concrete barriers and have them assume responsibility for the low levels of adoption.

This study indicates that time alone will not lead to consistent adoption. First, clinicians cannot be expected to use the EMR as mandated unless the main barriers to its adoption are addressed. Second, clinicians appear to explore new systems and adapt work practices for a brief period of time, after which work practices congeal and routinization takes over. Third, routinized work practices tend to stick until challenged by a discontinuous or disruptive event. Hence, consistent adoption of technologies such as the EMR requires periodic interventions to target selected barriers and provide opportunities for renewed exploration and modification of work practices. Such a systematic approach to organizational implementation is, at present, beyond the scope of most efforts to introduce electronic patient records.

Acknowledgements

Part of the survey data reported in this paper has previously been published in a conference paper at MIE 2008. We thank Jette Gudmundsen and Mikkel Lundstrøm, who were instrumental in the design and administration of the survey, and the anonymous reviewers, who provided pertinent comments. Special thanks are due to the respondents and interviewees.

References

Alapetite, A., H. B. Andersen and M. Hertzum (2009). "Acceptance of speech recognition by physicians: A survey of expectations, experiences, and social influence." International Journal of Human-Computer Studies 67(1): 36-49.

Asch, D. A., M. K. Jedrziewski and N. A. Christakis (1997). "Response rates to mail surveys published in medical journals." Journal of Clinical Epidemiology 50(10): 1129-36.

Ash, J. S., P. N. Gorman, M. Lavelle, P. Z. Stavri, J. Lyman, L. Fournier and J. Carpenter (2003). "Perceptions of physician order entry: results of a cross-site qualitative study." Methods of Information in Medicine 42(4): 313-23.

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

Beyer, H. and K. Holtzblatt (1998). Contextual design : Defining Customer-Centered Systems. San Fransisco, Morgan Kaufmann.

Brender, J., E. Ammenwerth, P. Nykanen and J. Talmon (2006). "Factors influencing success and failure of health informatics systems--a pilot Delphi study." Methods Inf Med 45(1): 125-36.

Cabana, M. D., C. S. Rand, N. R. Powe, A. W. Wu, M. H. Wilson, P. A. Abboud and H. R. Rubin (1999). "Why don't physicians follow clinical practice guidelines? A framework for improvement." Jama 282(15): 1458-65.

Carroll, D. L., R. Greenwood, K. E. Lynch, J. K. Sullivan, C. H. Ready and J. B. Fitzmaurice (1997). "Barriers and facilitators to the utilization of nursing research." Clin Nurse Spec 11(5): 207-12.

Colon-Emeric, C. S., D. Lekan, Q. Utley-Smith, N. Ammarell, D. Bailey, K. Corazzini, M. L. Piven and R. A. Anderson (2007). "Barriers to and facilitators of clinical practice guideline use in nursing homes." J Am Geriatr Soc 55(9): 1404-9.

Davies, B., N. Edwards, J. Ploeg and T. Virani (2008). "Insights about the process and impact of implementing nursing guidelines on delivery of care in hospitals and community settings." BMC Health Serv Res 8: 29.

Davis, F. D. (1989). "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." MIS Quarterly 13(3): 319-340.

Fichman, R., G. and C. Kemerer, F. (1999). "The Illusory Diffusion of Innovation: An Examination of Assimilation Gaps." Information Systems Research 10(3): 255-275.

Gallivan, M. J. (2001). "Organizational adoption and assimilation of complex technological innovations: development and application of a new framework." SIGMIS Database - Special issue on adoption, diffusion, and infusion of IT 32(3): 51-85.

Grimshaw, J. M., L. Shirran, R. Thomas, G. Mowatt, C. Fraser, L. Bero, R. Grilli, E. Harvey, A. Oxman and M. A. O'Brien (2001). "Changing provider behavior: An overview of systematic reviews of interventions." Medical Care 39(8 Suppl 2): II2-45.

Grol, R., M. Wensing and M. P. Eccles (2005). Improving Patient Care - The implementation of change in clinical practice, Elsevier.

Heeks, R. (2006). "Health information systems: Failure, success and improvisation." International Journal of Medical Informatics 75(2): 125-137.

Hommelstad, J. and C. M. Ruland (2004). "Norwegian nurses' perceived barriers and facilitators to research use." Aorn J 79(3): 621-34.

Hurwitz, B. (1999). "Legal and political considerations of clinical practice guidelines." Bmj 318(7184): 661-4.

Huysman, M., C. Steinfield, C.-Y. Jang, K. David, M. H. in 't Veld, J. Poot and I. Mulder (2003). "Virtual Teams and the Appropriation of Communication Technology: Exploring the Concept of Media Stickiness." Computer Supported Cooperative Work: The Journal of Collaborative Computing 12(4): 411-436.

Kaplan, B. and N. T. Shaw (2004). "Future directions in evaluation research: people, organizational, and social issues." Methods Inf Med 43(3): 215-31.

La Cour, V. and C. Hellstern-Hauerslev (2007). "Evaluating the implementation and use of a computerized physician order entry system: a case study." Stud Health Technol Inform 130: 75-9.

Landis, J. R. and G. G. Koch (1977). "The measurement of observer agreement for categorical data." Biometrics 33(1): 159-174.

Landry, M. D. and W. J. Sibbald (2002). "Changing physician behavior: a review of patient safety in critical care medicine." J Crit Care 17(2): 138-45.

Larum, H., G. Ellingsen and A. Faxvaag (2001). Doctors' use of electronic medical records systems in hospitals: cross sectional survey. 323: 1344-1348.

Leonard-Barton, D. (1988). "Implementation as mutual adaptation of technology and organization." Research Policy 17(5): 251-267.

Lium, J. T., H. Laerum, T. Schulz and A. Faxvaag (2006). "From the front line, report from a near paperless hospital: mixed reception among health care professionals." J Am Med Inform Assoc 13(6): 668-75.

Lorenzi, N. M. and R. T. Riley (2000). "Managing change: an overview." J Am Med Inform Assoc 7(2): 116-24.

Markus, M. L. (2004). "Technochange management: using IT to drive organizational change." Journal of Information Technology (Palgrave Macmillan) 19(1): 4-20.

Scott, J. T., T. G. Rundall, T. M. Vogt and J. Hsu (2005). Kaiser Permanente's experience of implementing an electronic medical record: a qualitative study: bmj.38638.497477.68.

Sobol, M. G., M. Alverson and D. Lei (1999). "Barriers to the adoption of computerized technology in health care systems." Top Health Inf Manage 19(4): 1-19.

Sobol, M. G., M. Alverson and D. Lei (1999). "Barriers to the adoption of computerized technology in health care systems." Topics in Health Information Management 19(4): 1-19.

Suchman, L. (1987). Plans and situated actions: The problem of human-machine communication, Cambridge university press.

Tyre, M. J. and W. J. Orlikowski (1994). "Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations." Organization Science 5(1): 98-118.

Venkatesh, V., M. G. Morris, G. B. Davis and F. D. Davis (2003). "User acceptance of information technology: Toward a unified view." MIS Quarterly 27(3): 425.

Wensing, M., T. van der Weijden and R. Grol (1998). "Implementing guidelines and innovations in general practice: which interventions are effective?" British Journal of General Practice 48(427): 991-7.

Zmud, R. W. and L. E. Apple (1992). "Measuring Technology Incorporation/Infusion." Journal of Product Innovation Management 9(2): 148-155.

PART FOUR: RESEARCH PAPERS

Paper I
Granlien, M. F., & Simonsen, J. (2007). "Challenges for IT-supported shared care: A qualitative analyses of two shared care initiatives for diabetes treatment in Denmark". International Journal of Integrated Care, 7.

Paper II
Bødker, K., & Granlien, M. S. (2008). "Participation and Representation: a Discussion Based upon a Case Study in the Danish Healthcare Sector." in Simonsen, J., Robertson, T., & Hakken, D. (red.): PDC 2008 Experiences and Challenges (s. 190-193). Indiana University: Association for Computing Machinery (ACM).

Paper III
Granlien, M. S., Pries-Heje, J., & Baskerville, R. (2009). "Project Management Strategies for Prototyping Breakdowns." Proceedings of the Annual Hawaii International Conference on System Sciences.

Paper IV
Granlien, M., Hertzum, M. "Longstanding Barriers to Organisational implementation of an Electronic Medication Record." Under review for International Journal of Healthcare Technology and Management.

Paper V
Granlien, M. S., & Hertzum, M. (2009). "Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record." in: Proceedings of the GROUP 2009 Conference on Supporting Group Work (s. 321-330). ACM Press.

Paper VI
Granlien, M.S. (2009). "Facilitating Participation in Formative Evaluation Supported by Effect Map", in Molka-Danielsen, J. (ed.) Selected Papers of the 32nd Information Systems Research Seminar in Scandinavia - Inclusive Design, Tapir Academic Press, Trondheim, pp 73-88.

Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record

Maren Sander Granlien
Roskilde University, Denmark
maren@ruc.dk

Morten Hertzum
Roskilde University, Denmark
mhz@ruc.dk

Abstract. Successful deployment of information technology (IT) involves implementation of new ways of working. Under-recognition of this organizational element of implementation entails considerable risk of not attaining the benefits that motivated deployment, yet knowledge of how to work systematically with organizational implementation is sparse. This study investigates a set of interventions undertaken to implement one mandated procedure associated with an electronic medication record, namely that all information about medication is recorded in the system. Medical record audits show that the interventions, which were devised and performed as part of the study, significantly lowered the number of records that violated the procedure. This positive effect was, however, not achieved until multiple interventions had been employed, and there is some indication that the effect may be wearing off after the interventions have ended. We discuss the implications of these results for efforts to work systematically with the organizational implementation of IT systems.

1. Introduction

Information technology (IT) is being introduced at considerable cost in many private and public organizations, yet systematic efforts to ensure the adoption and use of these IT systems are rare [29, 30, 38]. It is, for example, not uncommon that IT projects end when technical implementation and user training have been completed [30],

that system deployment is followed by long-lasting assimilation gaps during which systems remain unused or underused [16, 29], that users overtly or covertly develop workarounds to bypass parts of systems [5, 18], that use practices congeal quickly and users thereafter spend little time exploring systems further [22, 40], and that many systems fail to deliver the improvements that motivated their development and introduction [24]. IT projects in healthcare, the domain we focus on in this study, are no exception to this state of affairs [e.g., 3, 4, 10, 23, 36, 39].

This study investigates the effect of a set of interventions aiming to enhance the adoption of selected work procedures associated with an electronic medication record (EMR). During 2003 to early 2006 the EMR was deployed at all in-patient wards (except acute medical receiving wards) at the hospitals in Region Zealand, one of five healthcare regions in Denmark. The purpose of the EMR is to help ensure that the right medication is given to the right patients at the right time. Physicians use the EMR for ordering medication, and nurses for dispensing and administering medication. Patients' diagnoses, lab tests, treatments, and other non-medication information are not documented in the EMR but in other electronic and paper records. Specifically, the nurses document their observations and care of patients in the nursing kardex, which is presently a paper record. In total, approximately 10000 physicians and nurses use the EMR, and several work procedures involving the EMR are mandated in the region's standard operating procedures for medication. However, a region-wide survey [19] of the use of the EMR showed that by mid 2007 four of eight main EMR facilities were used consistently by only 3-37% of the region's hospital wards, and four of eight mandated work procedures involving the EMR were followed consistently by only 13-28% of wards. No EMR facility or work procedure was consistently adopted by more than 67%, respectively 48%, of wards.

According to the survey respondents, the barriers to consistent adoption of the EMR include a disintegration of information because information about medication is now in the EMR while information about, for example, diagnoses and symptoms is in other records. Moreover, information about medication is at times disintegrated because nurses sometimes record the dispensing and administration of medication in the nursing kardex, rather than in the EMR. This is contrary to mandated procedures, which prescribe that all medication is recorded in the EMR, but may, for example, occur when the physician ordering a medication has not yet recorded the order in the EMR, making it impossible for the nurses to record in the EMR that the medication has been dispensed and administered. If such barriers remain unaddressed they decrease the accuracy and completeness with which medication is recorded in the EMR. This may, in turn, have negative effects on clinicians' assessment and treatment of patients and on patients' health. We, therefore, considered the organizational implementation of the EMR and, in particular, the issue of having all medication recorded in the EMR a good case for working with interventions aiming to improve the work practices associated with an IT system.

This study targets the nurses' recording of the dispensing and administration of some medication in the nursing kardex rather than in the EMR. We do this by identifying and addressing the main reasons for this current practice. Reasons were identified through workshops with clinicians at a medical ward. At these workshops we also planned interventions to alleviate the reasons and, in general, promote the use of

the EMR for the recording of all medication. The interventions were carried out over a period of two months, and their effect was assessed by means of medical record audits supplemented with observation. In this study we describe the interventions at the medical ward, report their results, and discuss our experiences from working systematically with the organizational implementation of the EMR.

2. Related work

Below, we first look at studies of clinicians' adoption of healthcare systems, including barriers to adoption, then at researchers' proposals for models of organizational implementation, and finally at previous studies of the effect on organizational implementation of different kinds of intervention.

2.1 Adoption of Healthcare Systems

Gallivan [17] describes organizations' adoption of IT systems as a two-stage process in which a formal, managerial decision to deploy a system is followed by actual adoption by users. This accurately describes many healthcare systems, the adoption of which is often mandated in procedures instituted along with the deployment of the systems. However, the two-stage process creates opportunities for temporary or lasting lags between the formal decision and actual adoption, either because only some of the intended users adopt the system, because only parts of the system are adopted, or because adopted parts are used less or differently than intended [16]. Candidate reasons for such lags include that the formal decision to deploy a system and the decisions about actual adoption are typically made by different people, who may disagree, and that different considerations may be salient to the formal decision and to actual adoption.

Electronic healthcare records are gradually replacing paper records, but the transition is complex, stretched over a period of decades, and unlikely to result in completely paperless hospitals [11, 21]. Moreover, clinicians use healthcare systems for far fewer tasks than the systems support [23]. Lium et al. [27] find increased use of electronic records at a near paperless hospital compared to three years ago when the hospital had just started to phase out paper records. However, the reception of the electronic records among the physicians, nurses, and medical secretaries is mixed. For example, 23% of the physicians report that it is more difficult to review a patient's problems using electronic records than it was using paper records [27]. Conversely, Cunningham et al. [15] find that medication orders placed using electronic records are significantly more compliant with procedures than paper-based orders. This appears important as about 19% of all medication administered in hospitals contain some level of error in the process from ordering to administration [6]. Aarts et al. [2] emphasize the importance of organizational implementation to the successful introduction of healthcare systems. Differences in organizational implementation may result in the same system yielding different outcomes, even at two hospitals in a geographically confined area [1].

Studies of barriers that hamper or prevent the adoption of healthcare systems identify barriers relating to knowledge, approval, design, and implementation [39]. In addition, lack of time and resources are identified as important barriers in many studies, including the survey of the adoption of the EMR in Region Zealand [19]. In that survey the top five of the twelve barriers mentioned by respondents are:

1. Don't know: stating that barriers exist but not knowing what they are
2. Time: the system being too slow and time consuming to use
3. Lack of knowledge, information, and training
4. Inadequate support of certain work areas
5. Poor usability and overview

The first and most frequently mentioned of these barriers indicates considerable uncertainty about what constitutes the barriers to adoption of the EMR, and thereby suggests that it might be difficult to launch directed efforts to address the barriers. Apart from the first barrier, the barriers to adoption of the EMR resemble those identified in other studies [e.g., 12, 14, 35]. For example, Cabana et al. [12] identify seven kinds of barrier to guideline adherence among physicians: lack of awareness, lack of familiarity, lack of agreement, lack of outcome expectancy, lack of self-efficacy, lack of motivation, and external factors such as lack of time and resources. This suggests that there is no small set of issues sufficient to ensure the success of healthcare systems; rather, success depends on a host of interdependent issues [11].

2.2 Models of Organizational Implementation

Various socio-technical approaches [e.g., 8, 9, 26, 42] to the development of IT systems have long recognized the central importance of organizational implementation. Yet, it appears that IT projects tend to focus on technical implementation and to approach organizational implementation less systematically, if at all. For example, Markus [30] argues that there is typically little overlap between IT projects, which tend to end when technical implementation has been completed, and organizational-change programs, which tend to pay scant attention to IT. This state of affairs has obvious shortcomings in relation to IT systems, such as EMRs, that must be accompanied by the development and adoption of new work practices to be effective. Markus [30] terms such initiatives technochange and proposes a model for technochange management involving four phases: chartering, solution development, shakedown, and benefit capture. The two last phases concern organizational implementation. While shakedown is where an organization starts working in a new way and troubleshoots problems with the new technology and processes, benefit capture is the phase during which the organization systematically derives benefits from the new way of working. IT is not a magic bullet that automatically changes organizations and produces benefits [31]. Without a systematic approach to organizational implementation, organizations are likely to experience the problems associated with shakedown but unlikely to capture the benefits of the technology.

The window of opportunity for adapting to a system and reaching benefit capture may be brief. According to Tyre and Orlikowski [40] and Huysman et al. [22] adap-

tation is more likely to occur immediately after deployment than any time later. The reasons for this include the pressure of production, which discourages people from spending time and resources on adaptation, and the constraining effects of habitual patterns of use. Rather than a lengthy process of gradually adapting to a new system, habitual patterns of use tend to congeal quickly and without much exploration of alternative patterns of use. This suggests that for adaptation to continue – or resume – some time after deployment a disruptive event is generally necessary. The limited adoption of the EMR in Region Zealand appears to support this contention and emphasize the need for knowledge about which kinds of intervention are effective at producing disruptive events.

While Tyre and Orlikowski [40] argue that work practices congeal shortly after a system has been taken into use, Orlikowski and Hofman [34] argue that change to a considerable extent happens over time and is unanticipated. In addition to anticipated change, which is planned ahead and occurs as intended, Orlikowski and Hofman's [34] improvisational model for change management comprises two kinds of change: emergent change and opportunity-based change. Emergent change is local and spontaneous; because it is neither anticipated nor intended, it does not involve deliberate action but grows out of practice. Opportunity-based change is purposefully introduced in response to unexpected opportunities, events, or breakdowns that might arise after the introduction of a system. While emergent change appears to be contrary to the notion of a brief window of opportunity, opportunity-based change reiterates the need for knowledge about how to capitalize on opportunities arising after the initial window of opportunity.

With inspiration from the improvisational model for change management [34], Simonsen and Hertzum [38] propose a process model for a sustained participatory-design approach. The model is iterative, and the starting point of each iteration is the anticipated changes. These changes are specified in terms of the effects that are the intended result of using the system. The system (or a part/prototype of it) is then implemented and tried out for a period of time under conditions as close to a real use as possible. Such periods of real use allow for evaluation of whether planned changes occur as intended, and they allow for emergent changes to surface. Finally, each iteration informs the next iteration by indicating whether further work is required to achieve the effects associated with the anticipated changes and by revealing emergent changes, some of which may be selected and turned into opportunity-based and new anticipated changes. By subjecting the system to real use and iteratively evaluating whether specified effects are achieved, the process model integrates technical and organizational implementation.

2.3 The Effectiveness of Interventions

Working with organizational implementation involves interventions to change the work practices of the intended users of systems. Knowledge of which kinds of intervention are effective is therefore important to models like the sustained participatory-design approach [38]. In a review of interventions used in the healthcare domain, Grimshaw et al. [20] find that: (a) Passive approaches, such as distribution of educational material and clinical practice guidelines, are generally ineffective and unlikely

to cause behaviour changes. (b) Providing information in a one-on-one manner by visiting clinicians during work and providing ongoing feedback on clinicians' performance are effective interventions in many situations, including medication ordering. (c) Manual and computerized reminders are also effective in many situations but evidence is mixed for medication ordering. (d) The use of multiple interventions is more likely to be effective than single interventions. Other studies generally support these findings [e.g., 25, 41]. While active approaches and multiple interventions are probably more effective, they are also likely to be more costly. It can also be noted that the interventions covered in these studies are almost exclusively educational. While this appears to fit a two-stage adoption process where adoption is mandated but actual use depends on the staff's individual decisions to change their ways of working, it leaves out for example incentive-based interventions.

3. Method

To investigate how interventions and assessment of their effect can be used in working systematically with organizational implementation we conducted an action-research study at a medical ward. The study was approved by the management of the medical department and by the management board of the region's quality and development department.

3.1 The Medical Ward

The medical ward specializes in the treatment of contagious diseases and is one of six specialties at the hospital's medical department. The medical ward also includes the preadmission assessment of all patients who are not admitted directly to one of the five other wards at the medical department. As a consequence, the majority of the patients at the ward are admitted for only one or two days after which they are transferred to another ward or discharged. Approximately 1950 patients are treated at the medical ward each year. To accommodate this number of patients the ward comprises an infection-medicine unit with 10 beds and a preadmission-assessment unit with 12 beds. The ward is staffed with 1 associate chief physician, 19 nurses, and 9 healthcare assistants. To cater for the diversity in patients' diseases, 2-5 physicians from other medical specialties are involved in the treatment of the patients on an ad hoc basis. The staff works in three shifts to be able to admit and treat patients 24 hours a day.

The medication process is central to the work at the medical ward and comprises three main activities: ordering, dispensing, and administration. The ordering of medication is the physicians' responsibility, and they are also responsible for recording the orders in the EMR. Medication orders may be created, adjusted, and cancelled at all times. The dispensing and administration of medication is the nurses' responsibility. Medication is dispensed and administered four times a day, creating a division of the medication process into four daily timeslots. At the beginning of each timeslot, the nurses consult the EMR to get the list of medication orders for a patient. Each medication on the list is dispensed and signed for individually in the EMR. When the

medication has subsequently been administered to the patient, the nurse records the administration of each individual medication in the EMR. Thus, the communication between physicians and nurses about the patients' medication is fully supported by the EMR, but this communication is supplemented with recurrent oral communication. For example, the physicians in most cases inform the nurse responsible for a patient when they make adjustments to the patient's medication, especially if the adjustments are made close to the beginning of a timeslot.

The physicians and nurses at the medical ward have been using the EMR for four years. Thus, work practices have had time to stabilize. All new staff receives a half-day course in the use of the EMR and associated work procedures.

3.2 Interventions

The interventions were devised in collaboration with a nurse, a physician, a quality manager from the medical ward, and two project managers from the Quality and Development Department of Region Zealand. During a full-day workshop, these five healthcare specialists and the first author identified main areas for improving the medication process. For each of these areas they identified possible interventions, methods for assessing the effect of the interventions, barriers to their success, and the targeted group of clinicians. This process was facilitated by a wall-size chart on which workshop participants initially attached post-it notes with their individual thoughts about areas for improvement, interventions and so forth and then collaboratively discussed, refined, and rearranged notes. On the basis of the completed chart, the participants selected one area of improvement as the focus of the study, namely that all information about medication is recorded in the EMR. This area was considered important for several reasons. First, having all information about medication in one place provides for a better overview of patients' medication. Second, the regional medication procedures prescribe that all medication is recorded in the EMR. This has been a main aim of introducing the EMR, but it has neither been consistently attained at the medical ward, nor in the rest of the region. Third, recording information about medication in more than one place introduces a risk of discrepancies between the recordings with maltreatment of patients as a possible result. The occurrence of discrepancies between multiple recordings of medication is well documented [33, 37], but positive effects of redundant recordings have also been reported [13].

In devising interventions to change the clinicians' work practices, the workshop participants had to consider that neither the longstanding presence of the EMR, nor the training in its intended use had led clinicians to record all information about medication in the EMR. Thus, novel initiatives were required. The workshop participants also had to consider the practicability of the interventions and therefore decided to focus on the nurses rather than the physicians. This decision was based on a belief that the nurses would benefit more from having all information about medication in one place and would therefore be more motivated to change their ways of working. The resulting intervention process followed the sustained participatory-design approach of Simonsen and Hertzum [38] and involved four interventions:

Delegated medication orders. All permanently employed, registered nurses at the ward were allowed to order selected medication such as light painkillers. A list of the selected medication was prepared by a nurse, assigned recommended doses by the chief physician, approved by the pharmacists, and implemented in the EMR. Thus, even when the physicians had not ordered delegated medication or only ordered it by orally informing the nurses, the nurses could record its dispensing and administration in the EMR by first recording the medication order. Previously, the nurses had recorded such medication in the nursing kardex because it was impossible for them to record it in the EMR; only the physicians were allowed to record medication orders in the EMR.

Information and training. Two information sessions were carried out during the nurses' morning break to inform them about the delegated medication orders. During these sessions a physician and a nurse explained the motivation for introducing delegated medication orders and showed how to perform them in the EMR. To ensure that all nurses learned to use the delegated medication orders, the nurse who also participated in the workshop where the interventions were devised trained her colleagues during her shifts. After three weeks all nurses at the ward had received training in the use of delegated medication orders. While it is a rather simple procedure, the labelling of its six steps in the EMR is somewhat unintuitive.

How-to pocket guide. All nurses at the ward received a one-page pocket guide containing two screen dumps annotated with instructions about how to perform delegated medication orders. Also, a copy of the pocket guide was posted next to the computer in the room where nurses dispense medication. The aim of the pocket guide was to alleviate difficulties and reluctance caused by the unintuitiveness of the six-step process involved in making delegated medication orders.

A box of candy. A box of candy containing small bags with wine gums was placed in the staff room. The lid of the box and each individual bag of wine gums carried a label saying: *"The medication out of the nursing kardex and into the EMR"*. After a couple of days the box of candy was refilled. While the two previous interventions were educational, the box of candy was purely motivational.

3.3 Medical Record Audits

To determine the effect of the interventions six medical record audits were performed. The first and second audits were performed prior to the interventions to establish a baseline; the third and fourth audits were performed during the period where the interventions took place; and the fifth and sixth audits were performed after the interventions had ended. While the five first audits were performed at one-month intervals, the last audit was performed three months after the fifth audit to assess the long-term effect of the interventions.

An audit spanned a period of seven consecutive days. For each of the seven days we randomly selected four patients among the patients admitted to the ward during that day and audited their record for the first 24 hours of their admission. We chose the first day of patients' admission because critical decisions about patients' medication are made during this period and because the majority of patients are admitted to the ward for little more than a day. With an average of about 5.3 patients admitted to

the ward every day, the 28 patients included in each audit comprise about 75% of the patients admitted during the audit period.

The audits were performed by an experienced nurse with clerical assistance from the first author and consisted of reading through all nursing-kardex entries in the selected records to identify any instances of medication that was recorded in the nursing kardex. Each such instance was compared to the recordings in the EMR, and if any discrepancy existed it was considered a violation of the requirement to record all medication information in the EMR. Each violation was documented by recording:

The kind of medication (delegated or undelegated). We distinguished between two kinds of medication because delegated medication was the specific target of the interventions. Delegated medication can (after it has been implemented in the EMR) be documented correctly by nurses independently of other staff groups. Undelegated medication can only be documented correctly by nurses if physicians have ordered it in the EMR.

The shift during which the violation occurred (day, evening, or night). We recorded the shift because we expected that between-shift differences in tasks, workload, and staffing might have an impact on when violations occur.

The documentation of the audits contained no information about the identity of patients or clinicians. Across the six audits a total of 168 records were audited.

3.4 Observation

Before the intervention period, the first author explored the medication process at the medical ward by means of observation. A nurse and a physician were "shadowed" for two days each. The shadowing consisted of following the nurse or physician throughout a shift, observing their activities and, when possible, asking questions to clarify what they were doing, why it was done, and how it related to other activities. These observations served to familiarize the authors with the medical ward and the medication process. During the intervention period, the nurse was shadowed one more day, and about ten hours of additional observation were made by "hanging out" at the ward to get an impression of how the interventions were received by the staff. These observations complemented the audits and provided input about why delegated medication orders were or were not adopted. The periods of observation were documented in written notes.

After then intervention period, the nurse who had conducted the medical record audits was interviewed about her assessment and experience of the effect of the interventions. This interview lasted an hour and was audio recorded and transcribed.

4. The intervention process

Below, we analyze the data from the medical record audits and present findings from the observations of the intervention process.

4.1 The Results of the Interventions

The medical record audits identified 45 (27%) records that contained violations of the requirement that all information about medication is recorded in the EMR. Some records contained multiple violations; the total number of violations was 58. The numbers reported in the following analysis are exclusively the numbers of records containing violations for each kind of medication (i.e., a record is counted only once, even if it contains multiple violations for the same kind of medication) because these numbers can be directly related to the 28 records in an audit, or the total of 168 audited records.

We initially performed a multivariate analysis of variance of the data from the medical record audits with kind of medication and shift as within-groups measures and audit as a between-groups measure. This analysis showed a significant effect of audit, $F(5, 163) = 3.38$, $p < .01$, indicating that the interventions affected the number of violations. With the study-wide error thus protected, we proceeded with analyses of the individual kinds of medication.

Figure 1 shows the number of records violating the requirement that all information about delegated and undelegated medication is recorded in the EMR. A total of 22 violations occurred for delegated medication (13% of the 168 audited records), and 29 (17%) for undelegated medication. These numbers include six records that contained violations for both kinds of medication.

For delegated medication, the number of violations varied significantly across audits, $F(5, 163) = 2.87$, $p < .05$. Using reverse Helmert contrasts, we found that the numbers of violations identified at the May and June audits were lower than the average number of violations at earlier audits (both ps $< .05$). This indicates a positive effect of the interventions. At the September audit the number of violations was, however, not different from the average number of violations at the five earlier audits ($p = .6$), suggesting that the positive effect of the interventions may not be lasting. Dividing the violations into those occurring during the first three audits and during the last three audits, we get an indication of whether the interventions differentially affected the number of violations occurring at different shifts, see the right-hand side of Figure 1. While it appears that the interventions have mostly reduced the number of violations occurring during night shifts, the interaction between shift and audit was not significant, $F(10, 158) = 1.08$, $p = .4$.

For undelegated medication, the number of violations did not vary significantly across audits, $F(5, 163) = 2.05$, $p = .07$. Reverse Helmert contrasts revealed that fewer violations were identified at the May audit, compared to the average number of violations at earlier audits ($p < .05$). For all other audits there was no difference between the number of violation identified at that audit and the average number of violations at earlier audits (all ps $> .05$). This indicates that for the medication not targeted by the interventions, the number of violations remained stable across the six audits. As for delegated medication there was no interaction between shift and audit, $F(10, 158) = 1.67$, $p = .09$. Thus, the absence of an overall difference across audits in the number of violations for undelegated medication was not masking a difference across shifts.

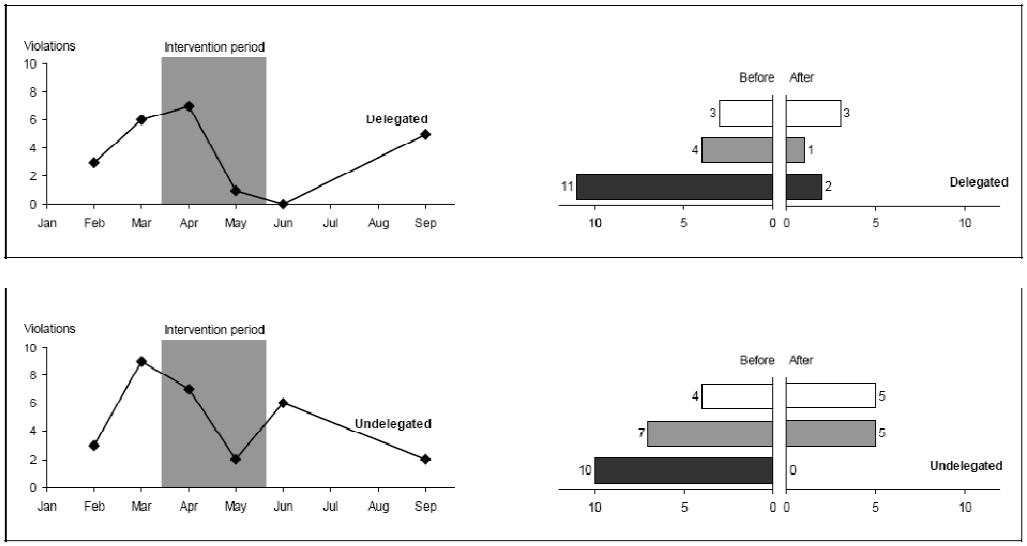

Figure 1. The number of audited records containing violations of the requirement that all information about delegated medication (top panel) and undelegated medication (bottom panel) is recorded in the EMR, N = 168 records. The curves on the left show the distribution of violations across the six audits. The bar graphs on the right show the same data distributed onto day shifts (upper, white bar), evening shifts (middle, grey bar), and night shifts (bottom, black bar); 'Before' is the sum of the three first audits, 'After' of the three last audits.

The absence of differences for undelegated medication provides some evidence that the medication process at the ward was not affected by other factors in parallel with the interventions. This strengthens the link between the interventions and the differences in the number of violations for delegated medication.

4.2 Adoption of Delegated Medication Orders

The intervention period started when the nurses were enabled to make delegated medication orders. On the first day of the intervention period, in mid March, the first information session was also performed; information and training activities continued in the following weeks. Thus, the intervention period began with the first two interventions. The nurses at the ward were very positive about the possibility of making delegated medication orders. One nurse said: *"This is exactly what we need"*. Observations at the ward confirmed the nurses' positive attitude and awareness of the interventions. Nurses also started sharing insights about how to use delegated medication orders among each other. No observations suggested that nurses were reluctant to adopt delegated medication orders because they, for example, perceived the ordering of medication as the physicians' job.

At the medical record audit in April it was, therefore, surprising to learn that the number of violations concerning delegated medication had not decreased (see Figure 1). A possible explanation is that delegated medication orders was just one of several initiatives being implemented at the ward. Other simultaneous initiatives included nutrition screening and registration of contact persons. While these initiatives were not targeting the medication process, they were competing for the nurses' attention.

It appeared as though some nurses forgot about the possibility of using delegated medication orders and simply continued documenting in the nursing kardex as they were used to do. The simultaneous presence of multiple initiatives competing for the clinicians' attention is, however, not exceptional, and the organizational implementation of one change in clinicians' work practices must be able to go on in parallel with other initiatives. Another possible explanation picked up during the observations was that some of the nurses had trouble remembering how to use the EMR functionality that supported delegated medication orders. This functionality was located in a part of the EMR not normally used by nurses, and the labelling of the steps involved in making delegated medication orders was not intuitive. For example, in choosing a delegated medication the nurse is presented with two options, labelled "Use" and "Approve". The nurse must select "Approve" to continue with a delegated medication order; selecting "Use" implies that a physician must approve the order before proceeding.

As the medical record audit in April showed that the desired effect was not being achieved after the first two interventions, additional interventions were necessary. It was unfortunately not possible to implement quick revisions of the interface of the EMR. Based on the observations of nurses forgetting about delegated medication and of their difficulties making delegated medication orders, we instead devised the third and fourth interventions: the how-to pocket guide and the box of candy. The box of candy was particularly well received. The nurses appeared to appreciate not just the wine gums but also the humorous twist and distinctly different nature of this intervention compared to the other interventions. In spite of a refill the box of candy was quickly emptied and during an observation session a week after it was initially introduced a nurse asked: *"When are we going to have candy again?"*

With respect to delegated medication, the medical record audits in May and June showed one and zero violations, respectively. The single violation at the May audit consisted of a delegated medication recorded in the nursing kardex rather than in the EMR. The recording in the nursing kardex was, however, annotated with a note saying: *"I have tried ordering in the EMR but without luck"*. Upon investigating this violation, it turned out that the nurse in question knew how to make delegated medication orders, but that she was, incorrectly, listed in the EMR as a nursing student, though she had for years been employed at the ward as a registered nurse. Consequently, she could not make delegated medication orders, because the possibility of making such orders was restricted to permanently employed, registered nurses.

Apart from this violation, all delegated medication was recorded in the EMR. This made sense to the nurses and made their work easier, as explained by one nurse: *"Now I can stay in the medication room and look in the EMR. I do not have to go back to the office, find the patient's paper record, and look in the kardex"*. This implies that the nurses benefited from their change of work practice. Consequently, the better overview of medication orders was not restricted to the physicians, who do not consult the nursing kardex.

In the period between the medical record audits in June and September neither interventions nor observations were performed at the ward. When the participating nurse was interviewed after the September audit and was presented with the results of the audits she remarked: *"We just did it so well, but now…"* She could not think

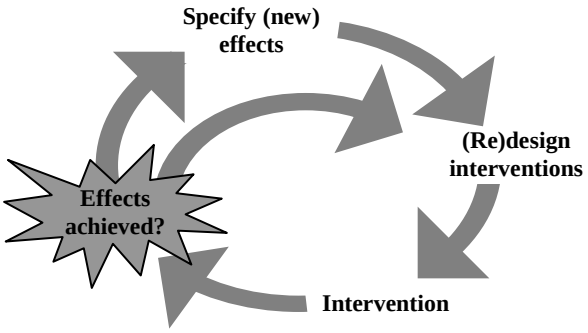

Figure 2. An iterative process for working systematically with organizational implementation.

of any obvious reason for the somewhat disappointing results of the September audit for delegated medication. The week covered by the audit had not been unusually busy, and no new nurses had been employed after the intervention period had ended; thus, all nurses at the ward had been exposed to the interventions. A possible, though more indirect, reason suggested by the interviewed nurse was that the charge nurse had not committed to the use of delegated medication orders. The charge nurse was not against the use of delegated medication orders, but she neither supported the interventions, which promoted the use of delegated medication orders. This absence of managerial support subtly affected the nurses' attitude toward the entire initiative, as stated by the participating nurse at the end of the project: *"I do not think they [i.e., the nurses] felt it was 'a ward project'; it was more of an EMR project"*. Thus, the nurses may not have assumed full ownership of the project but rather felt that it was to some extent imposed on them by those responsible for the organizational implementation of the EMR.

5. Discussion

The main focus of this study is our iterative, intervention-based approach to organizational implementation, not the nature of the concrete interventions. Below we discuss our approach to organizational implementation and the implications of our empirical findings.

5.1 Iterative Organizational Implementation

The organizational implementation of systems such as the EMR is not accomplished by specifying and mandating procedures for their use. Neither, is it sufficient to provide information and training, as illustrated by the ineffectiveness of the two first interventions in our study. Many organizational-implementation efforts are, however, considered complete when work procedures have been specified and training provided, especially when the procedures are well received by users – such as in our case.

We approach organizational implementation as an iterative process inspired by participatory design [38] and, more generally, action research [7]. In each iteration, interventions are performed to achieve effects that are specified and assessed as part of the process, see Figure 2. In this study the desired effect, the first interventions for achieving it, and the audits assessing whether it was in fact achieved were specified during the workshop that preceded the interventions. The early audits revealed that the two first interventions did not produce the desired effect in that a considerable number of orders of delegated medication were still recorded in the nursing kardex rather than in the EMR. This was surprising given the nurses' positive reception of the introduction of delegated medication orders and shows the value of assessing whether desired effects are achieved.

As the first interventions failed to produce the desired effect, another iteration was necessary. This was a first-order iteration in the sense that additional interventions were performed to achieve an unchanged effect. The additional interventions had the desired effect, at least temporarily, as evidenced by the May and June audits. In complex settings where technology and work practices are highly interrelated, an iteration may also lead to reflection on whether the pursued effect should be abandoned, amended, or complemented with additional effects. Also, opportunities may emerge and suggest new effects [34]. This can produce second-order iterations, which aim to achieve new or changed effects.

In the healthcare region's original plan (from 2002) for the organizational implementation of the EMR, the first success criterion was that *"99.5% of all medication orders are documented by a physician"*. This was seen as a necessary and important step toward accomplishing a high-quality medication process where all information about medication was recorded in one place, namely in the EMR. Relative to that success criterion, this study constitutes a second-order iteration by replacing the aim of having physicians record all medication orders with delegated orders permitting nurses to order selected medication. The clinicians involved in devising the present study considered it more realistic to achieve this effect, and it was consistent with the overall goal of recording all information about medication in the EMR. What seems to have changed over time is the clinicians' perception of how this overall goal is best attained. This emphasizes that effects specified ahead of organizational implementation will not remain static and that a mix of first-order and second-order iterations will, therefore, be required to match changes in context and organizational goals as well as to exploit emergent opportunities. For both kinds of iteration, interventions and assessment are necessary to instil change and ascertain how work practices are affected.

Obviously, overall goals can also be questioned and modified. Mabeck [28] finds that recording of medication in both an EMR and a paper record may serve as an informal quality control. In her study, clinicians generally relied on the paper record in cases of discrepancy, because the paper record gave information about medication in the context of other patient information whereas the EMR contained medication information only. This particularly suggests that the separation of medication information from other patient information by recording all medication in an EMR may make it easier to get an overview of a patient's medication but at the expense of making it more difficult to get an overview of a patient's condition. Cabitza et al. [13]

discuss the roles of redundancy in clinical work and provide a very useful distinction between redundancy of data and redundancy of effort. While the same information is often relevant in multiple situations and in combination with a variety of other pieces of information, redundancy of effort often consumes scarce resources and consists of mere copying of information. One of the conclusions of Cabitza et al. [13] is that electronic records, in contrast to paper records, make it possible to obtain redundancy of data without redundancy of effort. This suggests that recording all medication in the EMR may decrease redundancy of effort and risk of discrepancy and improve possibilities of useful data redundancy. These possibilities will, however, only become available as the EMR is gradually extended, so for a considerable period of time the recording of all medication in the EMR will involve extra effort to adapt to the system and few immediate benefits compared to paper records. In our study, the clinicians considered it an important and worthwhile goal to record all information about medication in the EMR and to avoid such information in the nursing kardex. One pragmatic reason for their point of view was that the physicians do not consult the nursing kardex. Thus, a third-order iteration, involving a change of overall goal, was not considered relevant.

While this study shows that the work procedures associated with an EMR are receptive to organizational and motivational interventions, we are not arguing that work with the organizational implementation of such systems should exclude technical changes of the system. Rather, it is a limitation of this study that it was restricted to organizational and motivational interventions. We would, for example, have preferred to combine the how-to pocket guide with a redesign of the interface of the EMR to make delegated medication orders easier to complete. It is, however, quite common that technical changes cannot be made during organizational implementation, at least not until the scheduled release of the next version. Often, this forces a choice between short iterations that are restricted to organizational and motivational interventions and long iterations that may include technical changes of the system but risk losing momentum. An integrated approach to technical and organizational implementation, as proposed by for example Markus [30], may be required to avoid that organizational implementation is unduly reduced to the adoption of a system that is no longer considered malleable.

5.2 Implications

This study has four implications for systematic work with organizational implementation of IT systems. First, it is encouraging that an iterative process consisting of interventions and assessments of progress can affect clinicians' ways of working. Some previous work have found that work practices tend to congeal soon after a new system has been introduced and that a disruptive event is necessary to resume adaptation [40]. Collectively, the introduction of delegated medication orders, the training in their use, the how-to pocket guide, and the box of candy appear to be an example of such an event. It is critical to the success of interventions that the involved clinicians are positive toward the change promoted by the interventions. This suggests that the effects pursued in the interventions must be specified in collaboration with the involved clinicians, but at the same time a survey of the adoption of the EMR

finds that the most frequently mentioned barrier to adoption of the EMR is uncertainty about what constitute the barriers to adoption of the EMR [19]. Thus, it may be difficult for local managers to identify effective effects and interventions, and the work with organizational implementation may benefit from an external facilitator, who could be part of the EMR project team or of a more permanent organizational-implementation group.

Second, to work systematically with organizational implementation it is important to assess whether the specified effects are achieved. Clinicians are busy with their day-to-day responsibilities, and multiple extra activities typically compete for their remaining attention. Thus, even though the nurses welcomed delegated medication orders, initiatives such as delegated medication orders may be forgotten unless their adoption is monitored. Assessments of whether effects are achieved may reveal that additional interventions are needed to, for example, increase motivation among clinicians or align a new work practice better with other mandated procedures. The assessments are, however, also an opportunity to reflect on whether the specified effects match overall goals and to exploit possibilities that have emerged during the interventions [34, 38].

Third, models of organizational implementation must address the risk that the effect of interventions wears off after the interventions have ended. One interpretation of the results of the September audit in our study is that they suggest the presence of a Hawthorne effect [32]. If so, the nurses were mainly affected by the attention that was devoted to their work during the interventions, whereas the content of the interventions was secondary; consequently, the reason for the nurses' changed behaviour disappeared when the intervention period ended. More research is needed to clarify not just the immediate but also the long-term effect of different kinds of intervention. Without such knowledge, periodic reassessment of previously achieved effects may be a necessary element of organizational implementation. From a practical point of view, this points toward a tension between a wish for brief organizational-implementation projects with clear completion criteria and a need for ongoing organizational-implementation processes to sustain long-term achievement of effects.

Fourth, it may be tempting to abstain from educational, motivational, and other organizational interventions in cases where technical changes of the system appear to be a better solution. Technical changes of systems are, however, outside the scope of much work with organizational implementation, at least in the short term. We do not consider unavailability of the best solution a legitimate excuse for not working with organizational interventions, which appear to have some effect [20]. In the healthcare domain, clinicians are morally obliged to improve their practices for the benefit of patients' health and safety by either intervening in system design, implementing new ways of working, or both. We believe that a combination of technical changes and organizational interventions will yield the best results. Future work should explore a tighter integration between technical and organizational implementation.

6. Conclusion

Deployment of information technology involves implementation of new ways of working to attain planned as well as emergent benefits. It is well known that new work practices do not follow automatically from the introduction of new systems or training in the new ways of working; instead, a systematic approach to organizational implementation is necessary. We have investigated an iterative, intervention-based approach to the organizational implementation of an EMR at a medical ward. The interventions focused on the nurses, who were permitted to make delegated orders of selected medication. While medical record audits indicated that the interventions led to a decrease in the instances of medication not recorded in the EMR, the audits also suggested that this positive effect might not be lasting. The three primary conclusions from this study are that interventions directed at achieving specified effects must be combined with assessment of whether these effects are in fact achieved; that although specification, assessment, and possibly revision of effects are important activities, they are rather straightforward compared to performing effective interventions; and that a sustained organizational-implementation process may be necessary to work systematically with the implementation of new ways of working.

Acknowledgements

The first author's Ph.D. scholarship is co-funded by Region Zealand. Special thanks are due to nurse Stine Friis Rasmussen, who conducted the medical record audits and took part in planning and conducting the interventions, and to physician Mikkel Dorff Christiansen and quality team member Susanne Due, who took part in planning and conducting the study. For support in planning the interventions and managing the study, we owe thanks to Jette Gudmundsen and Pia Pawlowski from Region Zealand. We also wish to thank the staff at the medical ward for their participation in the study.

References

[1] Aarts, J., and Berg, M. 2006. Same systems, different outcomes: Comparing the implementation of computerized physician order entry in two Dutch hospitals. Methods of Information in Medicine, 45, 1, 53-61.

[2] Aarts, J., Doorewaard, H., and Berg, M. 2004. Understanding implementation: The case of a computerized physician order entry system in a large Dutch university medical center. Journal of the American Medical Association, 11, 3, 207-216.

[3] Alapetite, A., Andersen, H.B., and Hertzum, M. 2009. Acceptance of speech recognition by physicians: A survey of expectations, experiences, and social influence. International Journal of Human-Computer Studies, 67, 1, 36-49.

[4] Ash, J.S., Gorman, P.N., Lavelle, M., Stavri, P.Z., Lyman, J., Fournier, L., and Carpenter, J. 2003. Perceptions of physician order entry: Results of a cross-site qualitative study. Methods of Information in Medicine, 42, 4, 313-323.

[5] Azad, B., and King, N. 2008. Enacting computer workaround practices within a medication dispensing system. European Journal of Information Systems, 17, 3, 264-278.

[6] Barker, K.N., Flynn, E.A., Pepper, G.A., Bates, D.W., and Mikeal, R.L. 2002. Medication errors observed in 36 health care facilities. Archives of Internal Medicine, 162, 16, 1897-1903.

[7] Baskerville, R., and Pries-Heje, J. 1999. Grounded action research: A method for understanding IT in practice. Accounting, Management and Information Technologies, 9, 1, 1-23.

[8] Berg, M. 1999. Patient care information systems and health care work: A sociotechnical approach. International Journal of Medical Informatics, 55, 2, 87-101.

[9] Bødker, K., Kensing, F., and Simonsen, J. 2004. Participatory IT design: Designing for business and workplace realities. MIT Press, Cambridge, MA.

[10] Bossen, C. 2007. Test the artefact - develop the organization. The implementation of an electronic medication plan. International Journal of Medical Informatics, 76, 1, 13-21.

[11] Brender, J., Ammenwerth, E., Nykänen, P., and Talmon, J. 2006. Factors influencing success and failure of health informatics systems. Methods of Information in Medicine, 45, 1, 125-136.

[12] Cabana, M.D., Rand, C.S., Powe, N.R., Wu, A.W., Wilson, M.H., Abboud, P.-A.C., and Rubin, H.R. 1999. Why don't physicians follow clinical practice guidelines? Journal of the American Medical Association, 282, 15, 1458-1465.

[13] Cabitza, F., Sarini, M., Simone, C., and Telaro, M. 2005. When once is not enough: The role of redundancy in a hospital ward setting. In K. Schmidt, M. Pendergast, M. Ackerman and G. Mark (Eds.), Proceedings of the GROUP '05 Conference on Supporting Group Work. ACM Press, New York, 158-167.

[14] Colón-Emeric, C.S., Lekan, D., Utley-Smith, Q., Ammarell, N., Bailey, D., Corazzini, K., Piven, M.L., and Anderson, R.A. 2007. Barriers to and facilitators of clinical practice guideline use in nursing homes. Journal of the American Geriatrics Society, 55, 9, 1404-1409.

[15] Cunningham, T.R., Geller, E.S., and Clarke, S.W. 2008. Impact of electronic prescribing in a hospital setting: A process-focused evaluation. International Journal of Medical Informatics, 77, 8, 546-554.

[16] Fichman, R.G., and Kemerer, C.F. 1999. The illusory diffusion of innovation: An examination of assimilation gaps. Information Systems Research, 10, 3, 255-275.

[17] Gallivan, M.J. 2001. Organizational adoption and assimilation of complex technological innovations: Development and application of a new framework. The Data Base for Advances in Information Systems, 32, 3, 51-85.

[18] Gasser, L. 1986. The integration of computing and routine work. ACM Transactions on Office Information Systems, 4, 3, 205-225.

[19] Granlien, M.F., Hertzum, M., and Gudmundsen, J. 2008. The gap between actual and mandated use of an electronic medication record three years after deployment. In S.K. Andersen, G.O. Klein, S. Schulz, J. Arts, and M.C. Mazzoleni (Eds.), MIE2008: Proceedings of the XXIst International Congress of the European Federation for Medical Informatics. IOS Press, Amsterdam, 419-424.

[20] Grimshaw, J.M., Shirran, L., Thomas, R., Mowatt, G., Fraser, C., Bero, L., Grilli, R., Harvey, E., Oxman, A., and O'Brien, M.A. 2001. Changing provider behavior: An overview of systematic reviews of interventions. Medical Care, 39, 8, Supplement 2, 2-45.

[21] Haux, R., Ammenwerth, E., Herzog, W., and Knaup, P. 2002. Health care in the information society. A prognosis for the year 2013. International Journal of Medical Informatics, 66, 1-3, 3-21.

[22] Huysman, M., Steinfield, C., Jang, C.-Y., David, K., Veld, M.H.I.T., Poot, J., and Mulder, I. 2003. Virtual teams and the appropriation of communication technology: Exploring the concept of media stickiness. Computer Supported Cooperative Work, 12, 4, 411-436.

[23] Lærum, H., Ellingsen, G., and Faxvaag, A. 2001. Doctors' use of electronic medical records systems in hospitals: Cross sectional survey. BMJ, 323, 7325, 1344-1348.

[24] Landauer, T.K. 1995. The trouble with computers: Usefulness, usability, and productivity. MIT Press, Cambridge, MA.

[25] Landry, M.D., and Sibbald, W.J. 2002. Changing physician behavior: A review of patient safety in critical care medicine. Journal of Critical Care, 17, 2, 138-145.

[26] Leonard-Barton, D. 1988. Implementation as mutual adaptation of technology and organization. Research Policy, 17, 5, 251-267.

[27] Lium, J.-T., Lærum, H., Schulz, T., and Faxvaag, A. 2006. From the front line, report from a near paperless hospital: Mixed reception among health care professionals. Journal of the American Medical Informatics Association, 13, 6, 668-675.

[28] Mabeck, H. 2008. Implementation of an electronic medication system and disregarded power of the record. In S.K. Andersen, G.O. Klein, S. Schulz, J. Aarts, and M.C. Mazzoleni (Eds.), MIE2008: Proceedings of the XXIst International Congress of the European Federation for Medical Informatics. IOS Press, Amsterdam, 443-448.

[29] Mark, G., and Poltrock, S. 2003. Shaping technology across social worlds: Groupware adoption in a distributed organization. In Proceedings of the GROUP '03 Conference on Supporting Group Work. ACM Press, New York, 284-293.

[30] Markus, M.L. 2004. Technochange management: Using IT to drive organizational change. Journal of Information Technology, 19, 1, 4-20.

[31] Markus, M.L., and Benjamin, R.I. 1997. The magic bullet theory in IT-enabled transformation. Sloan Management Review, 38, 2, 55-68.

[32] Mayo, E. 1933. The human problems of an industrial civilization. MacMillan, New York.

[33] Mikkelsen, G., and Aasly, J. 2001. Concordance of information in parallel electronic and paper based patient records. International Journal of Medical Informatics, 63, 3, 123-131.

[34] Orlikowski, W.J., and Hofman, J.D. 1997. An improvisational model for change management: The case of groupware technologies. Sloan Management Review, 38, 2, 11-22.

[35] Paré, G., and Trudel, M.-C. 2007. Knowledge barriers to PACS adoption and implementation in hospitals. International Journal of Medical Informatics, 76, 1, 22-33.

[36] Scott, J.T., Rundall, T.G., Vogt, T.M., and Hsu, J. 2005. Kaiser Permanente's experience of implementing an electronic medical record: A qualitative study. BMJ, 331, 7528, 1313-1316.

[37] Senderovitz, T., Christophersen, A.B., Christensen, H.R., and Kampmann, J.P. 1998. Discrepancies between medical records and dispensing records in two large hospital departments in Copenhagen. Ugeskrift for Læger, 160, 27, 4055-4058.

[38] Simonsen, J., and Hertzum, M. 2008. Participative design and the challenges of large-scale systems: Extending the iterative PD approach. In J. Simonsen, T. Robertson and D. Hakken (Eds.), PDC2008: Proceedings of the Tenth Anniversary Conference on Participatory Design. ACM Press, New York, 1-10.

[39] Sobol, M.G., Alverson, M., and Lei, D. 1999. Barriers to the adoption of computerized technology in health care systems. Topics in Health Information Management, 19, 4, 1-19.

[40] Tyre, M.J., and Orlikowski, W.J. 1994. Windows of opportunity: Temporal patterns of technological adaptation in organizations. Organization Science, 5, 1, 98-118.

[41] Wensing, M., van der Weijden, T., and Grol, R. 1998. Implementing guidelines and innovations in general practice: Which interventions are effective? British Journal of General Practice, 48, 427, 991-997.

[42] Wulf, V., and Rohde, M. 1995. Towards an integrated organization and technology development. In Proceedings of the DIS '95 Symposium on Designing Interactive Systems. ACM Press, New York, 55-64.

PART FOUR: RESEARCH PAPERS

Paper I
Granlien, M. F., & Simonsen, J. (2007). “Challenges for IT-supported shared care: A qualitative analyses of two shared care initiatives for diabetes treatment in Denmark”. International Journal of Integrated Care, 7.

Paper II
Bødker, K., & Granlien, M. S. (2008). “Participation and Representation: a Discussion Based upon a Case Study in the Danish Healthcare Sector.” in Simonsen, J., Robertson, T., & Hakken, D. (red.): PDC 2008 Experiences and Challenges (s. 190-193). Indiana University: Association for Computing Machinery (ACM).

Paper III
Granlien, M. S., Pries-Heje, J., & Baskerville, R. (2009). “Project Management Strategies for Prototyping Breakdowns.” Proceedings of the Annual Hawaii International Conference on System Sciences.

Paper IV
Granlien, M., Hertzum, M. “Longstanding Barriers to Organisational implementation of an Electronic Medication Record.” Under review for International Journal of Healthcare Technology and Management.

Paper V
Granlien, M. S., & Hertzum, M. (2009). “Implementing New Ways of Working: Interventions and their Effect on the Use of an Electronic Medication Record.” in: Proceedings of the GROUP 2009 Conference on Supporting Group Work (s. 321-330). ACM Press.

Paper VI
Granlien, M.S. (2009). "Facilitating Participation in Formative Evaluation Supported by Effect Map", in Molka-Danielsen, J. (ed.) Selected Papers of the 32nd Information Systems Research Seminar in Scandinavia - Inclusive Design, Tapir Academic Press, Trondheim, pp 73-88.

Facilitating participation in formative evaluation supported by effect map

Maren Sander Granlien

Roskilde University
maren@ruc.dk

Abstract. It has been suggested that formative evaluation should be an integrated part of system implementation in order to improve the outcome of system use. In a design project an approach combining participatory design (PD) and formative evaluation has shown a great potential for improving the design of large and complex systems. Thus, the aim of the study is to experiment with how PD combined with formative evaluation may improve the implementation and use of large and complex systems within the healthcare sector. This resulted in a participatory formative evaluation approach supported by a self designed effect map. The purpose of the effect map is twofold: a) To encourage user participation in the early activities of formative evaluation b) The effects specified can be used as formative evaluation measures and guidance in the process of improving the system. The evaluation approach and the effect map is applied in an action research study in the Danish health care sector aiming at improving the medication process and the use of the electronic medication record supporting the medication process.

1. Introduction

During the last two to three decades, evaluation has received increasingly more attention. Several researchers have suggested that evaluation should not only deal with system issues but also human, social and organizational issues (Southon 1999; Kaplan and Shaw 2004; Talmon 2006). Recently, some evaluation researchers have advocated for iterative evaluation to be an integrated part of system implementation rather than only assessing outcome in terms of summative evaluations (McGowan et al. 2008) in order to fight the high rate of system failures. The integrated approach is termed formative evaluation because the evaluation forms or informs the process that is being evaluated (Farbey et al. 1999; Kaplan and Shaw 2004; Talmon 2006; McGowan et al. 2008). Furthermore, the purpose of formative evaluation is to improve the process evaluated and to help ensure that the goals of the process are achieved. Within both the field of information system (IS) and medical informatics it

is widely recognized that development and implementation of Healthcare Information Systems (HIS), is a complex learning process. Hence, an iterative approach is desirable in order to minimize the risk of failure. Formative evaluation is mentioned as an essential component or activity in implementing HIS (Klecun and Cornford 2005; Sallas et al. 2007; McGowan et al. 2008) and in managing the realization of information system benefits (Farbey et al. 1999). This is an activity that (ought to) take place and continue long after system implementation (Markus 2004; Ashurst et al. 2008). However, more information on how to conduct formative evaluation and tools to support this kind of evaluation is needed (McGowan et al. 2008) as are new approaches to evaluation (Kaplan 2001; Kaplan and Shaw 2004; Klecun and Cornford 2005) .

Building on Orlikowski and Hofman's model for improvisational change management (Orlikowski and Hofman 1996), Simonsen and Hertzum (2008) propose a sustained PD approach to design and implement large-scale IS including formative evaluation. Their approach emphasizes iterative evaluation of anticipated changes and opportunity based changes through real use of the system or the prototype. The system or a part/prototype of it must be tested under real use conditions and the iterations are essential for turning opportunity based effects into anticipated effects and ensuring appropriated changes in work practice or system design to obtain the effects. The approach, which is very similar to what Farbey et al. (1999) request from a formative evaluation, is applied during the design and prototyping phases of a large-scale IS development project with a strong focus on user involvement. The sustained PD approach does not address how to handle adaptations and opportunity based effects after implementation of the final system and during daily use – the time when benefits are expected to occur. But the PD aspects in the approach seem to have a lot to offer the process of evaluation though challenges for PD still exist, especially when it comes to PD in large and complex projects that go beyond initial design. (Pilemalm and Timpka 2008b; Simonsen and Hertzum 2008). Nevertheless, it is believed that PD has a great potential in formative evaluation, also when it comes to large and complex projects dealing with implementation and use.

In this study we experiment with applying another suggestion to a new evaluation approach, a *participatory formative evaluation approach* to support the realization of desired effects of using an electronic medication record (EMR) in the medication process. The purpose of the experiment is to answer the research question: How does one facilitate participation in the early activities of formative evaluation? During the planning and design of the formative evaluation it was found necessary to develop a tool to support the process of iteratively specifying the evaluation criteria in terms of effects. No existing tools were found to cover exactly that need. As a result I designed an *effect map*. The purpose of the effect map is twofold: a) To encourage user participation in the early activities of formative evaluation b) The effects specified can be used as formative evaluation measures and guidance in the process of improving system use and benefits realization.

In the following, the development of the effect map and its application in a formative evaluation is explored as follows. First, a participatory approach to formative evaluation is presented. This is followed by the design of the effect map. Section four contains the background for the study and a detailed description of how the formative

evaluation approach was applied. Then a discussion follows of how the participation was facilitated and supported by the effect map, and finally some concluding remarks will be made.

2. A participatory approach to formative evaluation

The purpose of formative evaluation is to support the realization of desired effects of using an electronic medication record supporting the medication process. The iterative element in formative evaluation serves a twofold purpose: a) To evaluate whether the specified effects have been obtained, and b) to evaluate whether the *right* effects have been specified. It is important to consider whether the effects are desired or whether new and opportunity based effects would be preferable. In order to

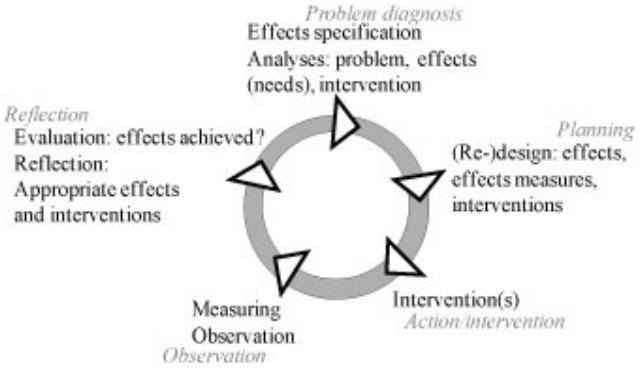

Figure 1: The iterative approach to formative evaluation illustrating the phases in the action research cycle

include opportunity based effects, the iterative element is essential. Figure 1 illustrates the formative evaluation approach which was applied in this study. The formative approach contains five phases. The effect map is designed to mainly support the activities taking place during the first two phases such as specification of effects and effect measures, eliciting problems and user's needs, designing interventions.

2.1 Specifying evaluation criteria as effects of changes in a work system

There are two central elements in a formative evaluation and evaluation in general, namely the object of evaluation and the evaluation criteria. If we rely on Alter's work system framework, the object of evaluation should be the work system more than the information system because the IS is an integral part of work systems (Alter 1999b).

A work system is "a system in which human participants and/or machines perform a business process using information, technology, and other resources to produce products and/or services for internal or external customers" (Alter 1999b: p 44). Work systems can function with or with out relying on information technology. Information systems can under certain circumstances be defined as work systems (Alter 2008). However, my interest is in work systems that rely highly on information system(s). As a result, work system means IS reliant work systems. In these cases the

IS and work system are distinguishable but profoundly connected. Looking at them separately does not make sense. Consequently, the evaluation of the IS alone is not fertile, especially because the work system is more important. The IS is only a service or support system to the work system (Alter 1999b). Thus, Alter argues that the work system should be the level of analysis and object for evaluation.

A similar view is raised by Ward et al. (1996). They argue that IS does not deliver but enables benefit opportunities, and these opportunities require changes in the business system to be realized. "Benefits may therefore be considered as the effects of the changes"(Ward et al. 1996: p 215). Thus "[…]it is the effects of theses changes which must be measured and evaluated […]"(Ward et al. 1996: p 216)

An implication of acknowledging the work system perspective, in relation to formative evaluation, is that the effects specified should thus be the desired effects *of changes in the work system relying on the information system.* Consequently the 'improvement of system use' should be understood as improvement of system use in relation to how the system supports the performance of the work system.

2.2 Participatory effects specification

The effects specified are pivotal for how the formative evaluation will support the improvement of system use and benefit realization. In many evaluations where IS constitute the object or part of the object of evaluation, the evaluation criteria are specified by the management. The specification often takes place prior to implementation as most IS evaluations are evaluating system implementation. However, in this study the object of evaluation is a work system relying on an IS that has been deployed for years. Furthermore, this evaluation approach rests on the assumption that PD has the potential to qualify the formative evaluation and improve the odds of obtaining the effects. In other words, the management is not necessarily aware of what changes are needed to achieve a certain effect.

Participatory design is typically on the agenda during design and implementation activities. However, it could be very useful for adaptation activities during system use, due to the fact that users are more experienced with system use at that point than before implementation (Braa 1995). Dittrich et al. (2002) also inquire for a broader perception of the 'design' in participatory design to also cover what they term 'design-in-use'. Here design is viewed as a continually on-going activity intricately interwoven with use, rather than primarily a development activity. The above are just a few reasons for involving the participants in the process of formative evaluation. The term 'participants' is preferred to 'users' because 'users' denotes somebody *using* a system. 'Participants' refer to people participating in a work system in which they might also use an IS. Accordingly the effects are to be specified by the participants in the work system or representatives of the participants. In this evaluation approach participants are perceived not only as able to specify desirable effects, but also as highly competent in suggesting how effects can be obtained. However, when involving participants it should be respected that they are not IS designers, organizational changers or evaluation experts but experts in their own work tasks and in being a participant in the work system. As a result they are involved on these premises. They are not being asked to suggest a redesign of the

system or the organization. Instead the aim is to facilitate their participation in the early activities of formative evaluation such as specification of effects, suggesting changes in the work system, pointing out problems and barriers.

3. The design of the effect map

In a previous study in which we experimented with having participants specify their needs in terms of effects, we found that the effects were specified on different levels, from very broad and overall effects to very specific and narrow effects. Though most of them were extremely general, it was difficult to relate them to actual changes and interventions that would be necessary in order to reach the effect. As a result, the effects turned out not to play an important role in the study. In addition, it was found difficult to facilitate the specification of the effects as there was no real structuring of the discussion and specification process. Later in the study we tried to structure the effect discussion around a scenario, in which the situation that was sought to be improved was described. Despite the effort, it was still difficult to incorporate the effects. Still, the participants were very positive about formulating their needs and wishes in terms of effects compared to functionality requirements, for instance. This was the case particularly because not all their needs were related to changes in the system functionality but some also to changes in the work system. A tool to help structure the effects specification and simultaneously provide suggestions to how the more general effects can be obtained, was therefore needed. A response to this need was found in the discipline of mapping techniques.

Mapping techniques are used to analyze structure and discuss problematic situations. Lanzara and Mathiassen (1985: p 5) describe a map as an "[…]interpretive description of a situation which provides insight into possible ways of acting on that situation or on similar situations". Mapping is a way to create an overview and a common ground for discussing possible actions in a given situation. There are different types of maps and they can be used both on an individual basis and as a group activity.

Despite the variety of maps and similar techniques, no map fitting the purpose of supporting the activities in formative evaluation was found. Thus, I found it necessary to create a new map founded on diagnostic and virtual map by Lanzara and Mathiassen (1985).

The effect map, presented in Table 1, was developed from the assumption that it is not possible to point out any causal relationship between effects, interventions, and barriers. One can only suggest or hypothesize about what might lead to the desired effects. The term hypothesis is used because in the complex of a work system and its environment we cannot point out means that will causally lead to the effect. In accordance with the concept of 'equifinality' the approach relies on the assumption that an effect can be obtained through equally effective sets of change (Drazin and de Ven 1985). From a participatory design perspective, and based on their knowledge of the work system, participants are likely to form plausible hypotheses on how to reach the desired effects,

It is important to stress that the effect map is completed for a single work system only, and its results cannot be transferred to other work systems. The columns in the map have been included in order to inform the evaluation process and the improvement of the outcome of the work system in order to obtain the effects. The order of the columns is not significant and they can be filled in any particular order. Fields can be left blank and/or filled out in later iterations. This is an important feature that facilitates participation as the participants for example can put forward an inexpediency or something they sense can be done better and place it as a barrier in the effect map despite they do not know what effect it might hinder, if any at all. But by filling out the row around the barrier new and opportunity based effects may arise.

In order to show a more complete hierarchy or tree structure of the effects additional effect columns may be added. To attain the effects it is valuable, especially for the project manager, to know which of the stakeholders are influential and should thus be consulted. There is a column for specifying the Target group(s) for the interventions and who has influence on attaining the effects. In many cases, there will be an intersection between the two but also a subset. It is illustrated in an example from this study: If the intervention is a modification in the administration part of the EMR, the system vendor will gain influence since they are the ones doing the modification, which is necessary to attain the effects. Maybe the management will also be influential as they are to grant the money to pay the vendor. The target group would be the pharmacists who uses the administrating part of the EMR and thus would be affected by the modification.

Table 1: Columns in the effect map with short description of the columns

Superior Effect	(Sub) Effect	Hypothesis about what creates the effect	Influence (on attaining)	Barriers (for obtaining)	Intervention	Effect measure	Target group (intervention)
For specifying effects. Effects can in most cases be divided into subeffects creating a hierarchy or tree structure. The two columns are an attempt to present this hierarchy.		Contains hypothesis and suggestions on what changes would lead to attaining the effects.	For stating whom or what might be influential on attaining the effects. Either because they are influential on what is suggested in column C or on the intervention suggested in column F.	For stating possible barriers hindering the specified effect to be attained. It could also be experienced problems or barriers that are believed to hinder an effect, which may not yet be specified.	Suggestions for interventions that are believed to help obtaining the effect either directly or by removing a barrier.	For describing the effect measure appropriate for measuring whether the effect has been obtained or not.	To specify the target group(s) of the intervention, such as who will be directly affected by the intervention.

The hypothesis about what creates an effect may in some cases be formulated as a sub-effect and thus moved to the Effect column. The hypothesis should be a loosely formulated description of changes that (may) create the effect e.g. “if time slot was improved to be able to handle first IV dose”. The Intervention column is for suggest-

ing one or more concrete interventions that can foster the change described as a hypothesis.

4. The action research study

In this section the research approach and design are presented as well as the background of the study. In subsection 5 the findings from the study are presented.

4.1 Background of the study

From 2003 to early 2006 an EMR was deployed at all in-patient wards (except emergency departments) at the hospitals in Region Zealand, one of five healthcare regions in Denmark (From this point on referred to as the region). The purpose of the EMR is to help ensure that the correct medication is given to the correct patient at the correct time. Patients' diagnoses, lab tests, treatments, and other non-medication information are not documented in the EMR but in other electronic and paper records. Though the EMR has been used for a considerable period of time, the expected level of use and the anticipated outcome are far from obtained (Granlien et al. 2008). Thus, the region decided to launch a project aiming at improving the use of the EMR in order to improve the medication process.

4.2 Case study settings

As the focus of the study is on the medication process, the management of the medical department on one of the hospitals in the region was requested to assign a ward to participate in the project and with the ward a physician and a nurse willing to participate in the study.

The medication process is central to the work at the medical ward and comprises three main activities: prescribing, dispensing, and administration. Prescription of medication is the physicians' responsibility, and they are also responsible for recording the prescriptions in the EMR. Medication prescriptions may be created, adjusted, and cancelled at all times. The dispensation and administration of medication are the nurses' responsibility. Medication is dispensed and administered four times a day, creating a division of the medication process into four daily timeslots. At the beginning of each timeslot, the nurses consult the EMR to see the list of medication orders for a patient. Each medication on the list is dispensed and signed for individually in the EMR. After the medication has been given to a patient, the nurses must sign for it after each patient. The physicians and nurses at the medical ward have been using the EMR for four years so, work practices have had time to stabilize. All new staff attends a half-day course in the use of the EMR and associated work procedures.

4.3 Research design

In order to investigate how participation in formative evaluation can be facilitated, an action research study was designed and conducted in collaboration with a project manager in the region. Action research combines practice and research through changes and reflection in challenging real-life situations and involves iterative cycles of problem diagnosing, planning, intervention, observing and reflection (Baskerville and Wood-Harper 1996; Avison et al. 1999), see the italicized text in figure 1. (It is worth noting that the phases in formative evaluation resemble the phases in action research.) The research interest lies on how to facilitate a participatory approach to formative evaluation and especially how participation in the early activities can be facilitated. The problem solving interest is related to an existing problem with clinicians not using the EMR as desired, and the region believes this will result in a negative influence on the medication process and quality of patient treatment. To address this problem the regional implementation unit wanted to be able to conduct a formative evaluation to improve the medication process as well as the use of the EMR.

The main research activity, which is specifying effects and barriers and suggesting interventions facilitated by use of the effect map, took place at the *specification workshop*. A all-day workshop was held at the beginning of the project period with the author as the facilitator. The nurse and the physician from the medical ward, a quality manager from the medical department, a project worker from the region's implementation unit as well as the chief physician and the head nurse of the medical department were all invited to the workshop. The department management was only present at the introduction and at the finishing of the day. The project participants had no previous experience with mapping techniques in general; however the project worker had previously participated in a prototyping project in which effect specification was tried out and effects were used as a supplement to requirement specifications. (Granlien et al. 2009)

The workshop began with an introduction to the effect map and its purpose. It was emphasized that the object of the formative evaluation was the medication process as a whole - not the EMR alone or the work practices alone. In addition, the concepts of effects were explained. The effect map was prefilled with realistic examples inspired by previous observations and in-situ interviews at the ward. The workshop will be described in detail in section 4.5. The map is designed to support formative evaluation which is an iterative process. Therefore it is also designed to be updated iteratively during later project activities. Table 2 provides an overview of the activities in study. The main part of the early activities of formative evaluation, which the effect map is thought to support, also takes place early in the study. But because the evaluation is iterative, the activities recur later in the study as well.

Table 2: Overview of action research study activities

Cycle	Phases and period of time	Activities
Preparation	*Initial study activities* *Fall 2007-February 2008*	1. Development of the effect map based on previous action studies experimenting with effect specification and mapping. 2. Presenting the effect map to a project manager of previous collaboration. 3. Refining the effect map in collaboration with the project manager. 4. Overall project planning. 5. Searching for a ward willing to participate in the study. 6. Establishing a good relationship with the people working on the ward. 7. Observing the medication process and the work in general on the ward. 8. Becoming familiar with the EMR – conducting e-learning classes. 9. Analysing relevant documents, such as medication policy etc.
First action cycle	*Effect specification, (problem diagnosing), and planning. Workshop with nurse, physician, quality manager, project manager, February 2008:*	1. Effects specification using the effect map. 2. Listing possible subeffects that can lead to an improved medication process. 3. Discuss possible barriers and suggest interventions. 4. Type the effect map into a spreadsheet. 5. Deciding on an effect (medication away from kardex) and planning interventions to reach this effect. 6. Discussing and deciding on how to measure and evaluate the selected effect. 7. Planning the steps towards carrying out the intervention. 8. Distributing work tasks.
	Interventions, February, March 2008	9. The physician write a list of drugs for delegation, on behalf of the nurse's suggestions. 10. List of drugs approved by medical department management. 11. Approved list implemented in the EMR by the pharmacists. 12. The nurse and physician inform and train the nurses on the ward in how to use delegated medication. 13. The nurse trains her colleagues individually in how to use delegated medication in the EMR.
	Observation, March 2008	14. Observation of medication process on the ward, documented by field notes. 15. Participation in morning meeting where I ask about the use of delegated medication. 16. Baseline audit of medication in kardex, done by nurse assisted by the author. 17. Audit to measure the effect of the interventions.
	Evaluation, March 2008	18. Meetings with quality manager to discuss the effect map. 19. Weekly meetings with nurse and physician to adjust the effect map.
Second action cycle	*Problem diagnosing and planning, March-April 2008*	1. Analyzing the barriers together with the nurse and physician. 2. Planning new interventions together with the nurse and physician. 3. Designing candy box intervention. 4.Updating the effect map.
	Intervention, April 2008	5. Creating candy box and placing it in the personnel room. 6. Creating and handing out how-to pocket guide.

	Observation and evaluation, April-May and September 2008	7. Observation of the medication process. 8. Observation of morning meetings at the ward. 9. Monthly audits to measure the effects after the second round of interventions. 10. Audit after 3 months without interventions to observe long-term effects. 11. Analysing the video from the specification workshop.
	Reflection, June 2008- February 2009	12. Reflective interview with nurse on both the effect specification process and the improvement of medication process, audio recorded. 13. Conversation with project manager reflecting on the process, both problem solving and research interest, documented by notes. 14. Analysing data for writing an article on effect map facilitating participation in formative evaluation activities.

4.4 Data gathering and analysis

During the study different data gathering techniques was used such as in-situ interviews, document analysis, audit of patient records, video recording but mainly observation. Observation was used in the preparation to gain knowledge about the medication process and the work taking place at the ward in general, but also to observe reactions to the interventions. The observations and the various short conversations made during the observations were documented by field notes on an A6 paper note pad which fit in to the pocket of the uniform. Approximately 40 hours of observation was conducted besides participation in five morning meetings at the ward. The meetings were documented by notes since recording was not possible due to confidentiality of personal patient information. All notes were sought transcribed the same or the following day while still fresh in memory.

The workshop was recorded on video in order to be able to observe the workshop afterwards. During the workshop the focus was on facilitating the effect specification process whereas the video recording made it possible to observe the facilitation process afterwards. The video was analyzed by watching it several times and taking notes. First time to re-experience the course of the workshop. Second time to see how the effect map and the specification process worked out. Third time I focused on how the discussions and opportunity based effects were derived. Various passages were later revisit.

The effect map documents were looked through from early to later version looking at the iterative development of the map and the effects specified. The field notes were read through with a focus on participation and effect evaluation.

The reflective interview with the nurse was audio recorded and transcribed. The transcription was printed and the interview was read through several times taking notes on the print. It was not possible to conduct an interview with the physician as he was on paternity leave. Furthermore, various documents relevant to the medication process and the EMR was analyzed e.g. the implementation plan for the EMR written by the implementation unit and legislative documents on medication administration and medication policy.

4.5 Findings from the study

In this section, the findings from the study are described. The description is focus on how participation in the early formative evaluation activities was facilitated. Both those taking place at the workshop and those activities that took place after the workshop.

4.5.1 The workshop

First the purpose of the map and the meaning of the column headlines were explained to the project participants. Next the participants were ready for the individual part of the workshop. The participants were given post-it notepads and asked to write down suggestions for the different columns. This was done very quietly without any talk. In the mean time four big pieces of paper, each assigned with a selected column from the effect map: Effect, Hypothesis, Barrier, and Intervention, were hung up on the wall.

After approximately 20 minutes, the participants were ready for the collective part. They were asked to hang up each of their notes on the paper chart, under the most suitable headline. First there was a bit hesitation and uncertainty about where to hang up the notes. However, one of the participants started by reading up one of her notes while hanging it up on the wall: “Fewer identification errors”. Then another participant said that she might have a note in continuation of the previous. Her note regarded a change of attitude to better comply with the procedures, especially on patient identification. The situation fostered a short dialogue on the subject and in that way many of the notes brought about a debate on the subjects mentioned.

Sometimes some of the participants were discussing while others hang up notes. When all the notes were distributed on the charts on the wall, the participants and the facilitator collectively went trough each note and discussed them according to the various columns in the effect map. This generated some very constructive discussions about the nature of experienced problems and desirable effects as well as possible solutions. E.g. the nurses had posted a note under the barrier headline saying: “Not signed for non-prescribed drugs” and she explained that sometimes the nurses gave medication (painkillers, sleeping pills) to the patients which was not prescribed by a doctor. An other participant asked questions to the nurse on the practice and she explained how and why the medication ended up in kardex and not in the EMR although this was against the procedures. (Kardex is the paper based part of the patient record where the nurses’ report on their observations and actions however information about medication is only suppose to be recorded in the EMR.) On the basis of the discussion, an effect was formulated: “get all medication registered in the EMR”. The discussion continued on how that effect could be achieved revealing hypotheses and suggestions for interventions. One of the participants was more knowledgeable of the EMR and thus able to suggest tailoring of settings in the EMR that could support a solution. It was discussed how the groups of nurses and physicians could contribute to achieving the effect. If new effects or problem arose during the discussions, the person was encouraged to write it on a post-it note and put it on one of the charts on the wall.

We went through the notes in the different categories and people themselves mentioned if they had written a note stating something similar but just formulated it differently so that these notes could be grouped together. Sometimes slight differences between the notes were discussed and consensus was reached whether they could be grouped as similar or not. The notes also shifted columns during the discussions. The project worker had written three notes on effects related to time true registration of prescribing, dispensing, and giving respectively. The nurse had placed a note on the barrier chart saying "time true registration of medication administration – e.g. bring laptops to patients (why is that not done)". First the note was grouped together with the other notes under 'effects' regarding time true documentation. But the nurse substantiated her note by, that *lack* of time true registration prevents the detection of errors in the medication because the nurses cannot command the complete medication of a patient if they do not take EMR-laptop with them. In that respect lack of time true registration was experienced as a barrier to the overall effect termed "safer medication". The note said nothing about *lack* of time true registration thus the note were placed under hypothesis for *how* to obtain safer medication and to obtain better compliance with time true registration namely by taking the EMR-laptop out to patients ward and do the registration on the ward when the medication is given. This is an example of how some of the notes shifted among the columns as the effects, barriers and hypotheses were discussed in details.

After having went through all the notes and discussed some of them in details, it was time to map the notes with each other. A spread sheet version of the effect map was projected on the wall next to the note filled paper charts The notes were typed into a spread sheet creating more or less complete rows. One row might contain only an effect where as another row contained a barrier and a hypothesis. The various rows were discussed and some of the blank fields were filled in for example with new sub effects, target groups, suggestions for measures and who was influential.

Acording to the plan, the workshop should end with the participants prioritizing what effects to continue working on. However, it did not happen as explicit as planned for but ended out being a consensus decision. The dicission followed from a discussion that balanced between the *extend of the problem* experienced either in severity or in scope (in terms of how often) and *what was possible to address* within the constraints of the project.

4.5.2 After the workshop

In the first month of the project period, meetings with the nurse and the physician were held on a weekly basis and later on ad hoc basis. At these meetings part of the reflection and evaluation activities took place, se Table 2. We discussed the observations and the formative effect measures. The evaluation sometimes fostered further analysis and planning which was also done at these meetings. For example an audit showed that the planned interventions did not lead to realization of the effect. Thus, suggestions for other interventions addressing the effects were developed (Granlien and Hertzum 2009).

Another result of these reflections at the meetings was that it was decided to postpone an intervention regarding the IV antibiotics because it was not found reasonable or possible to impose this extra work at the physicians. Instead, waiting for the tech-

nical solution was found more preferable, among others due to patient safety concerns. Furthermore, an intervention regarding telephone prescriptions was cancelled because it was realized that the telephone prescriptions were just adding extra work to the nurses without contributing significantly to achieving the effect. If the physician was reached by phone she would probably also be in front of a computer and thus able to type in the prescription herself – the telephone prescribing was not necessary. However, the last intervention regarding delegated medication was found very valuable, both among nurses and physicians, in order to obtain the desired effect so it was pursued. The intervention field in the effect map was refined and divided in to different steps to plan the delegated medication-intervention. First the list of drugs should be approved and related procedures worked out and decided upon organizationally. Then the list and the new role assignment had to be technically implemented in the system. Finally, a training effort was included. It addressed not only how to use delegated medication but was also aimed at influencing and changing the nurses' way of working so that they would use the delegated medication.

It was part of the original project design to have a second workshop as a supplement to the meetings and to refine the effect map technique and the formative approach in general. However for several reasons, mainly due to lack of resources, it was not possible to plan such a workshop.

5. Discussion

One of the main contributions to facilitation of participation in formative evaluation was the design and use of the effect map, which will be discussed a little further down. But also the design of the participatory approach to formative evaluation, especially the choice of the work system as object of evaluation, helped facilitate participation. The focus on effects of the *entire* medication process compared to a more IT/IS centric focus, made room for the participants to contribute with effects and suggestions for improvements not having to worry whether it was exactly related to the EMR or not. In addition, it made it possible to participate and contribute with valuable comments regardless of ones knowledge about the EMR and technology skills. Mapping techniques used within the IS field tends to have a very strong system/technology focus which is natural since they are developed by people with a computer science, or similar background. Organizational change management approaches do not seem to be effective on their own either. They tend to focus too heavily on people, organizational structures, and human resource management policies (Markus 2004). The focus on the effects of the work system fosters equal attention to all elements in the work system. In that way, we avoid the spilt between the social and the technical.

The choice of project participants and composition of the project group also seems to play a role in facilitation participation. The composition of participants worked very well in this project. The participants seemed to be very honest when they told about their ways of working and the problems they experienced in their work. This kind of honesty is not trivial, especially when you know that you do not always comply with the guidelines and procedures. This was despite the presence of the quality

manager, whose job is to secure compliance with guidelines. I don not think we would have seen the same openness if the management were present during the discussions. On the other side, it would be reasonable to believe that participation of the management could lead to better management support of the following process with intervening and obtaining the effects, as was the case in this project. But participation of management could also hinder people from talking freely and honestly about the things not working properly.

The composition with representatives from various stakeholder groups worked well as they could contribute with different perspectives to the discussion of effects and interventions etc. Although it was productive to have both a nurse and a physician represented in this case one should be aware of the power structures between these two groups. In another project where physicians and nurses participated in a series of workshops together the physicians was far the most influential. Even if the nurses disagreed, they kept quiet instead of arguing for their viewpoint. However, in this case the physicians were chief physicians, which might play a role.

A slightly remarkable but interesting observation from the workshop, was that the nurse's notes could mainly be categorized as barriers regarding daily problems, and the physician's notes could mainly be categorized as hypothesis for solutions. Which very simplified could be said to correspond to the work tasks of each of their professions. It would be interesting to investigate whether this is a tendency or not in order to select the participants for future effect mapping workshops. Generally, it would be relevant try out different compositions of participants, e.g. whether the management should be represented together with clinicians or it would be better to have a separate workshop for the management level etc. Of course, the composition of participants depends on the purpose and object of the evaluation. In addition it is important to bear in mind that there can be different rationales among the different stakeholder groups e.g. the politicians, the administration/top management and the nurses and physicians (Jespersen 2007) which can result in disagreements.

5.1 The effect map as a facilitator for participation in formative evaluation

The effect map was designed to support participation in formative evaluation. The map was used mainly at the workshop in the beginning of the project but also iteratively later in the project e.g. at meetings with the nurse and physician. The effect map helped structure the discussions at the workshop. It produced valuable information to inform and plan for concrete interventions in order to improve the medication process. As well as concrete effects and measurements to control whether the process is going in the desired direction. Especially the process of mapping the notes into the rows in the map supported this process.

Not all of the discussions were clearly structured around the columns or rows in the map and it was a balance for the facilitator when to stop a good discussion. Sometimes during the discussion, effects are revealed even though they might not be formulated as effects at first. But on behalf of the discussion the facilitator suggested new things to be filled into the map. The facilitator plays an important role in interpreting what is said and help formulate and structure the statements to suit into the

columns in the effect map. Consequently, how the facilitator acts plays an important role in the outcome of the effect mapping.

Certain issues regarding the design of the map was exposed during the test of the map in this project. The Hypothesis and Barrier columns are related in the way that Hypothesis often contains suggestions for changes to remove barriers. Whether a statement was a hypothesis or a barrier depends mostly on the formulation e.g. “the EMR is not used every where at the hospital” is formulated as a barrier. However, it is concerned with the same issue as “that out-emergency and the out-patients’ clinics start using EMR as well” which is formulated as a hypothesis. The Effects columns and Hypothesis column are also closely related which was intended from the beginning. A hypothesis can in many instances be reformulated as a sub-effect and then assigned with a hypothesis about how the new effect can be obtained.

It was the intention that the participants should not feel too hampered by the headlines and thus risking loosing good ideas and issues that they might not think of as effects due to a slightly different formulation.

The effect hierarchy was just indicated in the map by two effect columns. Hence, a hierarchy map in a separate document could be valuable to show the possible relations between the effects. It may also serve to illustrate that you can start different places in the hierarchy and work your way either up or down through specific effects to overall general effects. Furthermore, an effect hierarchy has the potential to show relations between concrete effects suggested by for example on-the-floor participants and more overall effects suggested by the management or a political level.

6. Conclusion

The action research study reported in this paper is an application of a participatory approach to formative evaluation which serves as an example of how participation in formative evaluation can be facilitated. The effect map has proven valuable to involve participants in effect specification and to provide suggestions for how effects can be obtained through various interventions. Having the work system as the object for evaluation seemed to broaden to possibilities for particpation as the participants could contribute regardless of the technology knowledge and skill. In addition the work system focus opens for a wider range of suggestions for improvements. Facilitating participation also implies a discussion on *who* is to particpate in what constellation contemporery being aware of power structures when planning the participation.

Acknowledgements

The author’s postgraduate scholarship is co-funded by Region Zealand. Thanks are to the workshop participants, the staff at the medical ward and especially the nurse and physician participating in the project. Furthermore, I would like to thank the IRIS working group and Morten Hertzum for valuable comments and suggestions to this paper.

References

Alter, S. (1999). The Siamese twin problem: a central issue ignored by “dimensions of information system effectiveness”. Communications of AIS Volume 2, Article 20: Letter by alter, Association for Information Systems. **2**.

Alter, S. (2008). "Defining information systems as work systems: implications for the IS field." European Journal of Information Systems **17**(5): 448.

Ashurst, C., Doherty, N. F.&Peppard, J. (2008). "Improving the impact of IT development projects: the benefits realization capability model." European Journal of Information Systems **17**: 352-370.

Avison, D., E. , Lau, F., Myers, M., D. &Nielsen, P. A. (1999). Action research, ACM. **42:** 94-97.

Baskerville, R. L.&Wood-Harper, A. T. (1996). "A critical perspective on action research as a method for information systems research." Journal of Information Technology (Routledge, Ltd.) **11**(3): 235-246.

Braa, K. (1995). Priority workshops: springboard for user participation in redesign activities. Proceedings of conference on Organizational computing systems. Milpitas, California, United States, ACM.

Dittrich, Y., Eriksen, S.&Hansson, C. (2002). PD in the Wild; Evolving Practices of Design in Use. Participatory Design Conference

Malmö, CPRS (Computer Professionals for Social Responsibility).

Drazin, R.&de Ven, A. H. V. (1985). "Alternative Forms of Fit in Contingency Theory." Administrative Science Quarterly **30**(4): 514-539.

Farbey, B., Land , F.&Targett, D. (1999). "The moving staircase - Problems of appraisal and evaluation in a turbulent environment." Information Technology & People **12**(3): 238.

Granlien, M. F., Hertzum, M.&Gudmundsen, J. (2008). "The Gap between Actual and Mandated Use of an Electronic Medication Record Three Years after Deployment." Stud Health Technol Inform **136**: 419-24.

Granlien, M. S.&Hertzum, M. (2009). Implementing new ways of working: interventions and their effect on the use of an electronic medication record. Proceedings of the ACM 2009 international conference on Supporting group work. Sanibel Island, Florida, USA, ACM.

Granlien, M. S., Pries-Heje, J.&Baskerville, R. (2009). Project Management Strategies for Prototyping Breakdowns. Hawaiian International Conference on system Science. Hawaii, IEEE.

Jespersen, P. K. (2007). New Public Management-reformen i det danske sygehusvæsen. Offentlig ledelse og styring C. Greve. København, Jurist og økonomforbundets forlag.

Kaplan, B. (2001). "Evaluating informatics applications--some alternative approaches: theory, social interactionism, and call for methodological pluralism." International Journal of Medical Informatics **64**(1): 39-56.

Kaplan, B.&Shaw, N. T. (2004). "Future directions in evaluation research: people, organizational, and social issues." Methods Inf Med **43**(3): 215-31.

Klecun, E.&Cornford, T. (2005). "A critical approach to evaluation." European Journal of Information Systems **14**(3): 229-243.

Lanzara, G. F.&Mathiassen, L. (1985). "Mapping situations within a system development project." Information & Management **8**(1): 3-20.

Markus, M. L. (2004). "Technochange management: using IT to drive organizational change." Journal of Information Technology **19**(1): 4-20.

McGowan, J. J., Cusack, C. M.&Poon, E. G. (2008). "Formative Evaluation: A Critical Component in EHR Implementation." Journal of the American Medical Informatics Association **15**(3): 297-301.

Orlikowski, W. J.&Hofman, D., J. (1996). An Improvisational Model of Change Management: The Case of Groupware Technologies, MIT Center for Coordination Science.

Pilemalm, S.&Timpka, T. (2008). "Third generation participatory design in health informatics-Making user participation applicable to large-scale information system projects." J. of Biomedical Informatics **41**(2): 327-339.

Sallas, B., Lane, S., Mathews, R., Watkins, T.&Wiley-Patton, S. (2007). "An Iterative Assessment Approach to Improve Technology Adoption and Implementation Decisions by Healthcare Managers." Information Systems Management **24**(1): 43-57.

Simonsen, J.&Hertzum, M. (2008). Participatory Design and the Challenges of Large-Scale Systems: Extending the Iterative PD Approach. 10th anniversary conference on Participatory Design: Experiences and Challenges, USA, ACM.

Southon, G. (1999). "IT, Change and evaluation: an overview of the role of evaluation in health services." International Journal of Medical Informatics **56**(1-3): 125-133.

Talmon, J. (2006). "Evaluation and Implementation: A Call for Action." IMIA yearbook of Medical Informatics 2006 **1**(1): 11-15.

Ward, J., Taylor, P.&Bond, P. (1996). "Evaluation and realisation of IS/IT benefits: An empirical study of current practice." European Journal of Information Systems **4**(4): 12.

RECENT RESEARCH REPORTS

#128 Thomas Bolander and Torben Braüner, editors. *Preliminary proceedings of the 6th Workshop on Methods for Modalities (M4M–6)*, Roskilde, Denmark, October 2009.

#127 Leopoldo Bertossi and Henning Christiansen, editors. *Proceedings of the International Workshop on Logic in Databases (LID 2009)*, Roskilde, Denmark, October 2009.

#126 Thomas Vestskov Terney. *The Combined Usage of Ontologies and Corpus Statistics in Information Retrieval*. PhD thesis, Roskilde, Denmark, August 2009.

#125 Jan Midtgaard and David Van Horn. Subcubic control flow analysis algorithms. 32 pp. May 2009, Roskilde University, Roskilde, Denmark.

#124 Torben Braüner. Hybrid logic and its proof-theory. 318 pp. March 2009, Roskilde University, Roskilde, Denmark.

#123 Magnus Nilsson. *Arbejdet i hjemmeplejen: Et etnometodologisk studie af IT-støttet samarbejde i den københavnske hjemmepleje*. PhD thesis, Roskilde, Denmark, August 2008.

#122 Jørgen Villadsen and Henning Christiansen, editors. *Proceedings of the 5th International Workshop on Constraints and Language Processing (CSLP 2008)*, Roskilde, Denmark, May 2008.

#121 Ben Schouten and Niels Christian Juul, editors. *Proceedings of the First European Workshop on Biometrics and Identity Management (BIOID 2008)*, Roskilde, Denmark, April 2008.

#120 Peter Danholt. *Interacting Bodies: Posthuman Enactments of the Problem of Diabetes Relating Science, Technology and Society-studies, User-Centered Design and Diabetes Practices*. PhD thesis, Roskilde, Denmark, February 2008.

#119 Alexandre Alapetite. *On speech recognition during anaesthesia*. PhD thesis, Roskilde, Denmark, November 2007.

#118 Paolo Bouquet, editor. *CONTEXT'07 Doctoral Consortium Proceedings*, Roskilde, Denmark, October 2007.

#117 Kim S. Henriksen. *A Logic Programming Based Approach to Applying Abstract Interpretation to Embedded Software*. PhD thesis, Roskilde, Denmark, October 2007.

#116 Marco Baroni, Alessandro Lenci, and Magnus Sahlgren, editors. *Proceedings of the 2007 Workshop on Contextual Information in Semantic Space Models: Beyond Words and Documents*, Roskilde, Denmark, August 2007.