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Enacted, Embedded, Relational, Multiple

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PhD dissertation by
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PhD dissertation.
Title: Pilot Implementations
Enacted, Embedded, Relational, Multiple

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SUMMARY

This PhD dissertation engages in the study of pilot (system) implementation. In the field of information systems, pilot implementations are commissioned as a way to learn from real use of a pilot system with real data, by real users during an information systems development (ISD) project and before the final system is implemented. Among others, their use is argued to investigate the fit between the technical design and the organisational use. But what is a pilot implementation really? In this dissertation, I set out to address this conceptual question.

I initially investigate this question by conducting a literature review. The concept of pilot implementation, although commonly used in practice, is rather disregarded in research. In the literature, pilot implementations are mainly treated as secondary to the learning outcomes and are presented as merely a means to acquire knowledge about a given objective. The prevalent understanding is that pilot implementations are an ISD technique that extends prototyping from the lab and into test during real use. Another perception is that pilot implementations are a project multiple of co-existing enactments of the pilot implementation. From this perspective tensions and negotiations are fundamental characteristics of pilot implementations.

Based on the analysis of a project that is pilot implementing an electronic pre-hospital patient record for emergency medical services in Danish health care, I investigate other perceptions of pilot implementations. The analysis is conducted by means of a theoretical framework that centres on the concept infrastructure. With infrastructure I understand the relation between organised practice and the information systems supporting this practice. Thus, infrastructure is not a thing but a relational and situated concept that emerges between people in practice. This understanding allows me to analyse pilot implementations as an emergent and relational phenomenon that emerges for project participants in the relation between an existing infrastructure and a pilot system.

Based on the analysis I propose the conceptual understanding of pilot implementations as enacted interventions into existing infrastructures. Moreover, being embedded in the day-to-day organisation of work pilot implementations intervenes in the conventions of practice making the taken for granted visible. This allows project participants to attend the needs of today while enacting a possible future.

SUMMARY (DANISH)

Denne Ph.d.-afhandling omhandler pilotimplementeringer. Forskning i systemudvikling har foreslået implementeringen af pilotsystemer som en tilgang til læring undervejs i et it-udviklingsprojekt og før pilotsystemet endeligt implementeres. Læringen finder sted gennem implementeringen af et pilot system i dets endelige kontekst, med rigtige data og med rigtige brugere. Forskning peger på, at det blandt andet er muligt at lære om tilpasningen mellem det tekniske design og den organisatoriske praksis. Men hvad er en implementering pilot egentlig?

Til at undersøge en konceptuel forståelse af pilotimplementeringer har jeg indledningsvis foretaget et litteraturreview. Til trods for en udbredte brug i praksis finders der kun begrænset forskning, der omhandler pilotimplementeringer som et forskningsområde i sig selv. Tit og ofte bliver de i stedet beskrevet som virkemiddel til tilegnelse af viden og læring. Iblandt den forskning, der findes, beskrives pilotimplementeringer ofte som en teknik inden for systemudvikling, der kan forlænge prototyping fra "laboratoriet" og ind i en virkelig brugskontekst. En anden og mindre udbred forståelse er, at pilotimplementeringer udgøres af flere parallelle opførelser enactment) af et multipelt projekt (project multiple). I denne optik er det sociale et fundamentalt aspekt af pilotimplementeringer.

Baseret på pilotimplementeringen af en elektronisk præ-hospital patientjournal til dokumentation af akutbehandling i dansk ambulancetjeneste (projekt ePPJ), undersøger jeg andre mulige forståelser af pilotimplementeringer. Jeg gør dette ved hjælp af et teoretiske begrebsapparat, der er bygget op omkring konceptet infrastrukturer. Med infrastrukturer forstår jeg relationen mellem organiseret praksis og de systemer, der understøtter denne praksis. Infrastrukturer er altså ikke en ting, men et relationelt og situeret koncept, der fremstår mellem mennesker i praksis. Denne forståelse giver mig mulighed for at analysere pilotimplementeringer som et emergent og relationelt fænomen, der opstår for projektdeltagere spændingsfeltet mellem en eksisterende infrastruktur og et pilotsystem.

På baggrund af min analyse af ePPR projektet foreslår jeg en konceptuel forståelse af pilotimplementeringer som en intervention, der op- og indføres i den eksisterende infrastruktur. Indlejret (embedded) i arbejdspraksis tydeliggør pilotimplementeringer de konventioner, der normalt tages for givet som en del af praksis. På denne måde gør pilotimplementeringer det muligt at varetage det daglige arbejde samtidig med en opførelse af fremtidig mulig praksis.

To my loving family who stood by my side all along.

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Contents

1 | INTRODUCTION

This PhD dissertation is concerned with *pilot system implementation*, or pilot implementation in short. In the field of information systems, pilot implementations have been put forward as a way of learning from real use of a pilot system, used by real users during development in an information systems development project and before the final system is implemented. Among others, it is used as an approach to overcome discrepancies between a technical design and its organisational usage.

Background and motivation

A common challenge in information systems development (ISD) is to design systems that fulfil the users' need and support the work practices they are designed for. This challenge is often described as "overcoming the discrepancies" between a technical design and its organisational context of usage (Swanson, 1988). In practice, there are several reasons for these discrepancies.

First, users are not necessarily able to fully describe their own practice and thereby their needs (the say-do problem) (Goguen and Linde, 1993). The users may describe their practice one way, while doing something different in actual practice. They may also tend to describe their practice at a more general level, which does not capture the richness of their practice. Moreover, some activities are not considered real work, rather they go unnoticed or they are intentionally kept invisible for various (political) reasons (Star and Strauss, 1999; Wagner, 1993). This implies, that they are being *invisible* to the designer of the information system (Schmidt and Bannon, 1992; Star and Strauss, 1999; Suchman, 1995). This can make it difficult for the designer to get a sufficiently detailed picture of the users' needs and requirements.

Second, although users are presented to and try out prototypes of the system being developed, they may re-prioritise their expectations to the system over the course of development. As users try out the system and become more knowledgeable about its possibilities and limitations, their expectations may change (Hansen, 2014). Third, even if the users would be able to express all their requirements, some organisational consequences and opportunities of using the system only emerge through real use (Markus and Robey, 1988; Orlikowski and Hoffman, 1997). This leaves space for new requirements and practices to arise for a period after implementation (Tyre and Orlikowski, 1994). Thus, implementation and adoption of the system, as learning by doing (Levitt and March, 1988), holds the potential for learning about the fit between the technical

design and the organisational use (e.g. Ang et al., 1997; Edmondson et al., 2001).

Considering these new horizons of contemporary information systems development, the importance of learning about the discrepancies between a technical design and its organisational setting, before final implementation, is becoming even more prevalent and pertinent. Information systems (IS) were traditionally custom designed, stand-alone systems developed from scratch for implementation and use in relatively stable organisations. Contemporary information systems, on the other hand, are often developed as generic systems requiring a solid configuration in the local contexts of use. Additionally, information systems are increasingly designed for support of cooperation and knowledge-sharing across organisational divisions or corporations (Aanestad et al., 2004). This calls for greater interoperability and data sharing between the particular systems as well the different groups of users. Hence, development and implementation has shifted from merely putting an information system into operation, to local configuration, ensuring integration between the new system and the larger system of systems, which the new system is to be part of.

This shift in information systems development is reflected in emerging perceptions of information systems as (information) infrastructures (Star and Ruhleder, 1994, 1996), networks of applications (Dittrich et al., 2002), or software ecosystems (Manikas, 2015). From this perspective, bridging the gap between technical design and organisational usage becomes a matter of extending existing infrastructures and work practices to include the new information system. This calls for a socio-technical practice, such as a pilot implementation, which provides the users hands-on experiences with the system through real use of a pilot system before the design is finalised and implemented.

Related work

Over time, various approaches and methods have been proposed to bridge the gap between technical design and organisational usage by identifying design shortcomings as well as implementation issues before the system is finalised and implemented. Iterative and incremental software development was introduced as early as the 1960s (Larman and Basili, 2003). The basic notion of this method is that learning from one iteration of development and use is fed into the following iterations (Boehm, 1988). Four decades later agile methods were introduced to comply with the challenges of emerging requirements in complex and fast-changing environments. These methods were focusing on dimensions of the technical system, although they also introduced a notion of learning during development.

Work shows that information systems development is a socio-technical endeavour, in which the technical system and the organisational work setting mutually shape each other (e.g. Bansler, 1989; Berg, 1999). The system yields changes to the organisation of work, while the users on the other hand also change the system once it is implemented. From this perspective, design extends from development and into the phase of implementation and the context of use. Thus, even though the design-usage gap can be reduced through iterative and agile development methods, new complexity will emerge as the system is im-

plemented (Orlikowski, 1996). Hence, learning during development should also include dimensions of the organisational setting and its work practices. Markus (2004) has proposed to use IT strategically to manage and drive organisational changes through technochange prototyping. This method is however limited to development and does not include implementation activities.

In parallel to software engineering and information systems research, recent strands of research in the field of design have proposed taking design into use, recognising that design is not limited to ISD projects (Dittrich et al., 2002). This includes a range of concepts such as design in use, co-creation, co-design, co-realisation, and living lab (Botero, 2013; Følstad, 2008; Hartswood et al., 2003; Sanders and Stappers, 2008). Stressing the fact that organisations are dynamic and changing environments, these approaches suggest that development is done together with the users in the respective organisations on a day-to-day basis through a long-term engagement between IT developers and users (Hartswood et al., 2002). In this case, evaluation and assessment becomes open-ended and on-going activities with no clear distinction from development and use. Pilot implementations on the other hand are conducted in relation to an ISD project and therefore are limited in scope and time. While proponents argue for its usefulness in complex and conflict-laden arenas such as health care (Bansler and Havn, 2010), research bares evidence of only few successful pilot implementations.

Pilot implementations are said to be promising as a means to attend to the increased complexity of contemporary information systems development. However, where pilot implementations are commonly used in practice, they have attracted limited research interest. The sparse literature points out that pilot implementations often fail, since little can be learned from them. Moreover, literature underlines the need for further studies of the reasons pilot implementations sometimes fail, in order to provide guidelines for conducting them (Bansler and Havn, 2010). Further research points out that pilot implementations should not be mistaken for full implementation and that they come with their own set of challenges. If these challenges are not addressed the pilot implementation is likely to fail (Hertzum et al., 2012). Hence, in order to address these findings, there is an overarching need for descriptive work and conceptual clarification on how to understand pilot implementations (Bansler and Havn, 2010; Hertzum et al., 2012). Based on a case study of a pilot implementation from the Danish health care, I set out to investigate this conceptual question and propose a conceptual understanding of pilot implementation in this thesis.

Research setting and approach

The research presented in this thesis is based on a interpretive case study conducted by means of ethnographic methods (Randall et al., 2010). The case study was carried out in one of the five health care regions in Denmark over a period of 20 months (January 2011 - September 2012). Here, I followed a project as it was preparing for, conducting and evaluating the pilot implementations of an electronic pre-hospital patient record (ePPR) for use in emergency medical services[1]. The ePPR pilot system was planned to replace the existing paper-based

[1]Sometimes these services are also described as ambulance services

pre-hospital record, once fully developed, and it was used by ambulance crew to document patient treatment. The project was conducted by the region, in cooperation with two emergency medical services providers (EMS providers), that were providing emergency medical services in that region. During my participation in the project, the pilot system was pilot implemented twice.

Information infrastructures as framework for analysis

The ePPR project encountred many problems and challenges, especially during pilot use. For instance, the poor usability of the user interface made it cumbersome to document patient treatment during ambulance run; print outs of the ePPR-record had not been tested prior to the pilot and only during pilot use was it discovered that the record spread across several pages; and insufficient training in the system made the pilot users unsure of how to fill out the ePPR. Although most problems were being rather tedious and often minor, trivial, or ordinary, they had a detrimental effect on the pilot users work practice and caused a lot of frustration. Moreover, some of the problems seemed to be consequences of conflicting interests that were related to day-to-day working relations and the organisation of the pre-hospital sector in the region. However, they caused problems to the pilot implementation. During my participation in the ePPR project, my initial frustration of the troubled pilot implementations turned into wondering and over time the problems shaped my focus of investigation.

To analyse the observations, I have examined the literature on pilot implementation for work that could support a further investigation. The literature primarily offer ways to describe and organise the different activities and elements of a pilot implementation (e.g. Bansler and Havn, 2010; Chin and McClure, 1995; Fullerton et al., 2006; Hertzum et al., 2012). To investigate the relation between pilot use and organised practice I have found it useful to apply the concept "information infrastructure". In general an infrastructure can be described as that 'which is running underneath' making an organisation or society function in certain ways (Edwards, 2003; Lee et al., 2006). The prevailing literature on information infrastructure defines information infrastructure, not as a physical thing but as a relational concept, that occurs through practice when local practices are afforded by a large-scale technology (Star and Ruhleder, 1996). Moreover, the literature emphasises that the efforts that goes into growing an infrastructure is a collaborative effort fraugt with conflicts and negotiations (e.g. Bowker and Star, 2000; Hanseth and Monteiro, 1997; Ribes and Finholt, 2009). Thus, we see that infrastructure can be understood as the relation between an organised practice and the technologies supporting this practice. Furthermore, we see that when the local practices and the large-scale technology are not aligned, tensions arise (Lee et al., 2006; Star and Ruhleder, 1996).

As a concept, information infrastructure provides a means to attend to the relation between the pilot system and the established work practices as that which must be aligned in order to carry out the ePPR pilot implementation. In particular, the understanding of information infrastructure as a relational concept allows me to investigate the ePPR pilot as a matter of infrastructural (mis)alignment. When the use of the pilot system is not afforded by the existing

infrastructure, tensions arise in the pilot implementation.

Research questions

Theoretically motivated by the different understandings of pilot implementation, I set out, in this thesis, to investigate how we may understand pilot implementations. The investigation of this question is refined into three questions with related sub-questions, through which I investigate different perspectives on pilot implementations:

1. What is a pilot implementation?
    (a) How is a pilot implementation defined in the existing literature?
    (b) What is the purpose of a pilot implementation?
    (c) What are the challenges of conducting a pilot implementation?
2. When is a pilot implementation?
    (a) When is a pilot implementation embedded?
    (b) When is a pilot implementation a multiple?
3. How is a pilot implementation?
    (a) How is the ePPR pilot implementation enacted?

The first research question investigates how pilot implementation is understood in general. The question is addressed through a literature review of scholarly literature on pilot implementation and it seeks to provide an overview of the ways pilot implementations are defined and described in the field of information systems.

The second and third research question are addressed through the case study of the ePPR project. The second research question identifies pilot implementation as a relational phenomenon, that emerges through situated use and between people. Hence in the second question, I investigate when a pilot implementation emerges. By means of concepts from the theoretical framework, I address the question by paying attention to the different ways in which the ePPR pilot implementation emerges as the relation between the pilot system, the organised practice and the supporting technologies.

The third research question investigates pilot implementation as an action, in which the phenomenon is not so much understood as it is experienced and realised through practice. In this question, I also take the ePPR project as my analytical starting point and look into how the project participants try to integrate the pilot system with the organised practice and existing technologies. The tenet here is, that creating a fit between the technological design and the organisational setting is a practice of trying to resolve the tensions that occur between pilot use and daily work.

Structure of the thesis

This thesis is structured around eight chapters. Following this chapter (chapter one), in which I have motivated the relevance of my research and the research questions, I will present the theoretical framework for analysis (chapter two). The primary concept of the framework is the notion of information infrastructure as a relational concept and as a long-term endeavour, but also other relational concepts are included in the framework. First, I will provide a synthesis of relevant literature on information infrastructure. Information infrastructure is defined as the relation between organised practice and the technologies used as part of practice and makes it possible to investigate pilot implementations as the relations between the existing infrastructure and the pilot system, rather than a set of development activities. Followingly, I introduce the other concepts of the framework: infrastructural inversion, tensions, infrastructure time, enactment, multiplicity and genuine participation. Altogether, these concepts allow me to analyse different understandings and dimensions of a pilot implementation that supports the view of pilot implementation as a relational phenomenon, which becomes only in relation to use and between people.

Chapter three presents the case study and the structure of the Danish health care. The purpose of this chapter is to give a picture of the broader context of the ePPR project. The chapter includes a general introduction to the Danish health care, including the larger context of emergency medical services and ambulance work. The purpose of the latter is to provide a basic understanding of the work conditions, in which the pilot system of the case study was implemented and used. In chapter four, I describe the overall research design of how to answer the research questions. This includes a presentation of the overall research approach and research strategies on how to construct the empirical material and followingly analyse it.

In chapter five, I investigate the first research question. It is investigated through a literature review. The literature review shows, that in general the line between the different pilot concepts is unclear and that there is a lack of definitions of pilot implementations. The prevalent work defines pilot implementations as a technique for information systems development or a field test, but also poinst out the need for further conceptual clarification. Thus, in chapter six, I address the second research question. Through four empirical examples of tensions, which occurred during planning, preparing and running the pilot implementations in the ePPR project, I investigate different aspects of pilot implementations as a relational phenomenon.

In chapter seven, I discuss the findings in relation to the concepts in the theoretical framework. One main argument is that a pilot implementation is an intervention into daily work that makes the taken for granted of work practice visible. Another argument is that a pilot implementation is enacted by the project participants while they are trying to overcome the tensions in the relationship between the pilot system and the existing infrastructure. The chapter finishes with a number of suggestions for further research. In chapter eight, I summarise the thesis and the main contributions.

2 | THEORETICAL FRAMEWORK

In the following, I present the theoretical framework for investigating how to understand the ePPR pilot implementation. First I present three different ways of understanding infrastructures. Then I present three selected concepts from information infrastructure, 'infrastructural inversion', 'tensions', and 'infrastructure time', which provide a means to make visible and investigate the relational qualities of the pilot implementation. Additionally, the concepts 'enactment' and 'multiplicity' from Science and Technology Studies allow me to focus on the social relations between the pilot implementation participants.It also allows me to investigate pilot implementation as a practice instead of a set of activities being planned and carried out. Finally, to examine the role of the pilot users, I will draw from the field of Participatory Design. In particular, I use the notion 'genuine participation' that allows me to investigate collaboration in a pilot implementation as the ability to participate.

Infrastructure

Research on information infrastructure derives from many different fields such as Computer science, Information Science, Communication, Organisation theory, Cognitive science, and Large Technical Systems in Science and Technology Studies (Bowker et al., 2010, p.112).

With the advent of large scale and networked information systems, information infrastructure has gained attention as a real-world phenomenon and as an analytical lens in the field of information systems to address the challenges of designing and implementing large-scale systems. Recent work includes two special issues published in 2014 (the Journal of the Association for Information Systems (JAIS) and the Scandinavian Journal of Information Systems). However, as the call for participation of the 3rd Innovation in Information infrastructure (III) workshop contested, the concept and theories of information infrastructures are still maturing and there is a need for further empirical contributions and new types of infrastructures[1].

In the literature there is a myriad of infrastructure types: information infrastructures (e.g. Monteiro and Hanseth, 1996; Ribes and Finholt, 2009; Star

[1] See http://www.mn.uio.no/ifi/english/research/news-and-events/events/conferences-and-seminars/iiios2014/, last accessed 13.02.2016

and Ruhleder, 1996), cyber-infrastructures (e.g. Lee et al., 2006; Ribes and Finholt, 2009), e-infrastructures (e.g. Hepso et al., 2009; Pollock and Williams, 2010; Ribes and Finholt, 2009), corporate IT infrastructures (Hanseth and Braa, 2001), health care infrastructures (e.g. Aanestad and Jensen, 2011; Johannessen et al., 2012), mobile infrastructures (Andersen and Jansen, 2012), virtual infrastructures (Séror, 2011a,b), work(ing) infrastructures (e.g. Andersen and Jansen, 2012; Pipek and Wulf, 2009; Star and Ruhleder, 1996), technical infrastructure (Aanestad and Jensen, 2011), communication infrastructure (Aanestad and Jensen, 2011), in-between infrastructures (Botero and Saad-Sulonen, 2010), and human infrastructures (Lee et al., 2006), to mention some of them. Information infrastructure, e-infrastructure and cyberinfrastructure are the most commonly used. Cyberinfrastructure is primarily used in an American settings where the main focus is on scientific research. The terms information infrastructure and e-infrastructure (a generic terms for information infrastructure) have a stronger uptake in Europe (Ribes and Finholt, 2009). Since this thesis is concerned with infrastructures at a conceptual level, I will refrain from accentuate any particular type of infrastructure and use the term *infrastructure* in short. I will, however, focus on literature on information infrastructures to build my theoretical framework.

In general, the literature on infrastructure adheres to socio-technical perspectives and stresses the reciprocal interrelationship between the technical development and the social arrangement of infrastructures. Yet, I notice a division in the literature on what aspects to emphasize and thereby how to address infrastructures. A part of the literature addresses infrastructures as a physical phenomenon and a structure consisting of different technologies (hardware and software), resources (data), and communication standards (protocols and networks) (Tilson et al., 2010). An example is software ecologies, which can be defined as the interaction of a set of actors on top of a common technological platform that results in a number of software solutions or services (Manikas and Hansen, 2013). Other literature addresses infrastructures as a relational concept, where an infrastructure only emerges between people and through organised practice (Bowker and Star, 2000; Star and Ruhleder, 1994). Finally, a part of the literature addresses infrastructures as a process and an act on its own terms (Karasti and Syrjänen, 2004; Star and Bowker, 2002). Based on this observation, I suggest an ontological stratification of infrastructure theory according to the inquirys: "what is an infrastructure?", "when is an infrastructure?", and "how to infrastucture?". In the following sections, I will briefly present the three different strands based on selected papers and argue for their relevance to the research questions proposed in the introduction of the thesis.

WHAT IS AN INFRASTRUCTURE?

The first strand of research focuses on the physical dimensions of an infrastructure. Central research from this area includes the work of Ole Hanseth, Eric Monteiro and Kalle Lyytinen (e.g Hanseth and Lyytinen, 2004, 2010; Hanseth and Monteiro, 1997, 1998; Hanseth et al., 1996; Monteiro, 1998; Monteiro and Hanseth, 1996).

In their early work, they defined infrastructure as large, technical, geographically dispersed, and interconnected systems (Hanseth et al., 1996), as highly

complex and extensive physical networks of interconnected modules of communication technologies (Hanseth and Monteiro, 1997), and as a systemic technology where standards make up the technical back-bone (Monteiro and Hanseth, 1996). In their work, they were concerned to understand how infrastructures are developed. They investigated different aspects of the social processes that go into the making of infrastructures such as the development of standards (e.g Hanseth and Monteiro, 1997; Hanseth et al., 1996; Monteiro and Hanseth, 1996). Examples of standards are email and internet protocols, that make it possible for an infrastructure to be shared and expanded across an unlimited range of communities. Although these standards are purely technical, Hanseth and Monteiro recognise that the standards are neither readymade nor neutral. They show that infrastructures are shaped through complex and social processes of negotiation and inscribed with political and ethical regulative patterns as well as diverse interests and anticipations of individuals and organisations (Monteiro and Hanseth, 1996). That is, the social processes are inscribed in the technical details, and the infrastructures are considered material manifestations of these processes (Hanseth and Monteiro, 1997).

This conception of infrastructure is also found in later work, where Hanseth and Monteiro, based on their work on infrastructure development, propose socio-technical design theories for information infrastructures (Hanseth and Lyytinen, 2004, 2010). Here, information infrastructures are regarded as a new class of IT-systems, which is characterized as a shared, open, evolving, heterogeneous installed base of IT capabilities based on open and standardized interfaces (Hanseth and Lyytinen, 2004, 2010). Thus, they suggest that infrastructures must be organized through technical, social and institutional layering (Hanseth and Lyytinen, 2004). Doing this, it is critical to take the installed base of existing technologies into consideration.

Although the work in this strand of research draws from Science and Technology Studies and recognises that infrastructures are shaped through complex and social processes, it adheres to a separation between the social and the technical dimensions. Thus, we get a picture of infrastructures as something tangible and omnipresent that is running "underneath" in order to support something else, such as communication across different local sites. Although I suggest a conceptual understanding of pilot implementation as a relational concept, I find this strand of infrastructure research useful in accommodating the basic understanding that an essential part of a pilot implementation is to ensure integration of the complex and interdependent landscape of the information systems the pilot system is implemented into. Moreover, where pilot implementations are directed towards the future, we are reminded, by this strand of research, that they build on the installed base.

WHEN IS AN INFRASTRUCTURE?

The second strand of research is often associated with the work of Susan Leigh Star and colleagues (e.g Bowker and Star, 2000; Neumann and Star, 1996; Star and Bowker, 2002; Star and Ruhleder, 1994, 1996) who have influenced later research by Karasti and Baker (2004); Karasti et al. (2010); Lee et al. (2006); Pipek and Wulf (2009) and Ribes and Finholt (2009). This strand of research defines infrastructure as a fundamentally relational concept. Hence, instead of asking what is an infrastructure Star and Ruhleder (1996) ask: "When is an

infrastructure?". The word *when* is the key word here as it emphasizes the contextualisation, situatedness, and relational qualities of infrastructures, where infrastructure emerges with the salient dimensions (Star and Ruhleder, 1996):

- *Embeddedness.* Infrastructure is "sunk" into, inside of, other infrastructures, social arrangements and technologies;
- *Transparency.* Infrastructure is transparent to use, in the sense that it does not have to be reinvented each time or assembled for each task, but invisibly supports those tasks;
- *Reach or scope.* This may be either spatial or temporal - infrastructure has reach beyond a single event or one-site practice;
- *Learned as part of membership.* The taken-for-grantedness of artifacts and organizational arrangements is *sine qua non* of membership in community of practice (Lave and Wenger 1992; Star, in press). Strangers and outsiders encounter infrastructure as a target object to be learned about. New participants acquire a naturalised familiarity with its objects as they become members;
- *Links with conventions of practice.* Infrastructure both shapes and is shaped by the conventions of a community of practice, e.g. the ways that cycles of day-night work are affected by and affect electrical power rates and needs. Generations of typists have learned the QWERTY keyboard; its limitations are inherited by the computer keyboard and thence by the design of today's computer furniture (Becker 1982);
- *Embodiment of standards.* Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardised fashion;
- *Built on an installed base.* Infrastructure does not grow *de novo*; it wrestles with the "inertia of the installed base" and inherits strengths and limitations from that base. Optical fibres run along old railroad lines; new systems are designed for backward- compatibility; and failing to account for these constraints may be fatal or distorting to new development processes (Monteiro, et al. 1994);
- *Becomes visible upon breakdown.* The normally invisible quality of working infrastructure becomes visible when it breaks; the server is down, the bridge washes out, there is a power blackout. Even when there are backup mechanisms or procedures, their existence further highlights the now-visible infrastructure.

Based on these dimensions, we can understand infrastructures as a relational concept that emerges and only becomes an infrastructure for somebody in a given (community of) practice and when connected to activities and structures over time. From this perspective, a central tenet in this strand of research is that the social and the technical cannot be separated. Rather, they are deeply entangled and imbricated (Star and Bowker, 2002).

I find this understanding of infrastructure particularly useful to critically scrutinise the pilot implementations as a relational phenomenon. The salient dimensions "embeddedness", "transparency", and "reach or scope" (Star and Ruhleder, 1996) are particularly relevant because they problematize the notion of pilot implementations as a distinct other (a field test) "attached" to day-to-day work for a limited period of time. Moreover, the dimensions address the problematic notion of a priori defined boundaries of a pilot implementation. Rather, these dimensions emphasise the understanding that boundaries are negotiated and situated, emerging only through use: when they become a limitation to work; when not everybody agrees on their definition; or when use of the pilot system is not supported by the existing relationship between organised practices and supportive technologies. Thus, the question of what is included in a pilot implementation becomes relative to the perspective of use and position.

The dimensions "links with conventions of practice" and "installed base" are also relevant, as they constitute the way in which new infrastructures grow and the ways that social activities are organised. In this thesis, these dimensions translate into the point that a pilot implementation wrestles with and plugs into the existing work practices, working relations, and the supporting technologies of the larger community of practice. In the case of the ePPR project this includes the pre-hospital sector and regional politics.

HOW TO INFRASTRUCTURE?

The third strand of research on infrastructure departs from later work of Star and Bowker (2002). While a part of the literature acknowledges infrastructure as an activity it is subjected to that of designing (e.g. Hanseth and Lundberg, 2001; Hanseth and Lyytinen, 2004; Rolland and Monteiro, 2002), building (e.g. Aanestad and Jensen, 2011; Edwards, 2003; Hanseth and Lyytinen, 2010), developing infrastructures (e.g. Hanseth et al., 1996; Ribes and Finholt, 2009; Rolland and Monteiro, 2002) or doing infrastructural development (e.g. Edwards et al., 2009; Grisot and Vassilakopoulou, 2013; Kee and Browning, 2010). In contrast, Star and Bowker (2002) propose that infrastructure is an action in itself, and ask: "How to infrastructure?".

With the notion "to infrastructure", Star and Bowker (2002) bring points from previous works to the fore. Two main points will be made here in relation to pilot implementations. First, infrastructure is more than a substrate "just being there". It does something to people – it affects the different ways organisations and society as a whole organise themselves and it affects peoples' (quality of) life *"It is not just the bits and bytes that get hustled into standard forms in order for the technical infrastructure to work. People's discursive and work practices get hustled into standard forms as well. Working infrastructures standardize both people and machines"* (Star and Bowker, 2002, p. 154). Second, infrastructures do not just happen. They require work getting done and this work carries along significant ethical and political choices as infrastructures provide not only access but also barriers. What may be an infrastructure for some may be an obstacle for others (Star, 1999). Hence, the shift from noun (infrastructure) to verb (to infrastructure) holds a political agenda to make the issues of power and position that goes into infrastructural development visible to the users of infrastructure.

Applied to pilot implementations, the notion of infrastructure as a politically textured action shows us that the implementation of a pilot system does

something to the organisation in which it is implemented. The power and positions of those involved easily become imbricated in the planning and running of the pilot implementations as it builds on the conventions of practice. Thus, some of the problems, which emerged in the ePPR project can be explained as relational issues and as power struggles hidden in the taken for granted.

Inspired by the notion "how to infrastructure" Karasti and Syrjänen (2004) coin the term "infrastructuring". The purpose of this term is to point out that infrastructuring has on-going processual qualities and emphasise that infrastructuring unfolds as part of practice over an extended period of time. The turn from "infrastructure" to "infrastructuring" indicates a shift towards addressing the long-term endevour (Ribes and Finholt, 2009) that extends beyond the single ISD project (Karasti et al., 2010).

The contribution of the notion of infrastructuring to this thesis is the emphasis of the long-term perspective on pilot implementations. It provides a view on the processes as not being limited by the pilot implementation and the ISD project in general. This view will be further elaborated in the section "Temporal scales of infrastructures".

Infrastructural inversion

To study infrastructure is a challenge in many ways. First of all, its extensive scope and relational quality makes it diffuse and without fixed boundaries. Moreover, the design and control of infrastructures do not belong to anyone in particular, but is exercised by certain actors at a certain time and place through processes of negotiation and exercise of power (Bowker and Star, 2000; Nielsen, 2012; Star and Bowker, 2002). The biggest challenge, however, is the invisible quality. Once infrastructures become part of practice, they are taken for granted and disappear into the background.

Thus, to study infrastructures and the political and ethical work that goes into growing them, Bowker (1994) proposes an *infrastructural inversion*. Conducting an infrastructural inversion means to *"[t]ake a claim that has been made by advocates of a particular piece of science/technology, then look at the infrastructural changes that preceded or accompanied the effects claimed and see if they are sufficient to explain those effects - then ask how the initial claim came a posteriori to be seen as reasonable"* (Bowker, 1994, p. 235).

In other words, an infrastructural inversion provides a methodological gestalt switch to analytically foreground that, which is normally in the background (the infrastructure) (Bowker and Star, 2000). The purpose of the infrastructural inversion is to critically question and resituate the relations between technologies, people, and the arrangements that originally permitted its use. Hence, when making an infrastructural inversion it becomes clear that what seemed to be a causal effect, is often a consequence instead (Star and Bowker, 2002).

In relation to the research question, "infrastructural inversion" requires looking at the organising of pre-hospital treatment and the relations between the involved participants and the pilot system in a pilot implementation, rather than the elements of a pilot implementation. Specifically, I find "infrastructural inversion" useful for investigating how and why everyday work relations between, the organisations, caused problems to the ePPR pilot implementation.

Tensions

One of the salient characteristics of infrastructure is "breakdown". When infrastructures break down they become visible (Star and Ruhleder, 1996). According to Pipek and Wulf (2009) breakdowns occur when the users experience an insurmountable incongruence between the expected infrastructure service and its actual or perceived behavior (p. 458). If we apply this definition of breakdown to a pilot implementation setting, we can see the breakdowns as occasions where the taken for granted of the infrastructure does not support the organisation of the pilot implementation and pilot use. Pipek and Wulf (2009) call these occasions of breakdown for *points of infrastructure*. Extending this notion, I will use the occasions as the starting point for operating infrastructural inversions in the analysis of the ePPR project. I do, however, find the term "breakdown" problematic, because of its connotations of something definite and absolute; a breakdown causes the "standstill" of a situation until what caused the breakdown is solved. In accordance with the relational view of infrastructures, breakdowns are however also relational and we may ask *when* is a breakdown? What is a breakdown for some might not be a breakdown for others.

To capture the relational quality of breakdowns, I will instead use the term *tension*, which is also commonly used in infrastructure literature (e.g Edwards et al., 2007; Hanseth et al., 1996; Ribes and Finholt, 2009). Edwards et al. (2007) for instance identify three base-line tensions: time (short term versus longer time scale), scale (global interoperability versus local optimisation), and agency (planned versus emergent changes). On another scale, tensions can be understood as conflicting goals, purposes, and motivations between those involved in developing the infrastructure (Ribes and Finholt, 2009). Hence, in general tensions are about divergence and discrepancies. Where a breakdowns can be understood as definite and static, tensions indicate a movement or tautness; that something is changing or is in progress. Moreover, tensions signify scales of severity down to the minute of a problem. When tensions are acknowledged, solved or somehow accommodated, they can be resources for further development or growth (Edwards et al., 2007; Star and Ruhleder, 1996).

Temporal scales of infrastructures

One of the big challenges in the ePPR project was to use the pilot system, while at the same time being able to go along with the daily work. In infrastructure theory, this tension is described as an issue of temporal orientation between short term and long term matters (Karasti, 2014; Karasti et al., 2010; Ribes and Finholt, 2009; Rolland, 2014).

With a reference to computer scientist Danny Hillis and environmentalist, Stuart Brand, who established the "Long Now Foundation" to develop a 10.000 year clock[2], Ribes and Lee (2010) describe the work to design infrastructure as a strategy of *the long now*. With this notion, Ribes and Finholt (2009) want to

[2]The clock is designed to tick once per year for 10.000. For every century the clock will chime and for every millennium the cuckoo comes out. Two prototypes have already been constructed but the final clock, which is placed inside a mountain in West Texas, is still under construction.

stress that sustainable design of infrastructures requires a long term perspective on technologies as well as organisational arrangements during development and maintenance of infrastructure: *"Infrastructure development is an occasion for the long now: it is as concept that collapses immediate design and deployment with the work of maintenance and sustainable development"* (Ribes and Finholt, 2009, p. 393).

In parallel strands, Karasti et al. (2010) describe the two distinct temporal orientations in infrastructure development work, project time and infrastructure time. *Project time* is characterised as closed in terms of duration and organisation and it is linked to near-time plans and closed-frame problem solving defined by the business plan and short-term funding. *Infrastructure time*, on the other hand, is characterised as favouring open-ended planning, long-range problem solving, and sustained funding. However, rather than seeing the different temporal orientations as a two-tier tension between short-term efforts and long-term aims, Karasti et al. (2010) argue that the tension is solved when short-term *and* long-term are addressed within infrastructure time. In other words, when the short-term activities (daily work) are balanced with long-term requirements (development, maintenance, and redesign). Thus, a central tenet in their work is that short-term activities related to project time should be seen as a trajectory setting for longer-term processes related to infrastructure time. The long-term requirements, on the other hand, should be followed by a concern for how the view to the long-term affects activities conducted in the short-term. The short term here includes not only what is afforded here-and-now but also the existing legacy and the installed base. Hence, rather than understanding infrastructure time as a matter of scale, Karasti et al. (2010) suggest that we think of infrastructure time as an extended temporal landscape or a continuum that links the past and present with future plans and actions *"In the case of infrastructure time, a process of short-term steps takes the information managers towards an emergent future along an unfolding long-term path of collaborative infrastructure development. This establishes a temporal landscape of continuity where closely associated efforts are planned and aligned as in-situ experience informs present and future plans"* (Karasti et al., 2010, pp. 402).

In relation to this thesis, the concept of "the long now" provides a way to conceptualise the challenge of testing the pilot system, while, at the same time, attending to everyday work and conforming to regulations of emergency medical services. However, I find that the challenges in the ePPR pilot implementation project are not only related to here-and-now, but also to the past. Therefore, I find the term "infrastructure time" more useful. It provides a sensibility towards investigating the tensions in the ePPR pilot implementation project as related to different dimensions of the past.

Following "infrastructure time", we can describe pilot implementations as a collapse of time with the pilot implementation being "stuck" in the present (the project constellation), while the pilot participants are trying to cope with an emergent future (pilot use) that must take the past into account (the established relations between the organisations and the technologies supporting pre-hospital treatment in the region). Thus, the constitution of the pilot implementation is coupled to its enactment of it as a landscape that extends from the present to the future and the past.

Enactment of project multiple

To investigate the third research question and provide yet another understanding of pilot implementations, I will turn to the concept *enactment*.

Following Ribes and Finholt (2009), the work that goes into developing a stable infrastructure can be described as the enactment of a desired future. Drawing on Fountain's (2001) research on IT implementation in digital government, Ribes and Finholt (2009) describe enactment as the work that goes into the transition from experimental technology to a usable and stable infrastructure. In this section, I apply this notion to pilot implementation to propose a way to understand the implications of the pilot implementation as a means to facilitate the transition from development to implementation and use. To further elaborate my understanding of "enactment", I will draw from the work of Mol and Law (2004). Although they use enactment in a medical anthropological research setting, I find their work useful to understand and describe the work that goes into conducting a pilot implementation, since they relate enactment to "tensions" and "invisible work".

Mol and Law (2004) propose a new way of knowing or understanding disease; it is a practice of enacting the body and the disease. With this suggestion, they wish to overcome the dichotomy of modern medicine, that either talks about having a body (as it is scrutinized by the doctor) or being a body (as it is experienced by the patient). Turning to look at 'the body we do', as an enactment, they foreground an episteme that talks about knowing as action rather than knowledge being something collectable. This shift from acquiring knowledge about the body to practicing the body holds the point that bodies are not just there – ready made, rather they require work done. It requires an orchestrations of actions to appear or to be enacted as a *whole* body-that-hangs-together.

Through the example of hypoglycaemia, Mol and Law (2004) show that enacting the disease involves the whole body from the hand that injects the insulin, to the digesting intestines and the sugar metabolism of the individual cells. The body however is not merely a body with diabetes but also a body that for instance does sports, and a body that likes to indulge in foodie activities. It is a *body multiple* that is entangled in ever so many ways with the diabetes it lives with (Mol and Law, 2004, p. 54). Yet the body is not *whole*. Rather the body can be seen as a set of tensions, which arise from the different oriented interests of the body multiple. To have them co-exist, requires a lot of work. Work that is often invisible and hidden beyond the apparent "body-that-hangs-together": *"Keeping yourself whole is one of the tasks of life. It is not given but must be achieved, both beneath the skin and beyond, in practice"* (Mol and Law, 2004, p. 56).

If we apply this understanding of a "body multiple" to pilot implementations, it underlines that a project consist of multiple co-existing enactments (Winthereik, 2010). It entails invisible work to manage the tensions and to align this project multiple and make it hang together as one. Moreover, with the enactment concept we can put forward the understanding that while project participants are planning, defining, measuring, and using the pilot system, they

also enact a possible future solution. Thus, as Winthereik (2010) notice, a pilot implementation is not merely a way to organise what is already there. Rather it is doing something; it is causing tensions related to the multiple and different enactments of a possible future in the continuum past-present-future.

Genuine participation

According to existing literature on pilot implementations, pilot implementations are conducted to learn. The learning that takes place is primarily derived from the pilot users' experiences with the pilot system as part of daily work (Bansler and Kensing, 2010; Hertzum et al., 2012). Although the pilot users are central to pilot implementations, they are almost invisible in the pilot implementation literature. Their voices are at most aired as user frustrations. Taken that pilot implementations are relational and that the work that goes into their making is politically textured, I turn to the field of Participatory Design to describe the terms of participation of the pilot users.

Participatory Design was pioneered in the Scandinavian countries in the 1970's as part of the "workplace democracy movement". Participatory Design research was a response to the introduction of computer systems in the workplace and built on the democratic ideal that the employees should have a say in the design of the computer systems. Researchers were concerned that the computer systems primarily would be a management tool to exercise power and control while at the same time reducing the workers' influence over their own work. Thus, Participatory Design researchers were committed to ensure that those who would be mostly affected by the implementation of the computer systems, would also have a say in the design of these systems (Kensing and Blomberg, 1998; Robertson and Simonsen, 2012). Over the years, Participatory Design has been dominated by three main issues: (1) the politics of design, (2) the nature of participation, and (3) methods, tools and techniques that supports participatory design activities (Kensing and Blomberg, 1998). I this thesis, I am mainly concerned with the second issue.

In the introduction of the Routledge Handbook of Participatory Design (2012) Robertson and Simonsen (2012) define Participatory Design, in essence, as a process of mutual learning and collective reflection, where the users are legitimate and acknowledged participants in the design process (contra the notion of participants as merely informants). This means that the participation must build on trust, confidence and genuine participation. With reference to Storm Jensen (2002), Robertson and Simonsen describe *genuine participation* according to three dimensions of participants working as themselves, with themselves, and for the task and the project *"Any user needs to participate willingly as a way of working both as themselves (respecting their individual and group's/community's genuine interests) and with themselves (being concentrated present in order to sense how they feel about an issue, being open towards reflections on their own opinions) as well as for the task and the project (contributing to the achievement of the shared and agreed upon goals of the design task and design project at hand"* (Robertson and Simonsen, 2012, p. 31). In the definition, the three aspects are presented as equally important, but I believe that without being able to participate as oneself and with oneself it is questionable how much it is possible to genuinely participate for the task and the project,

contributing to the shared and agreed upon goals. However, I find this definition of genuine participation useful to inquire into the conditions for participation in pilot implementations.

3 | THE CASE

Development of IS for the health care is often a messy and complex affair. The work is organized ad hoc in an environment where many different stakeholders with different interests have to collaborate to create an IS. This makes health care an interesting field for conducting and studying pilot implementations. Therefore, to study pilot implementations, I have followed the ePPR project in the pre-hospital sector in Region Zealand. As mentioned, in the beginning of the thesis, the project pilot implemented an electronic patient record in the ambulances to support emergency medical services also known as ambulance services.

In this chapter, I will introduce the ePPR project to present the setting of the case study on which I build my thesis. First, I will briefly describe the structure of the public health care in order to give an understanding of the context of the ePPR project in general. Then, I will describe the backdrop of the ePPR project and my participation in it. Finally, I will introduce the project and the particular conditions under which the ePPR was pilot implemented.

The Danish Health Care

The Danish health care is build up around three political and administrative levels represented by the following authorities: the State, the Regions and the Municipalities, which each have their area of responsibility. Traditionally, the Danish public sector was decentralised and the responsibilities of health care were resting on the counties and municipalities (Vallgårda and Krasnik, 2004), but with a structural reform in 2007 a (re)centralisation took place . The reform reshaped the administrative landscape by reducing the previously 271 municipalities to 98 and replacing the 13 counties by five regions: The North Denmark Region, The Central Denmark Region, The Region of Southern Denmark, Region Zealand and The Capital Region of Denmark (see fig. 3.1). At present, the regions are responsible for the Danish health care.

At a functional level, the Danish Health care consist of a primary, secondary and tertiary health sector (Vallgårda and Krasnik, 2004). The primary health sector is responsible for general care and health problems that does not require hospitalisation (Olejaz et al., 2012). The primary sector consists of private (self-employed) practitioners (including general practitioners, specialists, dentists, physiotherapists, chiropractors, and pharmacists) and municipality health services such as nurses and home nurses health visitors (Vallgårda and Krasnik,

Figure 3.1: The five regions in Denmark - Modified version retrieved from Wikipedia September 6, 2015, illustration courtesy of Jarke.

2004). The secondary health sector is responsible for medical care requiring specialised treatment, equipment, and intensive care (Kierkegaard, 2013) at the hospitals, whereas the tertiary sector is comprised of the nursing homes.

Emergency care, provided at the emergency departments of the hospitals, belongs to the secondary health sector. Emergency medical services on the other hand belongs to the primary sector (Syddanmark, 2009) and more specifically the pre-hospital sector. Emergency medical services include out-of-hospital immediate and life saving care to parturient and people with acute illness or injury (The Department of Civil Affairs, 2012). Other types of services include transport to definite care and different types of medical transports where the patients, due to illness or injury, are prevented from transporting themselves. The emergency medical services are provided in cooperation with the emergency dispatch centre, dispatching the ambulances for ambulance runs and the emergency department at the hospitals.

There are three ways to receive emergency care at the emergency departments: with referral from a general practitioner, by presenting oneself without referral[1], or by ambulance provided by the emergency medical services. The ePPR project focused on the latter case.

The pre-hospital sector in Region Zealand is divided in a political, an administrative, and an operative level, consisting of the regional council, the Pre-hospital Centre, and the emergency medical services providers (EMS providers) respectively. The regional council manages the affairs of the region including those related to health care. The Pre-hospital Centre administrates and executes the political decisions related to emergency medical services, among others, and the EMS providers run the ambulance services for the region. During the time of the study, the emergency medical services were provided by two different contractors.

The region includes 17 municipalities, spreads across 7222 km2 and has around 820.000 inhabitants (Region Zealand, 2016). This leaves the region with the second highest population density. The region has seven somatic hospitals with 1848 beds. In 2014 they provided ambulant care to 957.378 patients and inpatient care to 215.025 patients (Sjælland, 2015).

Project clinical overview

In connection with the 2007 reform, the Danish Ministry of Health presented a series of recommendations and provisions on how to strengthen acute care including the emergency medical services and emergency care (Sundhedsstyrelsen, 2007). An essential aim of the report was a reorganising and restructuring of the country's emergency departments into fewer but bigger joint acute rooms (in Danish 'Fælles akutmodtagelser'[2]). The basic tenet of these reductions was that the competences of the clinical staff were directly related to the volume of incoming patients and experiences. Moreover, the reduction would provide the patients a wider range of medical specialities upon hospitalisation. The report comprised 24 recommendations, 16 of which were directed at the pre-hospital

[1] Except from the Capital Region, where a Medical helpline (1813) can refer people to a hospital emergency department outside of the general practitioners' normal surgery hours.

[2] In 2007 there were 40 hospitals with emergency departments and the aim was to reduce it to 20-25 hospitals with emergency departments

sector, including a recommendation that all pre-hospital treatment should be documented in a nationwide electronic pre-hospital patient record. Another recommendation was to establish close collaboration between the general practitioners, emergency dispatch centres, emergency medical services, and the joint acute rooms.

In 2008, The Region of Southern Denmark initiated the implementation of these recommendations. This included constructing a new university hospital, a so-called 'super hospital', including a joint acute room[3]. To support this work, the region in joint collaboration with Roskilde University established the project *Clinical overview*. The project ran from 2010-2013 and I was associated with the project together with another PhD fellow and co-researcher, Magnus Hansen.

The project "Clinical overview" had two overall aims. The first was to find out how to best support clinicians at the joint acute rooms getting a clinical overview by means of IT. By clinical overview is meant an overview of data, coordination, and knowledge sharing between the involved actors (Hertzum and Simonsen, 2010a; Rasmussen et al., 2010). The second aim was to empirically expand research on the method *Effects-driven IT development* by using it to develop IT-systemst to support clinical overview. Effects-driven IT development is a method that addresses the problem of uniting the gap between technical development and organisational implementation through the use of effects (Hertzum and Simonsen, 2011). The cornerstone of the method is to specify and measure anticipated effects related to the implementation of an IT system. To assess whether the specified effects are achieved, a pilot implementation is conducted (Hertzum and Simonsen, 2011).

Within the frame of project Clinical overview, the co-researcher and I decided to focus on (a) IT support of clinical overview and coordination between actors from the pre-hospital sector, and (b) how to specify effects and evaluate them by means of pilot implementations. This focus was motivated by the fact that the pre-hospital sector was a neglected area of research compared to research on IT support in the emergency departments. Since The Region of Southern Denmark did not have any project with focus on pre-hospital acute care, the project decided to follow the recently established ePPR project in Region Zealand.

The ePPR project

The preparations for the ePPR project were initiated primo 2010 and the project ran until September 2012. It was conducted by the Pre-hospital Centre of Region Zealand and assisted by the two EMS providers in the region, which put their resources at disposal. Each provider participated with a number of super users according to the size of their organisation. The project was conducted in collaboration with an IT vendor, who distributed the ePPR in Denmark. In the periphery of the project was a software supplier, developing the ePPR, an electronic product manufacturer providing the hardware, and a multinational manufacturer of emergency medical products developing some of the technical equipment in the ambulances that the ePPR was going to be integrated with. The clinical staff was represented by delegated doctors and nurses from two emergency departments in the region.

[3]The hospital is not expected to be ready until 2022.

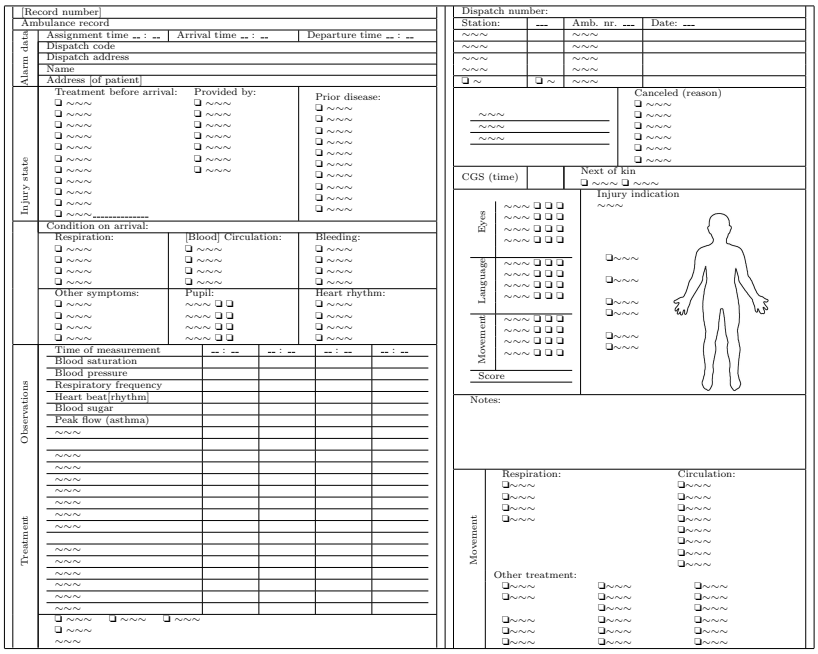

Figure 3.2: Modified version of the paper-based ambulance record

For the project, Region Zealand had made an agreement with the IT vendor to rent the ePPR. Initially the region turned to an existing solution in Northern Denmark, but the electronic record had not been developed for four years and hence did not contribute with new knowledge to the nationwide ePPR tender. Therefore, they turned at the Scandinavian market where they found an already tested commercial-off-the-shelf system, the ePPR. The region made a leasing contract with the vendor, including project management and translation of the content to Danish.

The ePPR consisted of a windows based mobile touch screen, in which the ePPR software was installed (fig. 3.3). The content in the ePPR user interface consisted of a superset of the information in the original one-page A4 carbonless paper based record (fig. 3.2) and it was structured around the concepts of tabbed browsing and drop-down menus. To enter information, the ambulance crew could use a stylus pen (supporting both letter recognition and virtual keyboard) or a physical keyboard installed in the patient compartment of the ambulance. It was expected that the ePPR would be integrated with other equipment in the ambulances, the emergency departments, and the dispatch centre to support seamless integration of data and a continuum of care across the different health sectors.

The ePPR project was initiated in relation to a new setup for pre-hospital care in the region, which was approved by the Business Committee and the Regional Council in 2010. The pre-hospital plan, in essence, aimed at removing the doctors from the ambulances and replacing them with a higher number of

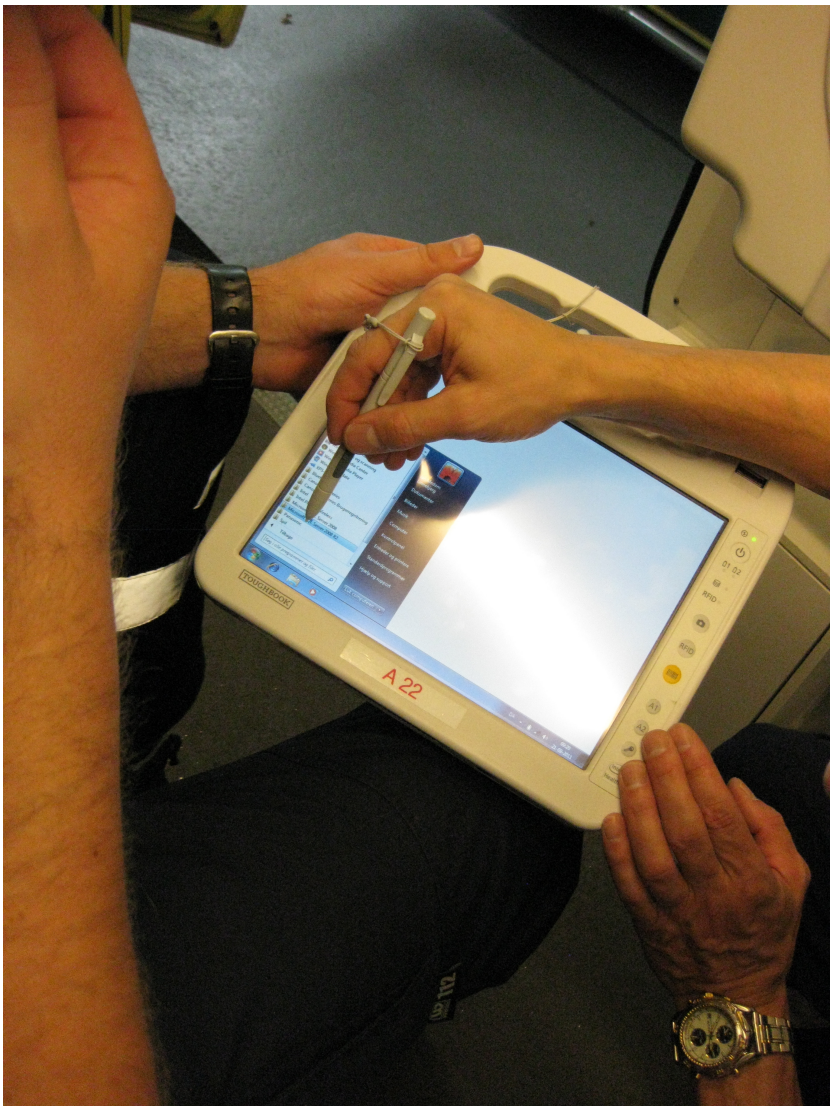

Figure 3.3: The electronic prehospital patient record

paramedics. It was, at the same time, expected that this plan would save the region approximately 20 million Danish Krones per year.

Overall, the existing pre-hospital setup favoured higher quality of care but for a lower share of the region's citizens. The purpose of the new pre-hospital plan was, therefore, to provide a more equal quality of care to all the region's citizens (Rasmussen et al., 2012). This entailed replacing the five response units (out of a fleet of around 70 vehicles), staffed with physicians and nurses, with 6 response units staffed with paramedics. In addition, 10 ambulances staffed with emergency medical technicians were going to be upgraded paramedics (Rasmussen et al., 2012). While the physicians and nurses would only be on duty from eight to around midnight and cover only a limited area of the region, the new response units and some of the ambulances would be staffed around the clock and cover a much larger area.

To evaluate the new pre-hospital setup and investigate the impact of removing the physicians, the region had decided to survey the ambulance work and gather data in the 16 new response units and ambulances staffed with paramedics. To ease data collection, the region decided to use an ePPR. This way, it would be possible to get real time data about the patient treatment, given en route to the hospital, and share these data with the clinical staff at the emergency departments prior to arrival. The use of an ePPR would, moreover ease the data collection.

The five Danish regions were, in parallel with the ePPR project, working on a tender for a nationwide ePPR, but it was not expected to be ready until 2012 and thus, Region Zealand decided to temporarily rent a electronic patient record for the the ePPR project until the national ePPR would be ready. Since only one other region at that point had previous experiences with an electronic pre-hospital patient record, Region Zealand also saw the ePPR project as an opportunity to be in the vanguard of health care IT and to be able to provide input to the national ePPR tender. Findings from studies were to inform The Region of Southern Denmark and Region Zealand's participation in the tender for a nationwide ePPR.

The pilot implementations

This section provides a description of the ePPR project as it evolved during the time that I followed it, January 2011 to September 2012. The original plan was to commence pilot use in March 2010 and use the pilot system until the national ePPR would take over.

The description is organised according to the five constituent activities identified by Hertzum et al. (2012): planning and design, technical configuration, organisational adaptation, use, and learning. The co-researcher's and my participation in these activities were mostly limited to pilot use.

Although the description may give the impression that the activities were orderly, arranged there were, as indicated in figure 3.4 loops and overlap between the different types of activities. As the timeline also shows, the pilot system was implemented for pilot use twice before the project ended.

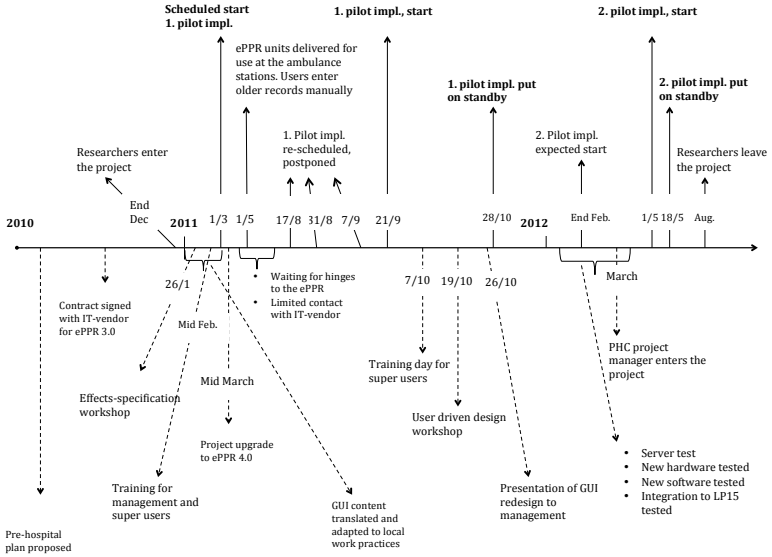

Figure 3.4: Timeline with central activities from the ePPR project

PLANNING AND DESIGN

Since identification and specification of effects were essential to our research project, we arranged with the Pre-hospital Centre to kick off the project with an effects-specification workshop using the method of Effects-driven IT development. The purpose of the workshop was to identify and specify effects by which pilot use of the ePPR was going to be evaluated[4]. The workshop was conducted in January 2011 with management and paramedics from the EMS providers, chief physicians from two emergency departments, and staff from the Pre-hospital Centre. The vendor was also there to introduce the system to the participants, since their knowledge about the system and the possibilities of the technical setup of the pilot implementation was limited. My role at the workshop was to facilitate the effect specification process together with the co-researcher and one of the supervisors. Prior to the workshop, we had interviewed the participants about what effects they were hoping to achieve by implementing this ePPR. These effects were then gathered, presented, and prioritised at the workshop.

The workshop resulted in a list of 20 prioritized effects, which were grouped and reformulated as three overall effects: (1) A better overview of the pre-hospital treatment can optimise the emergency departments' overview of the prospective treatment; (2) On-going information about the patients via electronic whiteboards at the emergency departments can help the staff provide the level of resources that matches the severity of injury of the incoming patients; and (3) A well designed and user-friendly user interface makes it easier to provide a detailed and comprehensive documentation and it will make communication with the ED more structured. These effects were going to guide the

[4]For more details about the workshop see (Hansen and Pedersen, 2011)

formal evaluation of the ePPR from pilot use.

The fellow PhD and I were responsible for the evaluation of the ePPR. The evaluation was going to take place through an electronic questionnaire that would appear on the screen of the ePPR, every time an ePPR had been completed. Eventually, we decided to use a traditional paper based questionnaire because of issues with anonymity in the electronic questionnaire . We scheduled the evaluation to take place one month into the pilot implementation to avoid that the results would reflect issues during the start-up phase rather than actual use. Therefore, the Pre-hospital Centre did not initiate any further feedback activities other than encouraging the pilot users to send emails with their experiences during pilot use. In the end, the first pilot use period was put on hold the same day as the evaluation was supposed to commence, and therefore the only material for evaluation was the pilot users emails and informal feedback given to the Pre-hospital Centre at casual encounters.

Two crucial elements in measuring the effects were the integration between the ePPR and the defibrillator LifePack 15 (LP15) on one hand and the integration between the ePPR and the electronic whiteboards at the emergency departments on the other. These integrations were to support a seamless flow of data, thereby easing the documentation work of the paramedics and the communication to the staff at ED. While the Pre-hospital Centre and the software supplier were trying to establish the integration to the LP15 throughout the project, data transmission from the ePPR to the whiteboards was aborted due to technical issues. Data mission between the ePPR units was also not possible, why patient handover between response units and ambulances was also excluded from the scope.

The scope of pilot was defined to include acute ambulance runs type 1 and 2[5], where the patients had to be taken to one of the four joint acute rooms in the region[6]. Due to the organisation of work, requiring staff around-the-clock at the ambulance stations, most of the paramedics were working on four day shifts. Thus, the project decided that the ePPR would 'follow' a number of ambulances instead of paramedics and hardware for the ePPR was installed in 11 ambulances and 6 response units across 13 ambulance stations. In the end, more than 90 paramedics tried using the ePPR.

The Pre-hospital Centre initially expected that the project would be a mere matter of translating the content of the ePPR and then implement it for pilot use. Therefore, they had not established an actual project steering committee or made a project charter. Additionally, they did not have an internal project manager from the region. Instead, two managers from the Pre-hospital Centre were responsible for the technical configuration and organisational adaption in joint collaboration with the project manager from the IT-vendor, who was paid

[5]Ambulance runs are divided into four categories: 1) acute and life-threatening illness or injury - ambulance run with callout, 2) acute but not life-threatening illness or injury - ambulance run without callout, 3) other types of none acute ambulance run, which still requires observation or treatment, and 4) other types of none acute ambulance run which does not require treatment.

[6]The region has seven hospitals with emergency departments but only four of them provided joint acute services

to run the project. For some reason, the project did not receive the expected project management and in the end the Pre-hospital Centre had to hire one.

One of the results of the missing project charter was a lack of shared understanding of the purpose of the project. The majority of the participants from the Pre-hospital Centre as well as the managers from the EMS provider saw the project as an implementation project that had turned into a development project once the region chose to implement a beta version of the ePPR[7]. According to other participants from the Pre-hospital Centre, the pilot implementation was going to run as iterations of three months of use, followed by evaluation and redesign.

It was in this setting that the planning and design of the pilot implementation took place. Though it started from a plan, unforeseen challenges and practicalities meant that the project turned out quite different. Arguably, some of the problems can be related to lack of communication and poor management. Following Winthereik (2010), another explanation is that there are different and co-existing enactments of a project and that a project is not merely a way of organising 'what already is there'. Rather a project is a dynamic constellation and its participants act according to what knowledge they have about the pilot implementation and its purpose and goals.

TECHNICAL CONFIGURATION

Working on the technical configuration of the pilot implementation, the project encountered with several challenges. The brackets mounting the ePPR hardware in the ambulances were recalled by the manufacturer due to a production error. The following redesign and re-authorisation took several months and was one of the main reasons for the delay of the first pilot use. While waiting for the brackets, the Pre-hospital Centre told the paramedics to re-enter older paper based records as of March 2011 into the ePPR at the stations. This way the users would get some hands-on experience with the ePPR while at the same time providing data to the evaluation of the Pre-hospital Plan conducted by Sheffield University. The 'lab-like' use revealed great performance issues as well as hardware issues. For instance, it took long time to process the content and sometimes the ePPR would shut down unexpectedly. Additionally, the screens of the hardware were not very sensitive and typing required heavy pounding on the virtual keyboard. Thus, where it normally takes 5-10 minutes to write a paper-based record, it took up to 40 minutes to write an ePPR record. For several months the Pre-hospital would discuss these issues with the software supplier and the electronic product manufacturer and who were responsible for them.

During the first pilot use, the performance and hardware issues had not been solved. As a result, the pilot users sometimes, chose to postpone documentation in the ePPR until arrival at the emergency department. This practice, however, prevented them from getting experiences with the ePPR during ambulance run. Eventually, the problem was solved by updating the hardware to a newer and faster model, but it did not happen until prior to the second pilot use period.

[7]The region had originally chosen to pilot implement the existing version on the market. When they were offered to try out a beta version of an upgraded version, which could be updated decentralized and on the run, they decided for this version instead

Figure 3.5: Paramedic at docking station at the emergency department

To compensate for the missing data transmission and bridge pilot use with daily work, the paramedics had to make a printout of the ePPR and hand it over to the receiving end of the patient handovers whenever the ePPR was used during ambulance run. For this purpose, a docking station with keyboard and printer was installed at each of the four joint acute rooms (figure 3.5). The response units were already equipped with printers.

For ease of technical integration, the Pre-hospital Centre decided to use the same type of printers at the emergency departments as the model already installed in the response units. The printers in the response units had been chosen due to their robustness. They were, however, quite slow and it took almost a minute to print one page. While this was not a big problem in itself, nobody had tested the printout before pilot use, and thus only during the first pilot did the project find out that the printouts spread across several pages[8]. The printer issues were of great frustration to the pilot users, since it took substantially longer to handover the patients to the emergency departments. More importantly, it took additional time before the pilot users were ready to be dispatched for a new ambulance run.

ORGANISATIONAL ADAPTATION

In parallel with the technical configuration, the Pre-hospital Centre prepared for the organisational adaptation. Prior to the planned implementation in March 2011, the IT-vendor taught participants from the Pre-hospital Centre how to retrieve data for quality assurance and provided basic training to the super users on how to use the system. However, no further activities were conducted to

[8]In the worst case the printed ePPR spread across 13 pages.

revise work procedures, plan workarounds, setup backup procedures and otherwise safeguard against errors and adverse consequences for the ambulance work during pilot use. Possibly because the project expected that the system would be ready to use without any further organisational adaptation.

Over the spring and summer 2011 there was no communication between the Pre-hospital Centre and the IT-vendor, even though the Pre-hospital tried to contact the vendor on several accounts. Later the Pre-hospital Centre found out that the IT-vendor had engaged in the tendering for a national IT solution for the Danish dispatch centres and therefore had down prioritized activities related to the ePPR project. Start of August, the project slowly got back on track. At a meeting, the Pre-hospital Centre and the IT-vendor discussed the issues that had come up from the lab-like use during the spring. Additionally, the EMS-providers pointed out uncertainty of whether it was possible to retrieve the archived ePPR records, while the EMS managers were still waiting for access to the administrative module.Something that they had been asking for since the commencement of the project. Despite the fact that the IT-vendor did not expect to solve several of the technical issues until October-November 2011, the Pre-hospital Centre planned for pilot use mid August. Mid August the pilot implementation was postponed to end of August, then to the beginning of September and finally to mid September. During this period the, IT-vendor was working on the issues addressed at the meeting in August, but several of them had still not been solved when the pilot use period commenced. Moreover, the users did not receive any further training in the use of the system.

PILOT USE

The first period of pilot use ran from mid September to mid October 2011 and included approximately 70 paramedics. During this period the users faced many technical as well as organisational issues, and on initiative of the users the user interface was redesigned. The second and smaller pilot implementation ran for two weeks during the spring 2012 and included one super-user.

The first pilot use period was announced with only two days notice, giving the EMS-providers little time to prepare and notify the paramedics. While the paramedics upon the beginning of project had welcomed the project as "the future is now", seeing the ePPR as means to move emergency medical services and documentation into the digital era, the feelings had transformed into yesterday's excitement over the summer, and the motivation was therefore low, when the pilot use period started. This is reflected in a note taken during our observations: *[The EMS manager] tells [the paramedics] to [test the system] in a calm and orderly manner. In reply one of the paramedics says: "Is it possible to do it otherwise with this record?"*, implying that the performance issues made it impossible for the paramedics to do anything but working in a calm manner. This attitude was only to be fortified as the days went by and, hence the pilot implementation was troubled before it had even started.

Many of the problems, which the users experienced during pilot use reflected the limited focus on organisational adaptation of the system ePPR. Although many of the problems were minor they added to the negative feel of the pilot implementation overall. For instance there was no written guidelines on how to

understand the different terms and how to fill out the ePPR - in contrast one of the EMS-providers had an eight page long document describing how to fill out the paper-based record; the technical setup had not been tested prior to the pilot, thus, on the first day of the pilot, many paramedics had to spent time installing print drivers on the ePPR whenever they would go to a new emergency department; the printers were setup to print in colours, so the print cartridge quickly ran dry, but the paramedics had not been told where to find new cartridges and paper at the emergency departments; the format of the printout of the ePPR had not been put in order and spread across several pages; the response of the virtual keyboard forced the paramedics to use the real keyboard, but the brackets for the tablet were mounted too far away from the paramedics making it impossible to read the content and easily shift attention between patient and ePPR. Finally, the staff at the emergency departments was not well informed about the pilot use and what to do with the new ePPR printout. Not knowing what to do with it, the secretaries at one emergency department made an improvised cardboard box in which they stored the printed ePPRs.

Among the more serious issues, the contents of the user interface of the ePPR were divided onto more than 20 screens, whereas the paper based record consisted of only one page. This reduced the paramedics' overview of what information they had already entered and what information was missing. Additionally, it was not an easy task to write on the screen during ambulance run and, while many entries were based on drop down menus and clicking buttons, it amounted to a lot of keying. Documentation in the ePPR thus became a cumbersome and time-consuming task for the paramedics. As a result, many paramedics did not fill out the ePPR until arrival at the emergency departments. This strategy, on the other hand, created queues of paramedics waiting to get access to the one docking station, which was installed at each emergency department. Being further delayed by the slow printer, several paramedics reported that they spent more than double the amount of time documenting treatment during pilot use. While it normally took around 5 minutes to fill out the paper-based record it was reported to take up to 50 minutes and in the worst case it took 90 minutes during pilot use.

One week into the pilot implementation management from the Pre-hospital Centre and the EMS providers had a status meeting. Here it came out that one of the EMS providers had told the paramedics to go back to the paper-based record, if they experience that working with the ePPR compromised patient safety. The other EMS provider had already taken them out of the ambulances; one did not work due to software issues and the other two could not print. At the end of the meeting it was decided to buy new and faster printers, but the ePPR had to be put back into use.

As a response to the many difficulties, which the users reported during the first week of use, another super user training session was arranged two weeks into pilot use. The representative from the IT-vendor conducted the training, but it quickly turned into a Q&A session where the paramedics gave voice to their frustration and came up with suggestions of improvement to the IT vendor. It also occasioned lengthy discussions about different work procedures, the design of the user interface, and the general pilot use setup. At the end of the day, three user groups had been established to look into some of the more

pertinent issues. One group was responsible for looking into the position of the bracket for the ePPR tablet in the patient compartment. Another group was responsible for finding a keyboard that could be disinfected due to sanitary and decontaminative requirements for the ambulances. The third group had to make suggestions for improvement of the user interface. This was done at a workshop two weeks later, including five paramedics from both EMS providers. A participant from the Pre-hospital Centre was also there to make sure that their design solution would comply with medical requirements, legislation, and existing work principles. The results were presented to the management from the EMS providers and the Pre-hospital Centre one week later, where the IT-vendor representative also participated. During the meeting, it became clear to the management that the medication module of the user interface was suffering from ambiguity and that the registration of medication was ambiguous. Few days later, the medical director from the Pre-hospital Centre send out an email to inform the EMS-providers that pilot use was temporarily put on hold due to the technical issues and the thorough need for corrections in the user interface.

WAITING FOR GODOT

In the period after suspending the first pilot (October 2011) and until end of January 2012, the Pre-hospital Centre was working on many fronts to make the ePPR usable again. One of the main concerns was that it would live up to a forthcoming accreditation[9]. As the first pilot use had shown, the requirements for documentation and patient safety were not fulfilled. However, a lack of communication from the Pre-hospital Centre made the EMS managers as well as the paramedics uncertain about the progress of the pilot implementation.

At the end of January, the server issues of storing and retrieving ePPR had been settled; the electronic product manufacturer had put a newer and faster version of their tablet at disposal; the software was ready to be installed on the new tablet and thus a new pilot use period was expected by the end of February. But in the end, it took additionally six weeks before it could take place. Lesson learned from the first period of pilot use, the newly appointed project manager from the Pre-hospital Centre and a super user conducted a pre-test of the software in one of the ambulances to check the setup prior to use. The test revealed issues with the keyboard and the hardware was still running slow. Moreover, the super user was discontent that there was still no printer in the response unit in which the test took place. This was otherwise crucial for the paramedics because most of the runs from this vehicle were completed at the site of injury.

In parallel with the technical challenges, the project was faced with different organisational changes. During the winter, the region employed a project manager, and the Pre-hospital Centre had severe vender issues. More crucially, communication between the IT vendor and the Pre-hospital Centre slowly faded out and during spring, it became known that the vendor had resigned from the distribution of the ePPR. Instead a Danish company was to take over collaboration with the software supplier. This complicated the whole project and the Pre-hospital Centre spent a lot of time and energy to find out what the consequences were for the ePPR project and whether they could collaborate with

[9]With the accreditation, the EMS providers as well as the Pre-hospital Centre had to document that they were competent enough to provide the services they offered.

the new Danish company. At the end of our collaboration with the project, this issue still had not been solved.

While these issues were being dealt with, the project ran a second and smaller pilot use session. It was conducted at one station with one super user for two weeks in May 2012. During the second week the ambulance hit a dear and the focus on finishing the accreditation reports had started to take over priority at the EMS providers. When the project was finally ready to re-launch pilot use, the EMS providers were too busy working on the accreditation and the super users did not have time to receive follow-up training. Hence, the pilot use was put on standby until after the accreditation. Meanwhile my PhD fellow and I had left the project.

LESSONS LEARNED FROM THE PILOT IMPLEMENTATION

Since the evaluation of the pilot use was planned to begin the same day as the first pilot implementation was put on standby, the use of the ePPR was never systematically evaluated according to the effects agreed on at the workshop. Yet, during the five weeks of running, the paramedics still provided the project with many insights about the ePPR and suggestions for improvement. I take these suggestions as lessons learned. The feedback was primarily provided via emails, which were forwarded from the EMS managers to the health care personnel manager, but insights were also expressed during interviews and observations.

The users mostly reported about usability, design, and usage issues related to hardware as well as software. While some of the issues were rather tedious, the users might not have learned about them if they had not tried out the pilot system during real-use. For instance, several of the paramedics had noticed how difficult it was to adjust the brightness of the screen making it impossible to read the content on the tablet when outside. Other issues included practical questions such as how to carry along the ePPR tablet with all the other equipment (doctors bag, oxygen supply equipment, stretcher, and LP15).

Often these issues caused changes to the paramedics' work practices and sometimes they gave rise to suggestions of improvements. Bellow, are some of the issues:

- The printers were extremely slow and slowed down patient handover
- The design of the user interface entailed a lot of clicking "No" to all the things not done, while normal procedure only required documentation for things done. This made documentation more time consuming and the paramedics equally frustrated
- The battery lifetime of the tablet was too short and because there only was a docking station in the patient compartment, the paramedics often forgot it in the car when it was charging or it ran out of battery because the paramedics used it in the driver's compartment. Thus, there was a need for extra docking stations and chargers in the driver's compartment
- The bracket for the ePPR tablet in the patient compartment was mounted to far away from the stretcher, making it difficult for the paramedic to attend patient and screen respectively in a flexible manner, to read the

content on the screen, and to get access to other equipment because it was blocking access

- It was not easy to get an overview of the information in the ePPR, because the content was divided onto too many screens
- The paramedics normally use the note field to write down contextual information. In addition they use it to support their memory in case of complaints. In the ePPR there was no general note field but several smaller once. To circumvent this issue, the paramedics choose a random field
- Mediation could be deleted or edited once it was entered into the ePPR, with possible adverse consequences
- Time stamps showed the time of entering information and could not be re-edited if the paramedics filled out the ePPR after end ambulance run. This made it difficult to get a picture of the treatment real time.

As mentioned, the lack of overview led to the design workshop with the medication module in particular being one of the concerns that eventually led to the standby of pilot usage. Thus, despite the frustration, the ePPR also entailed learning and common reflection between the paramedics and management from both EMS providers and Pre-hospital Centre. This point will be elaborated further in the analysis.

At a management level, learning was first of all related to management of the project and cooperation across the organisations. During interviews, most of the managers from the Pre-hospital Centre mentioned the implications of a lack of management as a central learning point and reflected on how they, as the project owners, should have been better at managing the project. Several managers also mentioned political aspects of cooperation and difficulties of working with the external IT-vendor, where competition rules as a learning point.

4 | RESEARCH DESIGN

When I commenced the PhD in 2010 it was with the intention to do research on communication and collaboration between different professions and organisational units in the Danish health care. The aim was to find ways to support clinical overview (Hertzum and Simonsen, 2010a; Rasmussen et al., 2010) in the intersection between the pre-hospital and hospital sector by means of an effects-driven IT development (EDIT) approach (Hertzum and Simonsen, 2011). This PhD is a journey, where I have undergone a personal process of maturing my understanding of the empirical material from the study of the ePPR project. My thesis documents this journey about pilot implementations. In the following, I will describe this research process.

Research process

At the outset of our (my co-researcher and I) participation in the ePPR project our role was to facilitate effects-driven activities including the effects-specification workshop and evaluation following the pilot implementation of the ePPR. Since previous research on EDIT had mainly been concerned with effects specification and evaluation, I waned to investigate how to feed back lessons learned from pilot use and evaluation to the on-going design process and keep a sustained focus on effects through several iterations. I therefore planned for an action research approach (Hult and Lennung, 1980; McKay and Marshall, 2001), which is well suited for research with a dual aim at practical problem solving and change processes in practice while at the same time expanding scientific knowledge and the competences of the respective actors.

During the period from March 2011 until the first pilot use took place, we mainly had contact with participants from the EMS providers. From them, we got the impression that the project was struggling with technical problems and that the ePPR were far from promising. During the pilot use period we also mainly had contact with the EMS managers and the involved paramedics. Our input was from observations during pilot use and participating in status meetings whenever possible. The pilot use period continued being troubled and in October 2011, when we were about to begin evaluation, the pilot use was suspended because of issues with hardware as well as software.

At the end of the year the prospects of a resumed pilot use period had diminished strongly and I was faced with the reality of a stalling project constraining my attempts at applying effects-driven activities. I therefore narrowed my focus to examine the pilot implementations being conducted by the project. While

waiting for the issues to be solved, I initiated a literature review on pilot implementation. Moreover, we started interviewing participants from the project. In parallel, I planned to follow the managers from the Pre-hospital Centre and the two EMS providers, to understand the pilot implementation from their point of view. However, the managers had many other obligations than the ePPR project, thus this proved to be challenging and in the end abandoned.

Guided by the literature review that showed that there was a lack of conceptual definitions on pilot implementation, I decided to look into how to understand pilot implementations. The decision was also motivated by the interviews we conducted and by the experiences (and stories) from the paramedics about their struggles with the ePPR during pilot use. This moreover guided me in the analysis of the empirical material, where I, among others, focused on the relationship between the EMS-providers and Pre-hospital Centre. Furthermore, I wanted to give a voice to paramedics, being underrepresented in research on IT in health care.

In the beginning of this chapter, I mentioned that during my PhD I have undergone a personal process of maturing my understanding of the ePPR project. Initially, my understanding of the pilot implementations was shaped by the work of Hertzum et al. (2012) and closely related to the empirical material. Hence, I initially investigated conditions for learning in pilot implementations in terms of the tensions that arose from the participants' challenges in balancing daily work and pilot use. Over time, and by means of the infrastructure framework, I have been able to distance myself from the empirical material and investigate the findings from a conceptual perspective.

Collaboration with co-researcher

The empirical material was constructed together with the co-researcher, and at that point PhD fellow, Magnus Hansen. We planned and conducted together the effects-specification workshop and several interviews, although we had different foci and therefore also questions.

All the material we constructed, was shared among us, while we had several discussions about our findings. The shared material includes notes and pictures from observations, recordings and transcriptions from interviews, and notes from meetings. The collaboration resulted in two papers that we wrote together. One paper reported on the findings from the effects-specification workshop (Hansen and Pedersen, 2011) and the other paper reported on findings from our ambulance runs (Pedersen et al., 2011).

All mentioned numbers and hours of observation and interviewing have been reviewed with the co-researcher. There might be variations in the reporting, since each of us only includes the empirical material that we each have found relevant for our respective studies. I have for instance included some observations of ambulance runs in Region Southern Denmark, which the co-author has not included since they were not related to the ePPR as such. Some variations are further the result of the exclusion of empirical material on behalf of ethical concerns to keep the participants anonymised.

Methodological approach

In order to investigate the research questions, I conduct a literature review of literature on pilot implementation. This review addresses the first research question. While the second and third research question, are addressed based on the study of the ePPR project and through a discussion of the findings in relation to the theoretical framework.

To study the ePPR project and examine the pilot implementation, I have used an (ethnographic-inspired) interpretive case study approach (Myers, 1999; Orlikowski and Baroudi, 1991; Walsham, 2006). Interpretive case studies are grounded in the assumption that reality is conceived as an emergent social process, in the sense that the world is not "given" but repeatedly being produced and reinforced through human action and interaction (Orlikowski and Baroudi, 1991). Thus, the access to reality is always socially constructed and interpreted, not only by the people under study but also by the researcher.

The aim of interpretive research is to understand how groups enact their reality, endow it with meaning, and to show how these meanings help constitute their social actions (Orlikowski and Baroudi, 1991). To study social processes, therefore requires that the researcher is getting involved in the social setting of those constructing it, because the social product cannot be understand independently of the social actors. Walsham (1995) proposes field study as an appropriate method for this purpose.

I initially mentioned that the study is ethnographic inspired. By this I mean that I have conducted fieldwork applying ethnographic techniques, but for various practical reasons the observations have been limited in terms of numbers. Overall, the methods included observations of the involved participants in different work settings, working from different sites in the field, participation in various meetings, semi-structured interviews and documentation review. The methods were applied and executed over a period of 20 months, but due to the few observations, which I regard as the main activity of ethnographic studies (Myers, 1999), I do not consider it as a pure ethnographic study. More importantly, I have not paid particular attention to referring and invoking topics and themes of generations of prior ethnographers into my work, which is key to the nature of ethnographic fieldwork (Randall et al., 2010). However, I have made an effort to understand the project and the ambulance work in its social and historical setting (Klein and Myers, 1999). This includes seeing the ePPR project in the larger political context, driven by ambitions to digitalise health care. It also includes looking at the collaboration within the project in the larger context of emergency medical services as a deliverable between a public institution and private companies.

Literature review

The purpose of the literature review is to get an overview of the literature on "Pilot implementation" while addressing the research question as expressed in the introduction.

In the following, I first describe the applied method of the literature review. Then, I provide a more detailed description of the review process. The result of the review is described in chaper five.

A HERMENEUTIC REVIEW APPROACH

One of the overriding issues of this literature review is that pilot implementation is not a well-established concept with a fixed definition and purpose in the field of information systems development. Thus, it has been a challenge to define and clarify what terms to use in the search for relevant papers. Another related challenge has been to point out crucial issues and areas to focus prior to the review. To meet these challenges, I have used a emphhermeneutic framework (Boell and Cecez-Kecmanovic, 2010). According to Boell and Cecez-Kecmanovic (2010), a review does not have to start with a research protocol and a predefined set of questions. Instead, they advocate for a process of *encircling relevant work*. Inspired by the hermeneutics, that sees understanding as an interpretive process of moving back and forth between the whole and the parts of a text, they argue that the literature review is an on-going and open-ended process in which a deeper understanding of the body of relevant literature (the whole) proceed through reading of potentially relevant literature (the parts) where increased understanding of the research field and the research question inform each other.

The process of moving back and forth between the whole and the parts can be broken into seven steps (Boell and Cecez-Kecmanovic, 2010): searching, sorting, selecting, acquiring, reading identifying, and refining (see Figure 4.1). In the process of moving from the whole to the parts, searching is the primary step whereas reading is the primary means for moving from the parts to the whole.

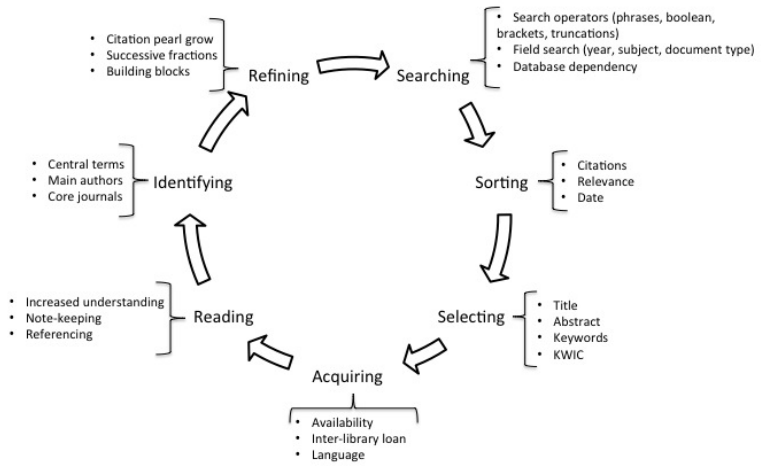

Figure 4.1: Modified from Boell and Cecez-Kecmanovic (2010).

It is important to emphasise that the circle does not have to be followed slavishly and that shortcuts, feedback, and loops between the different steps can take place. Therefore, I will argue that the steps are more of a functional than a sequential order and that it is possible to start at any point in the circle. Having

no fixed point of entry there is also no fixed exit point for where or when to leave the hermeneutic circle. However a point of saturation of the understanding of the whole could be an indication of when to stop (Boell and Cecez-Kecmanovic, 2010).

THE REVIEW PROCESS

The literature review is based on three iterations. In this section, I describe the review process, the particular activities performed for each iteration, and the results of the iterations. The description includes methodological implications for choosing a hermeneutic approach for the review process.
To get an initial understanding of pilot implementations, I read three papers (Bansler and Havn, 2010; Hertzum et al., 2012; Rzevski, 1984) recommended by one of my supervisors. Bansler and Havn (2010) and Hertzum et al. (2012) are both concerned with pilot implementation and both refer to Rzevski (1984), who is one of the first to describe pilot systems. Based on this work the first iteration resulted in a basic understanding of pilot implementation, in which I encircled seven key words to be used in a second iteration:

- Unfinished system
- Real data
- Real use experience
- Test in the real environment
- Asses technical design and organisational implementation
- Learning (through use)
- Iterative design process

In order to get a broader overview of use of pilot implementations, I made a second iteration. Initially, I did a search on Google Scholar and found that there is an abundant literature on pilots and that the use of pilots comes in many different variations. Pilots as an event: pilot studies, pilot test, pilot project, and pilot trials. Pilots as verbs: piloting and pilot testing. Pilots as systems or environments: pilot site, pilot implementation site and pilot system. Additionally, faced with what seemed to be a motley crew of pilots, I found that there was a need to map pilot implementation as a concept against the other types of pilots. To narrow the scope of literature, I combined the pilots with other terms such as information system, information systems development, organisation/organization, and health care, but with little effect. Thus, I applied the snowballing method going through references and citations of the three main papers (Bansler and Havn, 2010; Hertzum et al., 2012; Rzevski, 1984). This, initially, led to a pool of 62 papers. In parallel, I received a list with additionally 34 potential papers by on of my supervisors. To assess the relevance of the 96 papers I applied three criteria:

- The paper contains the word “pilot” in either title, abstract or keywords

- The paper is concerned with a concept similar to that of pilot implementation. To assess similarity the concept had to apply to either of the keywords
- The paper is concerned with information systems or IT technology in general

Out the 96 papers there were 41 relevant papers. Based on the literature of the second iteration, I applied an additional round of snowballing. This time, I would only track references and only include papers concerned with design or development of information systems development in organisations. This led to 38 potential papers. Out the 38 papers, there were 23 relevant papers. The remaining papers were discarded for reasons such as being concerned with pilot studies but outside an ISD context (Bradfield and Gao, 2007; Sampson, 2004); for primarily focusing on the integration of business process engineering; for primarily focusing on organisational learning as a potential approach to drive organisational improvements (Robey et al., 1995); or for viewing the use of technology as a process of enactment, but only with a view to better understanding the constitutive role of social practices in the on-going use and change of technologies in organisations (Orlikowski, 2000).

The relatively low number of relevant papers indicated that the snowballing method had reached its end and that further iterations of snowballing would provide papers that would only be concerned with a subset of the issues of conducting a pilot implementation as otherwise defined in (Bansler and Havn, 2010; Hertzum et al., 2012). An explanation to this could be that pilot implementations is a hybrid approach that draws on other methods and theories like software development or organisational theory and this becomes more apparent for each iteration of snowballing.

THE CODING PROCESS

While reading the papers, I noticed a lack of definition of the pilot method as well as the system. Many of the papers would briefly mention that they did a pilot implementation/test/study etc. but without further explanations of definition of either method or system. There was additionally a lack of descriptions of how the pilot was conducted and what challenges were related to the method. Thus, during the second iteration, I defined a set of codes to guide the coding process:

1. How is pilot implementation defined in the prevailing literature?
    - Characteristics of the method
    - Purpose of the method
    - Characteristics of the system
    - Use of the method
    - Use of the system
    - Elements included in the method in theory
2. What is the purpose of conducting a pilot implementation?

- Purpose of the method
- Purpose of the system

3. What are the challenges of conducting a pilot implementation - in theory and in practice
    - Challenges in theory
    - Challenges in practice

The papers were then read and coded using Nvivo, a software for qualitative analysis and different queries applied to extract data for analysis. The software itself does not analyse, but merely offers a way to extract, compare, and visualise data. For instance, the software can perform matrix coding. Among others, I used this function to get an overview of what elements of a definition of the different pilot approaches had been dealt with in the prevailing literature and by what researchers.

A natural limitation of the matrix is that it is subjective to understanding and categorisation of the different papers and rather than providing an objective and static picture of the research field(s) it simply reflects a snapshot of where one stands in the hermeneutic process of understanding the research field when applying the different coding categories to the papers. However, I do not consider this a weakness of the software nor of my research. Instead, I will argue that this is a fundamental condition of doing research as it is bound to an on-going process of learning.

Another limitation of the method overall relating to the snowballing method, is that the scope is defined by who is referencing whom and who is cited by who. On the other hand this is also what helps mapping the field.

The empirical material

To investigate the second and third research question, I have studied the pilot implementation of the ePPR. In this section I describe how I have produced the empirical material through my participation in the ePPR project, but first I will describe how I got access to the field. The empirical material is divided into the three categories: ambulance runs, interviews, and workshops and meetings. Following the empirical material, I propose some reflections about the implications of my role in the project for the production of the empirical material and my personal motivation for the analysis of the empirical material. Finally, I describe the analysis of the empirical material.

ACCESS TO THE FIELD

Initially, our contact with the project went through one of the managers at the Pre-hospital Centre and our participation in project related activities such as meetings and workshops were conditional on invitations from him. Thus we did not participate in all their meetings. However, over time, as we got to know the different participants we contacted them directly to arrange different activities or get information.

The regions approved our studies and presence in the ambulances overall, while the specific observations were agreed with the ambulance stations at an

individual basis. The observations were conducted as third passenger, and we wore jackets with an "Observer" tag, so that patients would know we were part of the crew and, thus, subjected to rules regarding patient confidentiality and anonymity. We were otherwise not introduced to the patients and only spoke with them when the patients addressed us. The teams that we observed were informed that the observations were done as part of our research and that we observed them to gain knowledge about acute care and how the use of the ePPR affected their work. Because of the paramedics' frustration about the ePPR, we experienced that it was sometimes necessary to emphasise that we were not there to evaluate the paramedics themselves or the work that they did.

Finding dictating machines less appropriate for acute care with sick or injured people, the observations during ambulance run were primarily based on written notes in a notebook or on our phones. Moreover, we were concerned that the dictating machine would affect the patient-paramedic interaction negatively, patients might feel intimidated by a dictating machine and withhold private but otherwise relevant information for the treatment. The observations were supported by pictures (private data being greyed out) to support our memory later, with audio-recorded notes at the end of each run and with diary notes containing impressions of the day.

AMBULANCE RUNS

To learn about ambulance work and as a preparation for the effects-specification workshop and evaluation, we observed several ambulance crews during ambulance run. The obvious strength of observations is that they provide direct first-hand impressions and experiences of the field under study. The co-researcher for practical reasons conducted the main parts of the observations in the ambulances.

The observations and participation align with different phases of my research process and serve different purposes. The first observations were conducted in the beginning of my PhD, in Region of Southern Denmark and region Zealand. The purpose was to build the foundation for an understanding of the pre-hospital sector and specifically the work of and cooperation between the dispatch centre and the ambulance crew. Therefore, I also observed the professional health workers at the dispatch centre taking incoming calls and the technical dispatchers dispatching the ambulances. This included sitting next to them while at work, noticing what (IT) systems they were using, when and for what purpose. Moreover, I observed the ambulance crew during ambulance run.

The second round of observations was conducted during our participation in the ePPR project and it stretched over a period of eleven months, from the project commenced until it was put on standby after the second pilot use period. The purpose of the observations was to see how work was conducted while using the paper based record and while using the ePPR. Additionally, we were able to experience pilot use from the paramedics' perspective.

In total we observed ambulance run 15 days with approximately 173 hours of observations. The observations are divided onto 67 ambulance runs with 21 teams. Seven of the days (approximately 79.5 hours of observations) were conducted during our participation in the ePPR project. Here we followed 33 ambulance runs with 8 teams. In total, I account for four days, approximately 36 hours of observations of ambulance drives divided onto 15 ambulance runs

with 6 teams.

While it would have been crucial with more observations of ambulance runs, if I had studied effects-driven IT development, I find the low number of ambulance drives acceptable for my research focus on trying to understand pilot implementation overall. Thus, I will argue that the observations have provided me with sufficient insight into the emergency medical services to understand some of the consequences of introducing the ePPR in the ambulance during pilot use. Moreover, the observations prepared me for the topics being talked about doing the interviews and made it possible for me to ask elaborating questions that would provide a deeper understanding of ambulance work and pilot use altogether.

INTERVIEWS

Interviews were the main source of this study. While the observations allowed us to follow the participants in action, the interviews gave room for asking questions to things we had noticed but did not understand or wished to elaborate on. Moreover, the interviews also gave room for reflection for the participants being interviewed. One paramedic, for instance, thanked us for the interview saying that some of the things we had talked about had become clearer to him during the interview.

In total we conducted 41 interviews with 29 participants divided onto a total of 53 hours. The main part, 36 interviews, was held with participants from Pre-hospital Centre and the two EMS providers. The shortest interview lasted 38 minutes and the longest 2 hours and 50 minutes. Among the participants from the Pre-hospital Centre, we conducted 8 interviews with five people from management and two from staff. This author was responsible for seven of the interviews.

We conducted 28 interviews with participants from the two EMS providers. 21 interviews were conducted with 14 paramedics and 7 interviews were conducted with three managers. Here I conducted 7 interviews. Finally, we conducted three interviews with the clinical staff from an emergency department in the region and two interviews with a politician from the region and an IT-developer from the IT-vendor. Out of these interviews, I conducted the four.

The most of the interviews, I did together with the co-researcher. One would interview and the other would write down notes and try to keep an overview of what had been asked and pose follow-up questions if (s)he felt that something had been missing or not sufficiently addressed. In accordance with the interviewees the interviews were recorded with dictating machine and afterwards transcribed. All the interviewees were guaranteed full anonymity.

It was important that the participants would be open and honest in their input. Therefore, we would assure them of their anonymity. Therefore, when presenting information from the empirical material, each participant is given a fictive name. The managers from the Pre-hospital Centre have been kept entirely anonymous, since their title or a potentially consistency on answers might give information on their identity. Moreover, each of the participants has been presented with the transcript of the of their input and have been asked on their preference on anonymity. Some of the participants preferred to remain anonymous, although not all. However, in the risk of revealing the identity of the few that wanted to be anonymous (e.g. by means of exclusion), I have

chosen to keep any participant input anonymous. Input from the same person might appear with different names, that is to exclude identification by means of speech or opinions.

The first interviews were conducted in relation to the effects-specification workshop. We interviewed participants from the Pre-hospital Centre, the EMS-providers, and two of the emergency departments in the region. On one hand the purpose was to introduce the participants to the concept of effects and have them reflect on their visions for the future system prior to the workshop. On the other hand, the goal was also to learn about the participants' background. While it may have clouded the effects specification process (Hansen and Pedersen, 2011), the interviews gave us an overview of the participants idea of the scope of the project in terms of work tasks as well as the range of interests and motivations for participation.

Shortly after the first pilot use period, we interviewed participants from the project with the purpose of hearing about their experiences with various aspects of the pilot implementation. For this reason, apart from paramedics, we also interviewed management from the Pre-hospital Centre and the EMS-providers to get their perspective on the pilot implementation.

After the second pilot use period we initiated a second round of interviews. The purpose was to hear about the progress of the pilot implementation since the first pilot use period and again what had been learned. The scope of the interviews was smaller since fewer participants had been involved in this pilot. Moreover, we also interviewed an IT-developer from the IT-vendor and a politician to get the political perspective of the pilot implementation.

Finally, we interviewed four paramedics as a part of preparations for a questionnaire that we were going to use for the evaluation of the pilot usage. The purpose was to get feedback on the questionnaires, but being an open-ended interviews, we also came around the project in general and thus we gained knowledge on the process of the project.

Because of the overlap between the participants that my colleague and I intended to interview, we decided to conduct them together. Moreover, we did it to avoid taking up too much of the participants' time. While most of the participants were interviewed at their work, the paramedics never knew when they would be dispatched for a new ambulance run. Thus, to avoid being interrupted during the interview, several of them offered to have the interview on their day off.

A disadvantage of merging our interviews was that we had to merge our interview guides into one. Although some of the questions were of general interest, there were also subjects being specific for each our area of research. The biggest disadvantage, however, was that time did not always allow us to elaborate equally on all matters. As a result, the interviews that we held on an individual basis reflect a foregrounding of the interest of the interviewing part.

WORKSHOPS AND MEETINGS

To get an overview and understanding of the activities conducted as part of the pilot implementation, I also participated in various workshops and meetings in the ePPR project. Besides practical reasons, the participation in meetings and workshops also served as a means to experience the relationship between

the EMS-providers and the Pre-hospital Centre, as much as the relationship between the two EMS-providers presented by the involved managers.

During this project, we participated in two workshops. The first was the effects-specification workshop. The workshop lasted for six hours and a total of eight people participated: five (two superiors and three paramedics) from the two ambulance contractors, two head clinicians, and one emergency medical dispatcher[1].

The second workshop, was a user-driven design workshop where five paramedics from the two EMS-providers and a manager from the Pre-hospital Centre gathered to discuss and propose improvements to the user interface of the ePPR. The workshop lasted six hours and resulted in a number of screen dumps of the original interface, which had been modified and edited with the software Paint. Our role during this workshop was to observe the process.

Besides the workshops, we participated in various meetings during the ePPR project including status meetings, a super user training session and a follow up meeting from a user-driven design workshop. In the follow up meetings, design proposals to the user interface were discussed collectively by users and managers from all three organisations with the IT-vendor. Our participation in the meetings was conditional on being invited by the Pre-hospital Centre and therefore we did not participate in all the meetings.

Observations from meetings and workshops were supported with notes written on our computers and shared among us. Moreover, we also recorded them. The recordings were with permission of the participants, who were informed that they were only for internal use to aid the handwritten notes and that we would contact them, if we would quote them in our dissertation. Finally we took pictures to aid memory later on.

My role as a researcher

In accordance with the interpretive approach, I follow up on my overall research process including my role as a researcher to explicitly show which values and meanings I personally brought into the field and which of them played a role in the production of the empirical material. Orlikowski and Baroudi (1991) present three different research approaches including the relation between theory and practice. In relation to an interpretive research approach they outline two different variants: the "weak" constructionist view and the "strong" constructionist view. In the following, I take this approach as point of departure for reflections on my own role as a researcher in the project and as a springboard for further discussion.

According to the authors the weak view presents the understanding that the researcher merely interprets the actions of the actor based on their own understanding of reality, whereas the strong view presumes that the researcher equally enacts the social reality (s)he is studying. My research could be in accordance with the weak constructionist view, to the extend that the co-production of the reality of the people under study is related to the breadth and length of involvement in the social setting. Despite studying the project for 20 months, I was only in the social setting in periods and not continuously for days and

[1] For a more elaborated discussion on the method and the findings of this workshop see (Hansen and Pedersen, 2011).

weeks. On the other hand, the production is also shaped by the degree of participation. I find that my initial action research approach and my initial role in the project as the facilitator of the evaluation, took my research towards being more of a participating observer than an outside observer (Walsham, 1995). It also shaped my engagement in the project: over time, I developed a feeling of co-ownership of the project and, mixed with my personal project (the PhD), this feeling enforced my interest in seeing the pilot implementation becoming a reality. Several of the involved participants, from their side, showed concern for and interest in us getting some useful material for our PhD projects. I take this as a sign of our involvement and as a sign that we established more personal relations with the participants beyond the joint project.

The interest in the project became manifested in different ways. We would follow up on the status of the project overall thereby signalising our interests to the involved participants. We would contribute to discussions during meetings etc., if we thought it would be beneficial for the communication and problem solving. Vice versa, we were also sometimes invited to contribute with our opinions and knowledge by the participants themselves. The project manager, who started on the project after the first pilot usage asked us about our viewpoint of the trajectory until then and, thus, we contributed to his understanding and interpretation of the project overall.

At one occasion, shortly after the second pilot usage, we further participated in a meeting with the Pre-hospital Centre, the IT-vendor, and the hardware producer to prepare the technical integration between the ePPR tablets and the defibrilators in the ambulances. My participation was motivated by a whish to help pushing the project forward while producing empirical material at the same time.

Previously, I mentioned that my roots in the Scandinavian tradition most likely influenced my interpretation of the project by making me foreground issues in this area instead of management issues, seen from the perspective of the Pre-hospital Centre. This process was also being supported through the interaction we had with the paramedics. In the beginning of the project, I noticed that some of the paramedics were being slightly aloof albeit helpful in explain ambulance work. It then came out that they thought we were representatives for the IT-vendor and had been involved in the design of the ePPR. Not appreciating of the design, there were issues which they were more reluctant to address. After our roles had been clarified we experienced that they were more open to us. Some of the participants explicit expressed that they felt that we were "on their side" and that they saw our participation as a guarantee that their voices were being heard. Their honesty and their hopes have also influenced my choice of focusing on their work conditions for learning. This said, there are also practical reasons on why I have more empirical material about the paramedics. They were more accessible than the management from Pre-hospital Centre, who had many different activities throughout the day, which were not especially fit for observations.

I actively sought to interview participants from the Pre-hospital Centre as well as management form the EMS, to avoid giving preference to the paramedics and growing an one-sided understanding of what the conditions might be that influenced learning to emerge during the pilot implementation. I additionally worked from the Pre-hospital Centre to understand the conditions under which they had to manage the project and while it was not possible to observe the

project manager, I encouraged him, as well as the two EMS-managers, to record his thoughts on the project. This way, I could still get an access to (a part of) Pre-hospital management's interpretation of the project. During analysis I have also paid extra attention to shed light on the different analytical themes from as many perspectives as possible.

Analysis of the empirical material

In interpretive research, the theory plays a central role (Klein and Myers, 1999). There are different ways to apply theory in relation to empirical material. As a guide in the early stage to create a theoretical framework, as part of an iterative process of data collection and analysis, and as a final product of research (Walsham, 1995). To investigate my findings, I have constructed the theoretical framework presented in chapter two and applied it as a final product of research. The framework allows me to analyse pilot implementation from a conceptual perspective.

Being positioned in the socio-technological field, I lean against the understanding that information infrastructure is as a relational concept, rather than a physical thing. While normally being invisible and taken for granted, it emerges for people in organised practice and connected to activities and structures (Star and Ruhleder, 1996). However, this definition also holds the recognition that the inherent quality of infrastructure (being universal yet local), carries with it an issue of accessibility, where not necessarily everybody have access to the infrastructure. As Star (1999) so poetically phrase it: *one person's infrastructure is another's topic or difficulty* (Star, 1999, p. 380). Returning to the work of Star and Ruhleder (1996) the authors also prove themselves critical to the distinction of information infrastructures as substrate carrying information on it or in it. Based on their work as ethnographers/evaluators of a system for virtual collaboration between scientific researchers, they instead argue that *the discontinuities are not between systems and person, or technology and organization, but rather between contexts.*

If we apply this definition of infrastructures to the analysis of the ePPR project, it is possible to examine the pilot implementations as part of the larger context of the political plans for the pre-hospital sector in the region, hence connecting the past with the present and the possible future. In addition, it provides a frame for examining how the conflicts emerged during the project, why some conflicts were acknowledged by some participants while yet others were not across the involved organisations. In practice, to study the conditions, I turn to the concept *infrastructural inversion*, originally coined by Geoffrey Bowker[2]. With infrastructures normally being invisible and taken for granted, infrastructural inversion foregrounds what is usually in the background by focusing on changes in the infrastructural relations rather than the technology itself. Thus, instead of focusing on what is afforded by the introduction of the ePPR, focus turns towards the conflicting interests as a change in the relations between the three organisations in and beyond the project. I do this by primarily focusing on the concept of tensions.

[2]"Information, Mythodology and Infrastructures" in Lisa Bud-Frierman (Ed.), *Information Acumen: The understanding and Use of Knowledge in Modern Business*, Routledge, London, 1994, 231-247.

PROCESSING THE EMPIRICAL MATERIAL

Once the empirical material was produced, the next step was to find a way to analyse it. In this section, I will first describe how I processed the material. Then, I will describe the different analytical terms that I arrived at and how I used them in the analysis.

The interviews were transcribed using the transcription software F5 and then uploaded to Nvivo, a program for qualitative data analysis. Other types of empirical material (such as minutes of meetings, pictures, or official documents) were also uploaded. The strength of Nvivo is that it can help organise the empirical material, but essentially breaking the material into simpler components and analysing them, is still done the traditional way. To organise the material Nvivo offers a functionality called nodes. Nodes are essentially containers for coding categories, and they make it possible to code and gather related material under one or more coding categories as well as allow for adding any given number of nodes to the same material. Once nodes are produced, they can be used to create new constellations and relations among the categories and to be extracted as data set, for further analysis.

van Maanen (1979) makes a distinction between types of information collected from the field of study. Although he is rooted in the ethnographic tradition, I find his work useful to distinguish between and describe the relation between the empirical material and theory in my own work. The first type, *first-order concepts*, are the "facts" of the ethnographic investigation such as descriptions of the social setting and situationally, historically, and biographically mediated interpretations used by the members of the organisation to accoutn for a given description (van Maanen, 1979, p.540). The second type *second-order concepts* are the theories, which the research uses to organise and explain the first order concepts. Below, I will first describe how I arrived at the first-order concepts and then how I used infrastructure concepts to derive second-order concepts.

FIRST-ORDER CONCEPTS

In the initial process of analysing the empirical material I solely focused on the interviews and the process was guided by the notion of tensions. With tensions, I understood conditions that were specifically reported as problematic, causing tensions or frustration, and episodes where things were missing, not working properly, or as expected according to the involved participants themselves. The process was done over three iterations. During the first iteration, I went through the interviews with the paramedics who had been closely involved in the pilot implementation and the management from all three organisations. This left me with a number of instances of tensions, which were all categorised as 'tensions'. In a second iteration, I examined each statement more carefully to categorise and organise them in smaller groups of sub-nodes. After the second iteration, I had two overall groups of tensions. The first included conditions directly related to practicalities of the pilot use. The second included conditions related to the relationship between the different involved organisations.

In the third iteration, I would apply the derived categories of tension at the remaining transcriptions. Whenever necessary, I would add new categories and edit the existing categories in a backwards and hermeneutic manner. During

this process, I paid careful attention to not categorise statements as tension based on my own experiences and understandings of the project. Following this coding process, I overall ended up with two main categories of nodes. The first, 'breakdown' included various types of breakdowns, and the second, 'relationships' included various issues and aspects of the relationships between the involved organisations. Below, I briefly introduce the different types of tensions, to establish a foundation for the following subsection in which I will describe how I reconstructed them in the analysis.

It should be also mentioned, that in parallel with the process of categorising the material I was also still transcribing the remaining interviews. In some cases I would, informed by the categorisation process, return the transcription to the participants with a set of follow up questions on things that needed clarification. At some accounts these questions were informed by my categorisation work.

A re-occurring issue across the interviews with the pilot implementation participants was a 'lack of support'. The category in many ways reflects what Bansler and Havn (2010) describe as a challenge to manage the organisational implementation. The lack of support unfolded at different, but interrelated, technical, as well as organisational levels. At a practical level, pilot users reported that guidelines and instructions on how to understand and fill out the ePPR were never provided. This left the paramedics with a feeling that the ePPR was just "dumped" down through the system and that they were left alone with the problem of figuring it out. At a management level, participants talked about lack of a clear division of responsibilities.

Here, I have identified two types of tensions. First, tensions that evolved around the creation of the ePPR record and occurred due to little or trivial things (normally taken for granted when creating the paper-based records) not supporting the new type of work entailed by the ePPR. Second, tensions that were related to the overall practice of acute care and which occurred on the boundaries of ambulance work as a result of the interaction with other departments such as the dispatch center and the emergency department. It is important here to mention that the work practice may be both current and future manifested through the pilot implementation.

In the first group I identified nine sub-categories of tensions, which emerged during the pilot implementation.

Existing infrastructures. Includes situations where the existing infrastructure cannot support the use of the ePPR.

Pilot use. Concerns pilot using the ePPR.

Work practices. Concerns the existing work practices.

Differences. Across organisations: concerns different ways of conducting work in the two EMS-providers.

Daily work and pilot work. Includes situations, which stems from the day to day relations interfering with the project work.

Integration to other systems. Includes both technical and social systems. An example is data transfer from the LP15 to the ePPR and handover to the emergency department.

Support during the project. Includes various things, which the participants reported were missing or not working sufficiently during the pilot implementation, thus making it more difficult for them to do work as intended. This included for instance the missing integration to LP15, insufficient training in the ePPR, missing information about the progress of the project, and lack of division of responsibilities in general.

Legal requirements. Concerns safety of patient treatment, documentation, and contractual requirements between the EMS-providers and the region.

Political agendas. Concerns the paramedics feeling of not doing their work good enough, because the ePPR does not support them in doing it.

The second group embraced various aspects of the relationship across and internally in the involved organisations. The organisations here are mainly the region (being the politicians), the Pre-hospital Centre, and the EMS-providers, but also the IT-vendor is to some extend being included. The different aspects of these relationships, which have emerged were:

Division of responsibilities. Concerns a lack of division or unclear division of responsibilities, which is reported by several of the participants of the project.

Foot soldiers. Includes notions of the EMS-providers as the foot soldiers being paid by the region to provide pre-hospital ambulance service.

Paramedics and ED-staff. Concerns the relationship between the paramedics and the staff at the emergency-departments.

EMS-providers. Concerns the relationship between the two EMS-providers at a management level as well as shop floor level.

The health regions. Concerns the relationship between Region of Southern Denmark and the other regions.

The IT-vendor. Concerns issues with the IT-vendor.

user involvement. Concerns issues about user involvement.

Power issues. Concerns issues of power.

SECOND-ORDER CONCEPTS

After having categorised the empirical material into different types of tensions I applied the other infrastructure concepts. Applying the notion of infrastructure time was useful to explore the relations and interconnectedness of different categories stratifying related nodes into new arrangements. At this point I was interested in understanding the reasons for the tensions arising during the pilot implementation. At this point the decision of which type of tensions to focus at was guided by my own experiences from participating in the project. One type of tension which I interested in was related to creating records by means of the ePPR tablet. With point of departure in the category, tension in existing

infrastructure, I would look at whether and what other types of tensions I had related to this category. In this case the most prominent categories also applied were lack of support during the pilot implementation and integration to other systems. Another type of tension was related to the overall practice of acute care reaching beyond the work in the ambulances. The use of the ePPR for instance also affected the staff at the dispatch centre and the emergency departments.

I did not discuss the findings beyond the limited feedback and answers to questions that I got when I emailed the transcriptions to the participants. However, I attended external documents such as reports from the region, newspaper articles and a forum for ambulance crew. The information that I found helped me to relate the findings to the larger context of acute care and public - private partnership constellations and to deepening understandings of the participants own interpretations.

5 | WHAT IS A PILOT IMPLEMENTATION?

To answer the first research question, what is a pilot implementation, I will conduct a literature review of scholarly publications on pilot implementation. The literature review addresses the three questions: How is pilot implementation defined in the prevailing literature? What is the purpose of a pilot implementation? What are the challenges of conducting a pilot implementation?

Mapping the field of pilots

Mapping out the scope of this literature review has not been easy. An initial query in Google Scholar with the terms 'pilot *' and 'information systems development', resulted in about 5,500 papers and at least fifteen different terms: pilot implementation, prototyping, pilot study, pilot test, pilot testing, pilot phase, pilot district, pilot survey, pilot case, pilot site, pilot project, pilot analysis, pilot program, pilot operation, pilot work, pilot system, and pilot software. Additional terms such as pilot site implementation, pilot implementation study, pilot implementation project, pilot experiment, pilot evaluation, and pilot trail appeared when I searched for the single term 'pilot'. The broad scope of pilots initially brought about the question what is a pilot *really*? Moreover, among all the different pilot concepts, what concepts were related to pilot implementation and how did pilot implementation differ from other concepts? According to the New Oxford American dictionary a 'pilot' can be defined as: *"a noun - a television program made to test audience reaction with a view to the production of a series; an adjective - done as an experiment or test before introducing something more widely; and as a verb - 1) to guide or steer and 2) to test (e.g. a plan, project) before introducing it more widely"*[1]. The common denominator in these definitions is the element of *testing* something prior to something else. A more subtle and implicit element in the definitions is the act of gaining knowledge in order to make informed decisions about that something.

In the field of IS the same understanding of a pilot seems to dominate with the difference that what is to be tested is an information system or a part of it. In the reviewed literature the test is conducted in relation to a project, often, referred to as a pilot project (Ahmad et al., 2002; Babar et al., 2006; Bansler and Havn, 2010; Fullerton et al., 2006; Glass, 1997; Gogan et al., 2010; Gogan and Rao, 2011; Hansen and Pedersen, 2011; Markus, 2004; Pal et al., 2008;

[1] Oxford English Dictionary, Apple's digital version 2.2.3

Ross, 1999; Winthereik, 2010) and the system under test is either described as a prototype (e.g. Alavi, 1984; Lichter et al., 1994; Lim et al., 2008; Naumann and Jenkins, 1982; Rzevski, 1984) or as a pilot system (e.g. Janson, 1986; Janson and Hammerschmidt, 1990; Rzevski, 1984). Although the term 'pilot project' is widely applied, there is an absence of a definition. Several of the papers which report on pilot projects seem to use it merely to indicate a preliminary character of a study (Ahmad et al., 2002; Bernstein et al., 2005; Halamka et al., 2005; Hansen and Pedersen, 2011; Turner, 2005) or use the term as an overall umbrella for various pilot activities such as conducting a system pilot implementation during a pilot study in a pilot project (Ahmad et al., 2002; Bansler and Havn, 2010; Hartswood et al., 2003). In other cases, different pilots are lumped together under one term without further clarifications of similarities and differences (Bansler and Havn, 2010; Hertzum et al., 2012). Furthermore, as Bansler and Havn (2010) point out, despite the widespread use of pilot implementation only little has been published about what it is. A pertinent question is therefore, whether there are any significant differences between the different terms and what these differences may be. The first question of this literature review therefore addresses the question what is a pilot implementation? How has it been defined in the prevailing literature?

Related to the first literature question, I will look at the purpose of a pilot implementation. Although there seems to be a general understanding that a pilot is conducted in order to test a prototype or a pilot system, it is unclear what the specific purpose might be. Furthermore, if we take into consideration the broad spectrum of pilots, assuming that pilots can be carried out at various points throughout an ISD project and knowing that prototypes come in many forms and shapes (Floyd, 1984) that calls for different types of testing, it is also easily assumed that there are several purposes of conducting a pilot. As for pilot implementations in particular, Hertzum et al. (2012) specifically mention that little has been published about why they are considered useful. In the second objective of this review, I thus address the question what is the purpose of conducting a pilot implementation. Are there any specific purposes of running a pilot implementation - and do they differ from other types of pilots?

One of the purposes of running a pilot implementation may be to learn. Bansler and Havn (2010), for instance, manifest that for a pilot implementation to be successful, something must be learned from conducting it. They further remark that it is not uncommon that little has been learned. Additionally, little is known about the challenges involved in conducting a successful pilot implementation (Bansler and Havn, 2010). To follow up on this issue, the third and last question of the literature review, focuses on what might be the challenges of conducting a pilot implementation. The purpose of addressing this question is to investigate what we can learn from the existing literature.

To scope the review, I lean against Bansler and Havn (2010) and Hertzum et al. (2012), who consider a pilot implementation as an activity performed as part of an ISD project and before the information system is implemented in operational use[2]. As shown initially, there seems to be an infinite number of pilot terms, thus, I only include terms appearing in those two papers. On the other hand, I have excluded otherwise related concepts outside the pilot terminology such as co-creation, living lab, configuration, and tailoring.

[2]For a full list of all the papers included in the literature review see Appendix A.

Co-realisation capitalises on the mundane, where the IT developer through long-term engagement and as a member of the workplace facilitate the users in realising needs during operation. Moreover, in many cases the systems are not developed anew, but constructed as a bricolage of so-called 'lightweight' constructions, combining already existing hardware and software (Hartswood et al., 2003). A concept closely related to co-creation is **living labs** or living laboratory (Følstad, 2008). Living labs is a rather new field and is both regarded as an environment as well as a method and a system. The main idea seems to be that innovations in an evolutionary fashion are created, tested, and evaluated in open, collaborative, multi contextual, real-world settings of everyday life (Bergvall-Kareborn et al., 2009; Ståhlbröst, 2008). The purpose is to provide insight into unexpected use of IS and discover new possibilities, but contrary to pilot implementations, it is more common to do this early in the development phase. Two additional concepts that can be related to pilot implementation are tailoring and configuration. In a historical context, tailoring precedes configuration (Balka and Wagner, 2006). **Tailoring** is the act of tailored characteristics of tailorable off-the-shelf- technologies (Trigg and Bødker, 1994) during operation by the users themselves. Tailorable systems are systems, in which end-users' actions are not dictated through predefined rules on how the technology should function (Germonprez et al., 2007). **Configuration**, is concerned with configurable (COTS) software packages or technologies (Anderson et al., 2008; Fleck, 1994; Pozzebon and Pinsonneault, 2005) and builds on the notion that systems during implementation can be configured into a wider network of interoperable systems within and across organisations (Martin et al., 2007) forming a technical and organisational infrastructure (Balka and Wagner, 2006). According to Fleck (1994), configurable systems are developed over time in an evolutionary fashion: "Rather than the technology being unproblematically available from technical suppliers outside the users firm, new developments are being forged during implementation within the user organizations, albeit in close corporation with generic technology suppliers" (Fleck, 1994, p. 640). In later work on configuration, Balka and Wagner (2006) defined configuration as a form of appropriation work that "not only involves redesigning aspects of the technology but requires reconfiguring organisational relations, work materials, as well as aspects of the physical environment". Tailoring and configuration are both conducted during operational use in an evolutionary fashion whereas pilot implementation is confined to development.

PILOT IMPLEMENTATION

The starting point of this review and my initial understanding of pilot implementation is based on the work of Bansler and Havn (2010) and Hertzum et al. (2012). Both papers build on Rzevski's (1984) definition and use of a pilot system.

Several papers about pilot implementation are written by Hertzum and Simonsen (e.g. Hertzum and Simonsen, 2010b, 2011; Simonsen, 2010) with Bansler and Havn (Hertzum et al., 2012). This is reflected in the definitions proposed in their papers. The remaining literature in the review depicts a more diverse picture of the concept. In several cases, pilot implementations are treated as means to achieve something rather than being the main objective of investigation (e.g. Chin and McClure, 1995; Hansen and Pedersen, 2011; Hansen and Simonsen,

2012; Miller et al., 1995; Peute and Jaspers, 2007). Few papers do not provide any definition of pilot implementation nor of the system being tested (Miller et al., 1995; Peute and Jaspers, 2007).

The definitions of a pilot implementation according to the work of Hertzum and Simonsen reflect work in progress and show variations over the same theme and with the main point being that a pilot implementation seeks to bridge the gap between system development and organisational implementation by applying an iterative approach to design, real-use (or as close to as possible), and evaluation during an ISD project. The purpose of these iterations are to learn and to feedback this learning into on-going design.

In their latest work, working with Bansler and Havn, Hertzum et al. (2012) discuss pilot implementation in relation to system development of new information systems and they sum up previous work by defining pilot implementation as a "*field test of a properly engineered, yet unfinished system in its intended environment, using real data, and aiming - through real-use experiences, to explore the value of the system, improve or assess its design, and reduce implementation risk*" (Hertzum et al., 2012, p. 314). In accordance to the definition of Rzevski (1984), they describe the system being tested as a 'pilot system'[3]. The pilot implementation and the pilot system are described by four characteristics (Hertzum et al., 2012):

- the system is still under development and is therefore only suited for limited implementation
- the pilot implementation is limited in scope and time as it must fit within the ISD project
- the pilot implementation is conducted in the intended use environment, with real users using real data
- the pilot implementation is conducted with the overall purpose of learning about the fit between the system and its use environment, how the system performs and how the users appropriate and use the system.

In their definition Hertzum et al. (2012) distinguish between five elements with the first four, i.e. technical configuration; organisational adaption; and use, resembling the standard ISD phases of initiation, development, implementation and operation: planning and design. The fifth element is learning, which is also the most essential element. During *planning and design* it is defined what issues should be addressed during the pilot implementation and how they are to be studied and evaluated during pilot use. During *technical configuration* the parts necessary for the pilot implementation are configured to fit the pilot site. This includes that data are migrated between the systems and that interfaces to the users' other systems are developed or simulations are set up. During *organisational adaptation*, the focus is on revising work procedures to align with the system, train the users in the system and the revised procedures, and possibly assign extra staff to duplicate work according to normal procedures or maintain other safeguards against tensions. During *use*, the pilot system is subjected to use at the pilot site and information about issues addressed

[3] A description of pilot systems will be presented in the section "Pilot systems and prototypes".

by the pilot implementation is collected for evaluation. These four elements pave the way for opportunities to *learn* about the system and its use in an environment with real users, realistically diverse background, and workloads. This includes collaboration with other interrelated organisational units, also, involved in the use of the system by using a technological environment of both hardware, network bandwidth, and data load. The test is not confined to a specific development approach but can be used in both phased and evolutionary development.

Bansler and Havn (2009) and Bansler and Havn's (2010) definition is quite similar with Hertzum et al.'s (2012). Bansler and Havn (2010) define pilot implementation as a limited implementation of a system under development (being a pilot system), in its intended environment, using real data, and with the main purpose of learning. Moreover, and contrary to Hertzum et al. (2012), they further define pilot implementation as a subclass of pilot studies and they specifically relate the success of a pilot implementation to the degree of learning.

Bansler and Havn (2009, 2010) and Hertzum et al. (2012) took an interest in describing the elements and usage of a pilot implementation as part of ISD project and they identified the need for conceptual clarification of what a pilot implementation might be. Winthereik (2010) proposed a conceptual definition of pilot implementation. In the study of an unsuccessful pilot implementation of a maternity record[4], Winthereik (2010) examined the reasons for failure, but instead of attending the pilot implementation as the starting point she focused on the pilot implementation as an outcome of a sociotechnical interplay between project participants and the pilot system[5]. To frame the problems in the studied pilot implementation, Winthereik (2010) introduces the notion *enactment* from the field of STS. Through this framework, she identifies three different ways in which the purpose of pilot implementation is perceived and enacted by the project participants: as a ritual, as a controlled experiment, and as a learning process. Based on this finding, she proposes a conceptual understanding of pilot implementation as a project multiple of different but co-existing enactments, presenting different wholes, which have to be coordinated. An essential feature of the project multiple, she notes, is the embedded normative position "which is to try to find ways in which different worlds might gain recognition and be able to coexist as a vague whole (more enactments are always possible) making up the project" (Winthereik, 2010, pp. 59). On this note, Winthereik places the social as a fundamental characteristic, rather than a factor in pilot implementations.

While the work of Bansler, Havn, Hertzum, and Simonsen present a coherent understanding of pilot implementation, the remaining papers in the review depict a more diverse picture of the concept. Chin and McClure (1995) for instance, are looking at the results of an evaluation of a pilot implementation of a vendor-supplied outpatient clinical information system at a pilot site. They build the evaluations on effects, much like Hertzum and Simonsen (2011), where findings are fed into on-going design and deployed into the pilot site as a version 2.0. However, they only focused on technical issues. Gell et al. (2000) were also concerned with vendor-based standard systems, but contrary to previous literature, they emphasised that a pilot implementation is not only beta-test

[4]The same study of a pilot implementation as the study presented by Bansler and Havn (2010).

[5]This view is similar to the operation of an infrastructural inversion proposed by Bowker (1994).

installations but the first phase of roll-out. In case of insufficient support from the vendor it is, however, still possible to step back from the contract. While the authors mentioned that further change specifications would be made to fix problems detected during the pilot, it is unclear whether the problems included both technical and organisational issues and whether it would be done iteratively or only once before the system was implemented in the remaining phases of the implementation. Fullerton et al. (2006) were concerned with lessons learned from a *pilot site implementation* of a vendor-based ambulatory electronic health record *after* end development. Pilot site implementation is defined as a staggered roll-out with focus on the site selection process and not the pilot implementation itself. While the method was iterative and knowledge gained from one implementation was applied to the implementation plan for the future sites, learning was confined to that of organisational implementation since the system was already fully developed. A similar approach was introduced by Xu and Quaddus (2005), who introduce a six-stage model for diffusion of knowledge management systems. Proceeding actual implementation, the authors suggest that the pilot implementation, among other, might facilitate the successful usage of the system by applying lessons learned from the pilot implementation into the actual implementation: "*take the local characteristics of that specific part, such as circumstances, values, into consideration when the organization is planning to implement the system*".

Abstracting, the field of pilot implementation shows a conceptual divide. While the general trend is to view pilot implementation as a temporary activity, often as part of a larger project, there is disagreement on when to conduct it (before, during or after development), what to pay attention to (technical issues, organisational or both), and what type of system to pilot (a system under development or a vendor-based system). The prevalent work defines pilot implementation as an iterative approach to be used as part of ISD projects of new information systems where formative evaluations of a pilot system during pilot use can provide input to the on-going design as much as the preparation for a full implementation (e.g. Bansler and Havn, 2010; Hertzum et al., 2012; Hertzum and Simonsen, 2010b). For others, pilot implementation is described as an approach to evaluate vendor-based systems either to inform a future purchase (Chin and McClure, 1995) or a final implementation (Xu and Quaddus, 2005). In the latter case, it is not necessarily conducted as an iterative process (Gell et al., 2000) and if conducted iteratively it is only done during (stepwise) implementation of the final system into different sites (Fullerton et al., 2006; Xu and Quaddus, 2005). The only conceptual understanding of a pilot implementation is presented by Winthereik (2010). In her work, she describes a pilot implementation as a project multiple of different co-existing pilot implementations being enacted simultaneously.

PILOT SYSTEMS AND PROTOTYPES

Before I continue to map the fields of pilots, I will take a closer look at the system being tested when conducting a pilot implementation. As previously mentioned, in an IS context, they are often referred to as pilot systems and prototypes. Since pilot systems in some studies are characterized as a special type of prototype, I shall start out by looking at prototypes, before I draw the contours of pilot systems.

A large part of research in prototypes define prototypes as variations over the same theme: a system that captures *the essential features* of a later system (Naumann and Jenkins, 1982); an early version of a system that exhibits the essential features of the later operational system (Alavi, 1984); a small-scale, inexpensive software/hardware artefact developed with a view to evaluating some aspects of the proposed information system (Rzevski, 1984); the first embodiment of an idea (Janson and Smith, 1985); early working versions of the future application system (Beynon-Davies et al., 1999; Lichter et al., 1994); or plainly as a *first type* (Floyd, 1984). These definitions have an implicit aspect of learning as an early or first type. Accordingly, Floyd (1984) considers prototypes as vehicles for learning that provide more precise ideas about what the final system should be like. Extending the notion of a learning vehicle, Lim et al. (2008) define prototypes as (1) tools for traversing a design space, leading to the creation of meaningful knowledge about the final design as envisioned in the process of design and (2) as purposefully formed manifestations of design ideas (Lim et al., 2008). From this perspective the focus moves from the product towards the process in which the prototype serves a higher purpose. Concerning the features of prototypes, Lim et al. (2008) describe prototypes as having an autonomy of possible shapes of structures that provides different ways of organising the use of the prototype as an informing tool in the design process. Inherent in this view, is the understanding of prototypes as something that the designer consciously forms and alters depending on the purpose of usage. This view is quite different from Janson and Hammerschmidt (1990), who describe prototypes as being incomplete, to be modified, discarded, and replaced by a different system and Beynon-Davies et al. (1999), who emphasise the tentative nature of prototypes and as being early, unfinished or a model of something. Somewhere in between, we find Floyd (1984), who defines prototype as a "first type" that can either be thrown away after use or be fully or partially used as a component in the final system (Floyd, 1984). Thus, a prototype can take on different shapes. Floyd (1984) separates between two types or strategies: *vertical prototype* and *horizontal prototype*. The vertical prototype offers only selected functions of the final system but in their intended final form. The horisontal offers all the functions but not in details as required in the final system. According to Lichter et al. (1994), there are four different types of prototypes within software development processes (with pilot systems being the fourth):

- A *presentation prototype*, which is used in the initiation of a software project to facilitate communication between a software vendor and a customer by illustrating various aspects of the future solution. The prototype is mostly used to show the user's view of the envisaged system but it may also include functional details.

- A *prototype proper* is a provisional operational software system constructed in parallel with the information system model. In general, this prototype serves to illustrate specific aspects of the user interface or a part of the functionality and to clarify problems related to these.

- A *breadboard*, which serves to help the development team clarifying construction-related issues. Thus users are generally not included in the evaluation of this type of prototype.

- A *pilot system*, which can be seen as an extended prototype with the pilot system being used not only for experimental testing but also the application area itself as the core of the application system.

Similarly, Kieback et al. (1992) describe how it is possible to extend the prototype properly and install it in the application area as a pilot system. Janson and Smith (1985) distinguish between three types of prototypes: *real life*, *simulated*, and *real life/simulated*. The first type is a full-scale representation of the basic design idea and it employs materials intended for the final design. Due to size, cost and time required for their construction and modification, real life prototypes are usually not used for much experimentation. Instead, they are used to verify the soundness of the design idea and that design specifications are met. The second type uses a medium for construction that is different from the final design, but it operates according to the final design and it provides understanding of the proposed design concept(s). The third type is a combination of the former two in a way that parts of the prototype are constructed using final design materials while other parts are simulated. This allows for verifying both characteristics (what works) and purpose (why it works) of the final system. Hence, the application of a real life or real life/simulated prototype seems to serve the same purpose as a pilot system. Finally, Beynon-Davies et al. (1999) mention three main forms of prototype evident in the literature: The first type, a *throwaway prototype* is used to test out some part of the system but then discarded. The second, *incremental prototype*, that by incremental refinement will form the whole or part of a delivered system.,Third, *evolutionary prototype*, which forms part of a proposed system which is planned to be delivered incrementally. Contested, there are overlaps between the different types. Lichter et al.'s (1994) presentation prototype is similar to the throwaway prototype - or in other literature also called *exploratory prototype* (Beynon-Davies et al., 1999). Likewise the incremental prototype (Beynon-Davies et al., 1999), the real life and real life/simulated prototypes (Janson and Smith, 1985) are similar to what Lichter et al. (1994) call a pilot system.

If we turn to the definition of pilot systems, there seems to be a more coherent picture. Although there are suggestions that pilot systems can be used to identify user requirements (Naumann and Jenkins, 1982) much like early prototypes, there is a general understanding, that a pilot system is a more robust prototype, developed in the later phase of an ISD project, which, once it has reached a certain level of sophistication, it is being implemented in the user organisation (Kieback et al., 1992) and then through cycles of enhancement the distinction between the pilot system and the application system ceases to exist (Lichter et al., 1994). This view is consonant with Rzevski's (1984) definition of pilot systems as "*computer-based systems properly designed and engineered, and therefore reliable and robust, offering only a small subset of facilities of the system under development. Pilot systems are designed to be gradually extended into full operational systems*" and Janson's (1986) similar but more elaborated definition as a scaled-down version of a proposed application package which "*offers a subset of capabilities present in the total system without sacrificing robustness, completeness, or reliability. Robustness implies that the pilot system does not yield unreasonable answers when operating with operational, and therefore at times, erroneous data. Completeness means that important parts of the system have not been left out from the pilot system. Finally, reliability indicates*

that the pilot system operates as intended under many circumstances". With the four elements of a pilot implementation in mind, completeness and reliability are however not inherent and well-established qualities. Instead, they depend on the scope of the pilot implementation.

Janson (1986) compares the qualities of prototypes and pilot systems (fig. 5.1). According to him, the main difference between the two is that the prototype aims at facilitating system development, while the purpose of a pilot system is to test major components of the final system to detect organisational resistance and provide training for the users once the system has been developed. Consequently, during the test of the pilot system, it is the users' needs that have to be adjusted to match the system and not vice versa. By bringing together the purpose of prototypes with the qualities from pilot systems as proposed by Janson (1986), pilot implementation builds toward a more sensitive understanding, in which the pilot system allows for traversing a design space. In this case the regular work practice, during (and after) development not only requires that the users' needs are adjusted to match the system but also that the system is adjusted to match to users' needs.

		Pilot system	Prototype
Purpose	Systems Development	No	Yes
Required action	Adjust user need to mach system	Yes	No
	Adjust system to match user need	No	Yes
Application area	User training	Yes	No
	System testing	By user	By designer
	Implementation	Yes	No
Characteristic	Robust	Yes	No
	Complete	Yes	No
	Reliable	Yes	Yes
	Operating conditions	Under user control	Under designer control
	Expected life	Long	Short

Table 5.1: Modified from Janson (1986).

Abstracting, an ISD prototype, in general signifies a 'first' or early and merely temporary small-scale version of a system, that over time will be replaced by the future and final system. However, as shown here, there are many variations of prototypes and they may be applied at different stages during the design process. A presentation prototype, for example, is used initially in an ISD project whereas pilot systems are applied in the later phases. While few papers (Hertzum et al., 2012) distinguish prototypes from pilot systems, the majority of the presented papers regard pilot systems as a more robust, complete, and reliable prototype (Janson, 1986; Rzevski, 1984), which except from size is identical to the final system (Janson and Hammerschmidt, 1990). In more general terms, a prototype can be described as a tool for traversing a design space envisioning the final design during the design process and as manifestations of design ideas (Lim et al., 2008). From this perspective, the centre of attention moves

from the product itself to the design process, as a learning process, facilitated by the product. This learning perspective is echoed in parts of the pilot implementation literature (Bansler and Havn, 2010; Hertzum et al., 2012), where the pilot system as the manifestation of a specific design idea during pilot use is being tested in real use and with real users during regular operating conditions with the aim "to explore the affordance of the system and experiment with its integration into and transformation of existing practice" (Hertzum et al., 2012, p.317).

PROTOTYPING

After examining the system under evaluation and test, I examine the different types of pilot. One of the approaches compared with pilot implementation is prototyping. Following a life-cycle based methodology (Lichter et al., 1994), prototyping may often be considered an activity restricted to the early phases of ISD projects. This view is contested by the reviewed literature, by which I show that pilot implementation and prototyping in some ways are quite similar. In the following I will pursue this argument, but first look at how prototyping is defined.

To some, prototyping is a means of communication between software developers and users (Kieback et al., 1992; Lichter et al., 1994), while also being an approach (Lichter et al., 1994), a technique (Beynon-Davies et al., 1999), or a component in software development methodology (Floyd, 1984). To others, it is a method on its own (Janson and Smith, 1985; Mason and Carey, 1983) applied to build information systems using prototypes (Beynon-Davies et al., 1999) or a methodology and an alternative paradigm to traditional development (Naumann and Jenkins, 1982). One reason against viewing prototyping as a method, according to Lichter et al. (1994), is that it does not offer any support for structuring the ISD process. Across and beyond the different definitions of prototyping, prototyping can be characterized by a varied numbers of steps to be taken while prototyping: identify basic requirements (Naumann and Jenkins, 1982) and decide what functionalities to exhibit in the prototype (Floyd, 1984); develop a prototype (Beynon-Davies et al., 1999; Floyd, 1984)[6] (Naumann and Jenkins, 1982); demonstrate or implement and evaluate the prototype in order to provide feedback for further development (Beynon-Davies et al., 1999; Floyd, 1984; Naumann and Jenkins, 1982); revise and enhance the prototype (Beynon-Davies et al., 1999; Naumann and Jenkins, 1982); and further use (Floyd, 1984). The two steps, evaluate and revise, are then repeated until the users accept the system as a good fit (Naumann and Jenkins, 1982). Overall, these steps may be translated into the elements of a pilot implementation, with the difference that the pilot implementation does not try to fulfil a set of requirements. Instead, it seeks to evaluate the outcome of the specified system by means of effects of using the system.

As stated initially, prototyping is not confined to the early phases of ISD but can be performed throughout the life-cycle of a project. The different types of prototyping are often named in accordance with the ISD phases. Beynon-Davies et al. (1999) propose a taxonomy of prototyping practice in which they, among others, define prototyping according to when to prototype and they distinguish

[6] This may initially only be a simulation that works to represent the essential elements.

between three forms of prototyping. Prototyping can be performed either during the feasibility or requirements analysis phase (*early prototyping*), during the design phase (*middle prototyping*) or during the implementation or even maintenance phase (*late prototyping*). Other literature suggests that the choice of prototyping should be governed by the goal one may want to achieve (Alavi, 1984; Floyd, 1984; Lichter et al., 1994). Inherent to this view is, as shown in the section on prototypes, a focus on the learning process rather than just the product. Floyd (1984) and Lichter et al. (1994) thus mention explorative, experimental, and evolutionary prototyping. *Prototyping for exploration* is used when the problem at hand is unclear (Lichter et al., 1994) and it facilitates communication between developer and users, particularly in the early stages of development, where emphasis is on clarifying requirements and desirable features of the target system as well as discussing possible alternative solutions (Floyd, 1984). *Prototyping for experimentation* is used to evaluate a simulation of a proposed solution to the customer's problem and it focuses on the technical aspects (Floyd, 1984). The evaluation serves to determine adequacy and evaluate (all or a subset of the functionalities of) the proposed solution to a given problem of a customer before investing in large-scale implementation (Lichter et al., 1994). In a phase-oriented development approach, the experimental prototyping is best suited in the phases after the initial specification has been written. *Prototyping for evolution* is based on the experience that the organisation surrounding the prototype, as well as the prototype itself once it is used, give rise to new requirements (Floyd, 1984; Lichter et al., 1994), which cannot reliably be determined in one early phase. To meet this challenge, evolutionary prototyping is either done incrementally, as stepwise extensions of the solution or evolutionary, as a sequence of cycles of (re-)design, (re-)implementation, and (re-)evaluation (Floyd, 1984), where development continuously accompanies the system instead of being confined to the ISD project (Lichter et al., 1994). Akin to this classification, I will argue that pilot implementations are similar to and located somewhere in between experimental and evolutionary prototyping. On one hand, a pilot implementation is conducted to evaluate the proposed solution before final implementation, but contrary to experimental prototyping, the evaluation includes real use of a pilot system and focuses on technical and organisational aspects. On the other hand, the concept of pilot implementation aims at learning about the fit between the system and the organisation during pilot use, but contrary to evolutionary prototyping, the success of a pilot implementation does not necessarily require an iterative approach and it is confined to ISD projects.

While not explicitly mentioned by most of the authors, there seem to be an underlying understanding that certain types of prototypes are intrinsic to certain other types. Lichter et al. (1994), however, state that while prototypes can be distinguished as products *"...the goals of prototyping are concerned with characteristics of the prototyping process. Certain strong relations exist, however, between process and product. For instance, an evolutionary prototyping process will eventually lead to a pilot system"*. Thus, early or exploratory prototyping most likely result in throwaway, demonstration or presentation prototypes, middle prototyping or experimental prototyping result in incremental prototypes or prototypes proper, and evolutionary prototyping result in evolutionary prototypes or different versions of the same system. Moreover, one type of prototyping does not exclude the user of others (Kieback et al., 1992; Lichter et al., 1994).

Initial demonstration prototypes being developed as part of project acquisition purposes, may become the basis for an evolutionary prototyping process in which the building of operational prototypes eventually culminates in the implementation of pilot systems. However, this perspective only seems to hold true for development of new systems, but not so when it comes to configurable systems. As shown by Chin and McClure (1995); Gell et al. (2000), configurable systems may serve as a kind of presentation prototypes during project acquisition, but having the robustness of a pilot system, the configurable system can be used from the outset to explore and experiment without any previous development activities. From this perspective, there is no difference between prototyping and pilot implementations, except that prototyping does not include issues about organisational implementation.

Interestingly, despite the inherent iterative element of prototyping, there is a lack of any accounts on how to manage the iterations and more specifically how to perform evaluations and feed back knowledge from the evaluation into the on-going ISD project in general and the prototyping activities in particular. Lichter et al. (1994) for instance point out that pilot systems are enhanced in cycles and that they should be geared exclusively to user priorities, a perspective that is consonant with literature on pilot systems (Janson and Smith, 1985), but they do not elaborate on how this should be done. From Kieback et al. (1992) we can infer that the feedback only concerns technical matters: "Since the users still lack experience in everyday use of the system, they seldom can make suggestions for the design of technical aspects of the system that does not yet exist. Their suggestions are generally confined to criticism of what already exists [the prototype]. The situation usually changes (see project 2 and 3) once a pilot system is installed at their place of work. Then, not only inconvenient and impracticable features of a prototype are identified, but also the absence of features needed to perform a particular task" (p.138 Kieback et al., 1992). Whereas they acknowledge the advantage of the use of a pilot system - and more importantly stresses that it should be installed at the users' place of work, they do not describe how iterations are performed.

In this section, I have shown that prototyping is not an activity only performed in the beginning of ISD projects. On the contrary, it can be performed across the life-cycle of an IS. The main point of this section is that there is a strong overlap between pilot implementation and prototyping in general - especially when it comes to the use of configurable systems. In some cases of prototyping, pilot systems have also been implemented in a real setting with the purpose not only to criticise existing features of the system but also to become aware of the absence of features that are necessary for the system to support the tasks at hand (Kieback et al., 1992). Thus, both pilot implementation and prototyping serve to learn during development and before investing in large-scale implementation. However, technical matters take precedence over organisational. The main difference, from my perspective is that pilot implementations are confined to the later phases of ISD projects, whereas prototyping can be applied throughout the ISD project and in some cases prototyping even extends into operational use (late or evolutionary prototyping). Furthermore, the pilot system seems to be a result of the learning process for prototyping, whereas for pilot implementation it is the point of departure.

PILOT STUDIES

Another field widely referred to by Hertzum et al. (2012) is "pilot studies". As Glass (p.86 Glass, 1997) writes a pilot study is "explorations into unknown territory" and just like pilot implementations, a pilot study, being a small-scale version or trial run (van Teijlingen and Hundley, 2001, 2005), is undertaken as part of a larger project or programme (Turner, 2005; van Teijlingen and Hundley, 2005) to gather data about that unknown territory (e.g. Aziz et al., 2005; Babar et al., 2006; Iredale et al., 2002; Pal et al., 2008; Samoutis et al., 2008), thereby providing knowledge to the overall project. The study may be carried out using data in a live operating environment (Pal et al., 2008; Turner, 2005) but it is not an imperative. An operating environment, for instance, does not necessarily translate into pilot system. Iredale et al. (2002), for example, report on a case of exploring video conferencing as an acceptable means of genetic information delivery between hospitals by patients and health care professionals. Pal et al. (2008) describe how they simulated operations of an RFID system for a parking operation by using hardware and software with the same key functions as the actual system. It does not seem to be a requirement to use real users. It may also be users similar to those expected to use the future system (Babar et al., 2006). Even though the pilot study makes use of real users and the real system, it does not mean that the users are also the ones operating or that the system is applied in the real setting. Liang et al. (2006), thus, report on a pilot study in which they evaluate a web-based intervention support system for patients with multiple sclerosis, but instead of having the patients use the system directly, they used a number of so-called "chauffeurs" which would mediate the system and the patients by phone. During phone calls the chauffeurs would deliver information provided by the system to the patients and then enter the patients' reactions into the system. So where the element of realism is vital for a pilot implementation, it may only be fulfilled to some extend in pilot studies. Two additional differences in relation to this area are: first, that pilot studies do not entail an iterative process, and second, that the main focus is either technical matters or business matters (e.g. cost benefits).

The main difference between pilot implementations and pilot studies evolves around the time of conduction of the pilot. Although the main idea of pilot implementation is to perform it during development, in order to capture and include both technical and organisational issues in the on-going design, the literature on pilot studies mainly describes it as an activity performed prior to the main project. In that case, it may function as a means to assess research instruments to be used in the main project (van Teijlingen and Hundley, 2001). Babar et al. (2006) for instance, report on a pilot study of an evaluation process prior to a larger experiment with a groupware system to support distributed software architecture evaluation. It may also be used to help organisations get a feel of a technology and analyse cost-effectiveness prior to making a decision on whether to go forward with a given project (Glass, 1997; Pal et al., 2008). Aziz et al. (2005) for instance, applied a pilot study in order to assess the introduction of handheld computers as a replacement of traditional pagers among doctors at hospitals before a large-scale clinical trial, and Pal et al.'s (2008) pilot study of the RFID system for parking operations was also conducted prior to the actual project evaluating the cost-effectiveness of it.

Only few papers provide accounts of pilot studies conducted during an ISD

project. Turner (2005) gives a brief account of a case that uses prototypes in relation to a pilot study, while at the same time referring to other literature that points out how prototypes precede pilot studies, which are always conducted during the implementation. Along the same line, Turner (2005) and Yang et al. (2013) describe how pilot trials, as part of pilot studies, by means of prototypes provide opportunities for a preliminary evaluation of a system's usability and usefulness and allow rectification of potential issues that may arise if the system is implemented. As a result, the pilot study can influence an organisation's decision for full implementation. Liang et al. (2006) provide an example of a pilot study conducted before the final roll out, to preliminarily evaluate the success of implementation of a web-based intervention support system. While the authors recognise a need for iterations of design, coding, and testing during development, there are no reports on iterations of the pilot study. Instead, they merely conclude from the pilot study that "Overall, [the call centre representatives] thought that the WISS made sense and they were satisfied with it, suggesting that the WISS has good system quality, information quality, and user satisfaction" (p. 444 Liang et al., 2006).

Finally, Samoutis et al. (2008) describe how they use a pilot study to introduce and evaluate the implementation of an electronic medical record system tailored to primary care professionals after end development. In order to evaluate the system, they used both quantitative and qualitative methods like monthly narrative reports, personal interviews, and focus groups where based on this feedback various changes were accomplished to meet the users' need. Unfortunately, the authors provide no further accounts on how the feedback was fed into on-going development - or if there was any actual on-going development with one or more iterations of evaluation and redesign.

In sum, pilot implementations and pilot studies both are concerned with explorations of unknown territory and thus have a focus on evaluation and learning. Their main difference is that for pilot implementations evaluation is conducted as part of an iterative design process. Moreover, the evaluation is not confined to technical issues but does also include organisational perspectives. Pilot studies, on the other hand, are mainly conducted before a main project or after development if conducted as part of a main project. In that case, knowledge from the evaluation is not fed back into development.

The purpose of pilot implementations

The second question of this review concerns the reasons for conducting a pilot implementation. Going through the pilot implementation literature an endless list of purposes surface. The overall purpose, according to Bansler and Havn (2010) and Hertzum et al. (2012) is to learn. Bansler and Havn (2010), thus, relate the success of a pilot implementation with lessons learned and Hertzum et al. (2012) place learning at the centre of attention by stating that learning "is the objective that motivates performing the four other activities [planning and design, technical configuration, organisational adaptation, and use]" (p. 318). Examples of learning are: to learn about the misfit between the system and its use environment (Hertzum et al., 2012); to learn how the system performs in a real environment (Bansler and Havn, 2010; Hertzum et al., 2012); and how users appropriate it and use it (Bansler and Havn, 2010; Hertzum et al., 2012).

Additional purposes, not explicitly related to learning, are to contribute to the identification and prioritisation of the final system requirements (Bansler and Havn, 2009); to identify enhancements to the system (Chin and McClure, 1995); to asses design (Hertzum et al., 2012); to provide opportunities for system optimisation (Xu and Quaddus, 2005); to solicit ideas for design improvements from the users (Bansler and Havn, 2009); to improve the systems design based on user feedback, practical use experience, and observed results (e.g. productivity or quality data) (Bansler and Havn, 2010; Hertzum et al., 2012); to examine usability and usefulness of a system in its actual work setting in order to inform a decision about whether to continue the development of the system (Bansler and Havn, 2009, 2010; Hertzum et al., 2012); to become aware of unanticipated changes that emerge from using the pilot system and may call for preventive actions to avoid unwanted changes or supportive action to sustain desired change (Hertzum et al., 2012); to identify necessary or desirable changes in the work organization and processes in which the system will be embedded (Bansler and Havn, 2009, 2010; Hertzum et al., 2012); to experiment with the systems integration into existing work practices and transformation of same (Bansler and Havn, 2010; Hertzum et al., 2012); to explore the value of the system (Hertzum et al., 2012); to measure planned effects, to allow for emergent and opportunity-based changes to occur and to identify curtailed effects (Hertzum and Simonsen, 2010b); to clarify if current development activities need to be finalised or if revision of previous development activities is necessary (Hertzum et al., 2012); to support decision making on whether to proceed with development or implementation (Chin and McClure, 1995); to produce insights for full-scale deployment (Bansler and Havn, 2009); to provide input for formulating implementation strategies and plans, on the basis of users' reactions to the pilot system and thereby reduce implementation risks (Bansler and Havn, 2010; Fullerton et al., 2006; Hertzum et al., 2012); to provide an organisation with opportunities of optimising its systems and making adjustments to its structure and its culture to facilitate successful implementation of the system (Xu and Quaddus, 2005); to support decisions on whether to continue roll-out (Chin and McClure, 1995; Peute and Jaspers, 2007); and to bring a system in contact with future users (Winthereik, 2010).

If we look at the purposes of conducting a pilot across the reviewed literature, learning is merely one among several other objectives. To mention a few: explore and get a feel of a new IS (e.g. Glass, 1997; Iredale et al., 2002; Pal et al., 2008) and (Gogan et al., 2010), provide data to support decision making (Chin and McClure, 1995; Iredale et al., 2002; Pal et al., 2008), reduce risk and select an appropriate risk mitigation strategy for the overall project (Gogan et al., 2010; Turner, 2005), evaluate an IS (Ahmad et al., 2002; Babar et al., 2006; Gogan and Rao, 2008; Liang et al., 2006), and provide input for a final implementation strategy (Gogan et al., 2010; Pal et al., 2008; Samoutis et al., 2008). A reason may be that learning in general is not considered a purpose in itself, but rather a mean to support other objectives, such as the above mentioned. Contested, as Bansler and Havn (2010) remark the success of a pilot implementation depend on the lessons learned, and thus it could be argued that learning should somehow be directed back into the overall ISD project to serve a higher purpose than simply learning for the sake of learning. With this said, it is interesting to notice that there is only one paper in the reviewed literature, which provides descriptions of how to facilitate and fed back learning into the overall ISD project. A reason

may be that when learning is considered a mean, the product attracts more attention and the learning process leading to the product is neglected.

Challenges of conducting pilot implementations

As already pointed out by Bansler and Havn (2010) and Hertzum et al. (2012), there is a lack of descriptions of the challenges of conducting pilot implementation and Bansler and Havn (2010) remark that the lack of published studies on pilot implementations in general calls for "*conceptual clarification and for further study that systematically attends to analyzing why pilot implementations sometimes fail, so that improved guidelines for conducting such implementations can be developed*". Following, the third question of the review identifies the challenges of conducting a pilot implementation in practice.

Among the reviewed papers there are several that did not provide any or only brief accounts on the challenges involved in pilot implementation (Chin and McClure, 1995; Gell et al., 2000; Miller et al., 1995; Ross, 1999; Simonsen, 2010). Chin and McClure (1995), for instance, only remark that "[s]tarting in July 1994 we implemented a pilot system in two medical offices. Forty-six primary care clinicians are now using this system day-in and day-out in the delivery of health care" (p.717 Chin and McClure, 1995). Although they give a hint that it did require work to get there the process is black-boxed: "During the pilot phase, over one-hundred enhancements to the system were identified by pilot clinicians and implementation team" (p.720 Chin and McClure, 1995) it remains unanswered how the enhancements were identified and managed. Ross (1999), similarly, describes how an international corporation manages to meet the deadline of implementing a pilot version of a SAP system in three sites of 80 employees, while only briefly mentioning that it was at the expense of some functionality that was abandoned. What and how management was led to prioritising some functionalities over others and how the pilot implementation was conducted in general is not dealt with by the author. A reason for the pilot implementation being treated more subsidiarily could be found in the fact that the pilot implementation is only a mean for investigating other issues related to design and implementation of IS (Hansen and Pedersen, 2011; Hertzum and Simonsen, 2010b, 2011). Hertzum and Simonsen (2011), for instance, are concerned with effects-driven IT development and notice that it is impossible to specify all desired effects ahead of pilot use (p.15 Hertzum and Simonsen, 2011).

Few papers directly investigate the challenges to be faced with when running a pilot implementation (Bansler and Havn, 2009, 2010; Fullerton et al., 2006; Hansen and Simonsen, 2012; Hertzum et al., 2012; Hertzum and Simonsen, 2010b; Winthereik, 2010). Overall, the challenges which are identified are related to technical issues, defining an appropriate scope and time frame, ensure commitment, communication and collaboration, IT support, and managing the organisational implementation. The category most often referred to is technical issues including for instance technical tensions (Bansler and Havn, 2010), performance problems (Hertzum et al., 2012), configuration problems, servers

crashing and upgrade processes (Fullerton et al., 2006). Defining an appropriate time frame is a challenge on balancing the fact that the users should familiarise themselves with the system before real learning can occur and that the pilot use may delay the final implementation and possible benefits from real use (Bansler and Havn, 2010). Scoping the pilot implementation involves hardware, software, users, and procedures in that it concerns the overall question - what and who should be included in pilot use in order to yield a proper evaluation (Bansler and Havn, 2010; Hertzum et al., 2012). Ensuring commitment is challenging as it can be difficult to maintain commitment from users and from management, because the pilot implementation loses priority to other obligations (Bansler and Havn, 2010).

As a result, learning objectives may also be contested (Hertzum et al., 2012). Fullerton et al. (2006) argue that the commitment of the users and management is a key factor in achieving a successful pilot implementation. Examples of challenges related to communication and collaboration are the unclear division of responsibilities between, for instance, the project organisation and the IT vendor (Winthereik, 2010), the vendor giving low priority to fixing problems of the pilot system (Bansler and Havn, 2010), and users missing information about the progress of the pilot implementation (Bansler and Havn, 2010). User involvement includes issues of maintaining commitment to the pilot use (Bansler and Havn, 2010) and a closely related issue is that the pilot implementation looses priority to the main obligations of the organisation (Bansler and Havn, 2010). A crucial factor to the success of pilot use is IT support (Bansler and Havn, 2010; Fullerton et al., 2006; Hertzum et al., 2012; Hertzum and Simonsen, 2011). Since the pilot system is not fully developed, technical problems and malfunctions are expected and, thus, extra IT support should be allocated during pilot use. However, the high level of IT support can be very costly and research also shows that IT support may be down prioritized for the benefit of systems already in operation (Hertzum et al., 2012). Due to the many technical as well as organisational issues, which may occur during the pilot implementation (Bansler and Havn, 2010) and Fullerton et al. (2006) point to the importance of a proper project organisation, which can handle these issues. Fullerton et al. (2006) also emphasise the need for a plan for knowledge transfer as essential to the pilot implementation.

In this review there are only few papers, which reflect upon the elements that would lead to either a failed or successful pilot implementation. These papers apply a phased perspective on information systems development in which challenges and successes are linked to particular phases. Hertzum et al. (2012), for instance, ascribe technical configuration and organisational adaptation as the main reasons for two failed pilot implementations. Fullerton et al. (2006), on the other hand, point to three aspects that cater for a successful pilot implementation. First, identifying an appropriate pilot site. Second, involving as many users as possible. Third, sufficient on-site support, which is essential during the first week of implementation. Contrary to this viewpoint, I find several examples in the literature where the challenges are described as linked to each other and across the different elements of a pilot implementation. The technical challenges, for instance, all together not only complicate pilot use but also frustrate the users who have to become familiar with the pilot system while at the same time attending their ordinary work (Bansler and Havn, 2010; Hansen and Simonsen, 2012; Winthereik, 2010). Bansler and Havn (2010) report on

how users felt that they were not taken seriously and that this feeling would exasperate and demotivate them to the point where some users left the pilot implementation project. Furthermore, an important factor in this regard is the lack of IT support.

In relation to IT-support, Peute and Jaspers (2007) make the conclusion that low usability of the pilot system directly instigated the users' rejection. What is interesting here, is to notice that, while the robustness and usability of the system are widely recognised as factors that affect the pilot implementation, the (state of the) design of the pilot system itself as an influencing factor defining what can be learned is only pointed out in one paper (Hansen and Simonsen, 2012). Hansen and Simonsen (2012) for instance notice that due to the design of user interface of an electronic ambulance record, users would perform circumventions by not filling out the record until after the end of an ambulance run, thereby increasing time spent on the hospital. Thus, despite the fact that pilot implementation is inspired by or grounded in the socio-technical tradition, this is only vaguely reflected in the literature and it could be questioned whether this silo mentality is a constructive way of perceiving the challenges.

Areas of further research in this dissertation

In this literature review, I have shown that there is a substantial amount of pilot concepts to be found in the prevailing literature but there are no clear distinctions between them. Therefore, there is an overarching need for further discussions in research and practice about how should we understand and use the different pilot concepts. In the case of pilot implementations, while both practitioners and academics (Bansler and Havn, 2010; Hertzum et al., 2012) argue for its usefulness in design and evaluation of complex information systems, there are only few academic publications in the field of information systems (Bansler and Havn, 2010; Hertzum et al., 2012; Hertzum and Simonsen, 2010b). Moreover, there is no consensus in the pilot implementation literature about when and how to use the approach.

Therefore, there is an overarching concern for conceptual clarification about what pilot implementations actually are and why they might be useful (Bansler and Havn, 2010; Hertzum et al., 2012). Such a contribution is fundamental and pivotal to maturing the field, since this understanding affects the way pilot implementations are carried out and how research should be approached to investigate other concerns of pilot implementations. Framing the conceptual investigation as a quest to unearthing what pilot implementations are, does, however, have certain limitations, as it predisposes descriptions of the constitutive elements of pilot implementations. Albeit such an understanding is important, it does not provide any further conceptual clarification. Thus, following Star and Ruhleder (1994, 1996), I will instead investigate the conceptual nature of pilot implementation by asking *when* – not what – is a pilot implementation?

The implications of this ontological shift for the investigation of the conceptual nature of pilot implementation is a move away from looking at the pilot implementation as being "there", having a concrete form constituted by different kinds of activities, to looking at the pilot implementation in relation to technical

development and organisational change, as it emerges to the project participants of an ISD project. Recognising that there can be multiple understandings of the pilot implementation as it emerges for different project participants, this dissertation also argues for the importance of investigating the question: When is a pilot implementation a project multiple?

An area closely related to the conceptual nature of pilot implementations concerns with how to conduct pilot implementations (Bansler and Havn, 2009; Hertzum et al., 2012). As this literature review showed, pilot implementations are often treated as a black box because they are considered secondary to their purpose. As a result, only few works report on how the pilot implementations have been conducted. In relation to this more methodological concern, the prevalent literature is calling for more studies that look into the reasons pilot implementations might fail (Bansler and Havn, 2009; Bansler and Kensing, 2010) as well as succeed; the elements that goes into a successful pilot implementation (Fullerton et al., 2006); and more specifically the effect of organisational and technical conditions for a successful completion (Bansler and Havn, 2009). In the literature where challenges and problems are depicted, they are generally treated as related to single activities such as technical configuration or organisational adaptation (Hertzum et al., 2012).

Extending the notion of pilot implementations stripped of use but rather a relational concept that emerges for people through organised practice, this dissertation addresses the methodological concerns through the question: When is a pilot implementation embedded in day-to-day organisation of work?

Again, following (Star and Ruhleder, 1994, 1996), infrastructure occurs when the tension between local and global is resolved, meaning that a mutual adaptation and integration has taken place. I find this viewpoint useful to examine how pilot implementations are planned and carried out and to use tensions as occasions where *something* is at stake in the relationship between participants, pilot implementation, and day-to-day organisations.

Looking at the purpose of pilot implementation, the literature review showed that regardless of the importance of learning, learning is rarely dealt with by the literature. Hence, there is a lack of research that evolves around issues of learning. Hertzum et al. (2012) call for more research on how to conduct and use pilot implementations as a vehicle for learning in ISD projects. Also fundamental questions such as how and when learning takes place, between what participants and how is learning fed back into and inform decisions related to further development, are relevant as well as more critical questions such as who defines when and what learning takes place?

The literature provides several examples of how the malleability of the pilot systems affects pilot use and frustrates the users. However, the impact of the actual design and affordance of the pilot system on failures and success of the pilot implementation and for learning during pilot use is neglected. Therefore, there is a need for further research on the role of the pilot system for the learning, which can take place. While this view acknowledges the relevance of the material qualities of the pilot system, it is the relational qualities, which are in focus here. To pursue this viewpoint, the dissertation will investigate the following question: When is a pilot system pilot implementing? The tenet here is that the affordance of the pilot system affects the types of relations established between pilot system, pilot implementation participants, and day-to-day organisation. Thereby, the pilot system has an active role in the course of the pilot implementation as well

as its success or failure.

6 | WHEN IS A PILOT IMPLEMENTATION?

In the previous chapter, I addressed the research question, 'what is a pilot implementation?' and, I showed, that the existing literature on pilot implementation addresses pilot implementations as a tangible phenomenon, which is conditional with a phased view on information systems development. In this chapter, I present a different approach to pilot implementation, where I investigate it as a relational phenomenon. A main point is that a pilot implementation is not only a matter of (good) planning and proper management. Rather a pilot implementation is emerging between people in situated practice.

To demonstrate this point, I address the second and third research question, through the findings from the ePPR project. As I illustrated in chapter three, the pilot implementation was faced with many challenges, which nurtured the project participants' experience of the project being a failure. In the following I will, however, seek beyond the dichotomy of success and failure. To investigate how we can understand these challenges and what they might bring to the understanding of pilot implementation as a relational phenomenon, I will apply the notion "tension" and conduct infrastructural inversions (Bowker, 1994).

As mentioned in the beginning of the thesis, infrastructural inversion allows me to further investigate the pilot implementation as discrepancies between the pilot system and the existing infrastructure, which comprises both organised work practices and the technologies supporting these practices, and look at the arrangements of organizations and actors that must be brought into alignment in order for the pilot implementation to be accomplished (Lee et al., 2006).

The first empirical example (Collaborators and foot soliders) takes place at an organisational level and evolves around the contractual relationships between the Pre-hospital Centre and the EMS providers. The second (Patients and politics) and third example (Politics and professionalism) focus on different aspects of the ambulance work of the participating pilot users. Where the first three examples evolve around tensions, the final and fourth example (An emerging future) centres around two situations, where the tensions (partly) resolve.

Collaborators and foot soldiers

> *I have one single important task at this office and that is to make us capable of proposing an attractive bid in 2014. It is my undertaking from 2009 till 2014 to make us an attractive partner to the*

> *region. Serious with responsibility, economy and everything settled, but an attractive partner, which they want to collaborate with also in the future. So therefore I don't want to be the guy who puts a damper on [the project], unless I have the authority to do it. And maybe I just don't have that, because it hasn't been defined.*
>
> (EMS manager, Per)

One tension, which emerged during the project, evolved around the arrangement of the emergency medical services in the region. During fieldwork and interviews with the project participants, I experienced how the arrangement caused tensions and affected the running of the pilot implementation. Key in this arrangement was the contractual relation between the Pre-hospital Centre and the two EMS providers respectively. The contract, supposedly irrelevant to the pilot implementation, was of such concern to EMS managers that it created tensions between the collaboration during pilot implementation and daily work. In the remaining of this section, I will describe when and how they materialised.

THE CONTRACT

The matter of a clear division of responsibilities and a lack of space to address criticism was a recurring theme in the interviews with the project participants across the organisations. Among participants from the EMS providers these issues were sometimes addressed through the metaphor of the EMS providers being the foot soldiers of the project: *"[...] basically it is us who are going to be the foot soldiers in this job or in this project."* (EMS manager, Per). To understand the meaning and the magnitude of this metaphor I have operated an infrastructural inversion to investigate the social arrangement of the emergency medical services and the relation between the three organisations as pertinent to the collaboration during the pilot implementation.

In 2008 the Danish regions put out emergency medical service to tender for the first time (Beredskabsinfo, 2013). Until that point, it was otherwise custom to simply renew the contract with the existing EMS providers in the particular region. In Region Zealand the tender process had a crucial effect on the relation between the Pre-hospital Centre and the EMS providers. The EMS providers would normally work more autonomously - or "do their job and send in the bills" as one participants from the Pre-hospital Centre would describe it. However, this tender made the customer and provider relation more apparent. As the customer, the region obtained a different foundation for specifying requirements and making decisions. The EMS providers on the other hand, suddenly found themselves in a position where their presence in the region was now conditional on their ability to be cost-competitive and appear attractive to the region. This was clearly underlined with the tender in 2008, where one of the EMS providers in Region Zealand lost the entire emergency medical service to another EMS provider. Similar, while the ePPR project was being conducted, the EMS providers were preparing for a new tender in 2014. Therefore, as one EMS manager explained it during the interview, they had the attitude "what the region wants the region gets":

> Basically, [the region] pays our salary. It is them who decide if we are going to run in this region or not. Therefore, in my opinion, if they want us to contribute to something, we contribute. Because, how should I put it, they own us. If they tell us that the ambulances should be blue, we'll paint them blue. That's how it is and in fact that's even how it is at a national level. It is actually the regions who decide on the design of the ambulances and the equipment as well.
>
> (EMS manager, Søren)

Thus, while the contract had a central role for the social arrangement of the emergency medical services, it also came to play a significant role in the project. In many cases, what would appear as collaborative issues were related to the contract. This becomes evident when we apply the salient characteristics of infrastructure (Star and Ruhleder, 1994, 1996) and infrastructure time (Karasti et al., 2010).

While the EMS managers were very aware of the contract, some managers from the Pre-hospital Centre saw the contract as clearly separated from the ePPR project. The fact that it was related to the project, it was merely as a statement that the EMS providers, in accordance with their role as service providers were obligated to cooperate in project and product development. Other managers from the Pre-hospital Centre recognised the role of the contract for the collaboration. From one perspective the contract was in favour of the Pre-hospital Centre; since they were the paying customer they were also the ones to make the decisions. From another perspective the contract was described as a means for the EMS providers to negotiate the scope of their obligations:

> Interviewee: [The contract] has a great influence [on the collaboration]. We do as the contract states, both in relation to [the project] but also in other contexts, this is what we have agreed to.
> Interviewer: Why do you think it has such a strong influence?
> Interviewee: It is a business that has to make money, both [EMS] providers have to make money, and because [the EMS providers] have agreed to provide various services and have based their service on the expected revenues, then it is clear that they cannot afford too much wobbling. I don't know the profit, but you cannot afford too much wobbling. So they have been very focused on directing it to where it belongs.
>
> (Manager from Pre-hospital Centre, Arne)

From this point of view it seems that the managers primarily understood the impact of the contract as rooted in financial concerns. While I will not reject this dimension, I will argue that reducing the collaborative issues to financial concerns had a detrimental effect on the way the problems were handled during the pilot implementation. Since no initiatives were taken to counteract the contractual relationship during the pilot implementation, the EMS managers felt limited in their ability to make any decisions and this created tensions between daily working relations and the pilot implementation. This feeling was

emphasised by the lack of a project charter with clear specification of division of responsibilities, legal rights and division of financial resources, and the lack of the steering committee in which the EMS managers could participate as decision makers:

> [...] when you are operator, then you have to take part in for instance development of things like [the ePPR], then the collaboration should be described. What are my rights in relation to this? What are my obligations? What are the rights and obligations of the region? And what are the rights and obligations of the vendor? When this hasn't been settled beforehand, you easily end up in a situation, where [...] someone have to be the fall guy, and here I am not talking about the patient. I am talking about the reason why things are not working. The reason that we are not in operation. The reason that things are not running the way that the politicians expected it to and there is probably nothing worse for an EMS provider than feeling, that we were to be blamed.
>
> (EMS manager, Per)

As the snippet shows, concerns for the contract took precedence over the pilot implementation because of fear of exacerbating the changes of winning the next tender. For the EMS managers, it was more crucial to remain on good terms with the region than to address problematic issues that occurred during the pilot implementation and in the pilot use in particular. In other words, the EMS managers were directed by a long-term perspective (infrastructure time) on the collaboration with the Pre-hospital Centre that was not limited to the ePPR pilot implementation. The Pre-hospital managers, on the other hand, were driven by a short-term perspective (project time), in which they focused on implementing the ePPR and therefore did not see the contract as relevant to the project.

BETWEEN THE DEVIL AND THE DEEP BLUE SEA

During the time we followed the pilot implementation, we saw how the contract affected different situations. After one week of pilot use, one of the managers from Pre-hospital Centre and the EMS managers had the first status meeting. During the meeting, one of the EMS managers reported that they had stopped using the ePPR because it did not work properly. In general it was too slow, it shut down unexpectedly, it took too long time to log on again and, in some cases, the content had been deleted. Thus, concerned that the frustration eventually would affect the patient treatment and with a view to the long-term consequences of the use of the ePPR, he decided to take the ePPR out of operation to protect the paramedics from unnecessary and escalating frustration and potential patient complaints. This decision was however overruled by the manager from the Pre-hospital Centre, who demanded the ePPR back in use, even though it did not work properly.

For the EMS providers, the decision was a clear message that the use of the ePPR was of paramount importance and that they did not have the mandate to independently decide to stop the use of the ePPR. Moreover, the situation demonstrates how the EMS managers, to some extend, ended up caught between

the devil and the deep blue sea. On one hand, the interests of the patients was of paramount importance to the EMS providers. The purpose of their service is to be on the streets helping sick and injured people and to provide that service, they must ensure proper working conditions for their ambulance crew. During pilot use, however, it quickly became apparent that the ePPR was far from being in a state where it could support the pilot users in their work. On the other hand, the periodic tender process entailed a strong incentive for the EMS providers to stay on good terms with the Pre-hospital Centre and not be too critical about the project, despite the consequences for the ambulance crew.

One EMS manager, thus, explained how he had restrained himself from further addressing any critic towards the region. He had the experience, that the region had an agenda, and this was not to be changed:

> Interviewer: Even though that you have been told that it was [the region's] project and that management was their responsibility, was there anything you none the less would tell the region?
> Interviewee: No. It is far too political to do that. I have already burned myself once. I am not gonna do that again.
> Interviewer: Okay. Political in what way, if I may ask?
> Interviewee: There is an agenda, and [the region] sets the rules. No matter if we jump through hoops, they still set the agenda. It's a sure thing. And that's how it is. There common sense doesn't work.
>
> (EMS manager, Søren)

The conflicting interests, which prevented the EMS providers from escalating the problems and convey criticisms to a higher level, was however also evident among the paramedics. One paramedic described the relationship with words such as "fear of not making [the region] satisfied" and "management does not dare to pass on information to the region". Another paramedic described the EMS provider as *"just an entrepreneur in this, and somewhere, I think, an actor [at the region's] beck and call, because as such they have no saying in this [project], because it is the region who wants this [ePPR] implemented, [...]"* (Paramedic, Esben).

The conflicting interests also affected the paramedics in their daily work during pilot use. The paramedics would normally save a physical copy of the paper based ambulance record but during the pilot implementation the digital copies were only accessible through a special management module in the ePPR. The EMS managers repeatedly asked for access to it throughout the project, but never got it. This caused great frustration to both the EMS managers and the paramedics, who wanted reassurance that the electronic ePPRs were actually saved and retrievable from the servers. The record served as the paramedics' memory of the particular ambulance run. They would, for instance, write particular observations or information in the record, which were not necessarily directly related to the treatment, but which could aid their memory later in case of patient complaints. Not having the assurance that the ePPR was retrievable made them feeling vulnerable and fostered the tendency of obstructing the project all together. All the EMS provider managers, however, could do was to encourait ge on-going use and otherwise shrug their shoulders and refer to

the problem as the region's responsibility. This experience further nurtured the feeling of being the foot soldiers that just had to obey orders and otherwise not speak up. Some of the paramedics for instance were explicitly cautious in what they were telling during the interviews, one of them half way jokingly expressed worries that he might loose his job if he would address his critique to Pre-hospital Centre. Other paramedics felt that their complaints were not taken seriously and that their feedback experiences were not acknowledged. In one interview, the notion of being the foot soldier is described as a feeling of being imposed to use the ePPR and a feeling of capitulating to this order:

> Interviewee: [The region] implemented something in our ambulances that was supposed to ease our work, but which makes it much more difficult, right. And then it is even imposed on us to use the damn thing, right. I mean directly imposed on us, that we have to use it. [...] And then you sit and think: "Okay, if that's were we are? That we have to be ordered to use it even thought it doesn't work", right. Then we are doing foolish things just for the sake of foolishness, because somebody wants this to work. I am aware that there are some political concerns, I am very well aware of that. But then [the region] has to take the consequences and find another solution. It is as if they had to take it to the edge, they simply had to take it so far that we had to throw in the towel and surrender. The [region] couldn't just say: "It simply doesn't work" from the start. [In the beginning of the project], they simply didn't wanted to listen to us. We just had to use it. [...] [It did not change until the region] found out that, I don't know how many people were queuing in front of the emergency departments to dust of the ePPR.
>
> (Paramedic, Lars)

Beyond the problems of not being able to convey criticism and not being taken serious, the quotes in this section reflect that different temporal scales are at work. From the EMS participants perspective, the Pre-hospital centre was focused on making the ePPR a success. The EMS participants on the other hand, were concerned with the potential outcome of the malleable pilot system on the longer run.

Through an infrastructural inversion, I have shown how problem handling during the pilot implementation was not merely a question of poor project management and collaboration. Rather, the tendering established a relation between the Pre-hospital Centre and the EMS providers, in which participants from the EMS providers felt that they were reduced to mere foot soldiers who could not speak up their mind or were not heard at all. This inability to recognise the importance of the contract and to create another foundation for the collaboration during the pilot project created tensions between everyday work and the project in general and between short-term perspectives related to project outcomes and long-term sustained collaboration.

Patients and politics

> [I have] an expectation that, when you initiate a project this size, a project [in which] you work with legal documents, which an ambulance record becomes the moment it is completed, then I think, there ought to be a corresponding attention and management of the project. Thus [...], the seriousness, if we can call it that, which it imposes to [the paramedics] by not having a complete record or by not being able to locate the things they need, must be counterbalanced by the setup of the project, so that it is ensured that the interest of the patients have been taken care of, and that there is taken care of the [paramedics], which are legally obliged to document [the ambulance treatment].
>
> (EMS manager, Per)

The second snippet also evolves around the implications of the arrangement of the emergency medical services in the region. However, this time the purpose is to investigate the effect of the arrangement on the work in the ambulance during pilot use and in particular the difficulties balancing patient treatment and using the ePPR to document patient treatment.

Acute ambulance run includes that the attending paramedic in the patient compartment observes and treats the patient while en route to the hospital and document it accordingly. A central aspect of this work can be described as an act of balancing between working with the patient (comfort work and sentimental work) and monitoring equipment (machine work). Whenever necessary the paramedic will give priority to one type of work at the expense of the others. Often it is the equipment being down prioritized in favour of the (acute) patient treatment (Pedersen et al., 2011). As several paramedics explained it to us during our participation in the ePPR project, the most important task for the paramedics is to serve/save the patient: *"This is just how it works in the ambulances. If there is a patient, who requires extra attention, then you don't register the treatment in the ambulance record at the exact time of treatment. Then the treatment of the patient is paramount."* (Paramedic, Esben).

Applying the notion of infrastructure time and elaborating in my previous work of (Pedersen et al., 2011) a main point of this snippet is that the poor design of the ePPR user interface became a matter of balancing ambulance work during pilot use with contractual obligations, legal requirements and possible patients complaints. In other words the pilot use of the ePPR caused tensions between the short-term goals (using the ePPR) and long-term endeavours (to retain a position as EMS provider in the region). In the following, I will elaborate this point.

Ambulance work, time and money

From a business perspective, ambulance work is time and money; the EMS providers receive payment in return for their provided emergency medical services. As a part of the contract between the EMS providers and the region, the EMS providers are obliged to handover the patients to the emergency department within a certain number of minutes. The region does not honour time

spent beyond this limit. Thus, the paramedics fill out as much of the ambulance record during ambulance run as the patient "allows". Otherwise they have to do it upon arrival, where they also have to clean and prepare the ambulance for the next ambulance run.

With the paper-based record it is normally not an issue if the paramedics have to finish the documentation at the emergency department, because they can manage within 5-10 minutes. The poor usability of the ePPR however made it difficult to comply with the agreed time for handover during pilot use. One of the problem with the design was that, when the paramedics had to make the ABCDE assessment of the patients [1] they had to re-enter the information for each assessment – even when the patient was stable. With each principle containing up to ten fields that had to be filled out, it required an exponential number of tabbing. Moreover, doing this while driving, made documentation even more time consuming and difficult.

During ambulance run, one way of circumventing the issues of entering information into the ePPR while en route to the hospital, was to dot down data on e.g. a rubber glove, in a paper based record or register them in the defibrillator (LP15) and then use the docking station to enter the data in the ePPR tablet upon arrival. This however, created a bottleneck at the emergency departments, since there was only one docking station at each emergency department. On the first day of the pilot implementation, I experienced this personally. During an ambulance run, the paramedic which I followed, had documented the treatment in the paper-based record and so, after having handed over the patient to the ED staff, went back to the docking station at the entrance of the ED with the ePPR, the paper-based record and a print out of vital parameters printed from the LP15 to write the documentation into the ePPR. While he was re-entering all the information into the tablet PC, another ambulance arrived; they too had to use the docking station, so they lined up in queue after having handed over their patient and prepared the ambulance for a new run. After 45 minutes the paramedic was finally done entering the documentation into the ePPR only to deal with printer issues. One of the other paramedics waiting in line helped him. After some additionally minutes of waiting the ePPR was finally printed. At that point, yet another ambulance had arrived and the paramedics had joined the line too, waiting for their turn.

On the ambulance runs that we observed during the pilot use, the pilot users spent on average 25 minutes to finish documentation at the emergency departments. In one case it took almost 90 minutes. However, it was not only the paramedics who were waiting. At the dispatch centre the technical dispatchers were also waiting for the ambulances to become available again, so that they could dispatch the ambulances for new ambulance runs. So, from one side the paramedics had problems finding a balance between the different types of ambulance work in the ambulance. From the other side, if they postponed documentation till arrival at the ED, they had to comply with handover times. One paramedic, thus told how he, in one case had felt forced to abandon documentation all together. As explained in the excerpt below, he partly did this, knowing that the technical dispatchers at the dispatch centre had fewer ambulances at their disposal for new ambulance runs when they spend more

[1] The ABCDE principle for first aid: *Airways*, *Breathing*, *Circulation*, *Disabilities*, and *Environment*

time than expected documenting the patient treatment. Moreover, there was also the concern of the new patient waiting at the scene of injury to be taken:

> We are all the time being measured on what we do. So even though you say: "It doesn't stress me", it does stress you, because you know that there is a [manager] looking at you and what you are doing out there. Then there is also the [technical dispatcher] in here [at the dispatch centre] and the ambulance runs just waiting to be dispatched right? There is a technical dispatcher who has to deal with the new ambulance runs just waiting to be dispatched so how can you defend saying that you have to write an electronic ambulance record, and that Mrs. Jensen has to wait? No, that doesn't really work, right? [...] One thing is if the ambulance simply cannot run; there is no oxygen or some of the equipment is missing, right. Obviously you don't go driving with an ambulance that doesn't work. But because I have to write an electronic ambulance record that has been imposed on me, and which doesn't work I can't be bothered with that [...] I think that in this situation the citizens must come first [...]. And this is also what we have been taught [as paramedics], right, and that is how it should be somehow.
>
> (Paramedic, Anders)

As the excerpt illustrates the issues with the user interface is not merely a matter of documenting the patient treatment (short-term project focus). For the paramedics it also involves financial concerns (long-term focus) as well as concerns for the next patients. Thus, for the paramedics, ambulance work during pilot use was also a matter of a proper documentation and financial concerns.

DOCUMENTATION AS LEGAL ACTIONS

Apart from the problem of balancing patient treatment with documentation and financial concern, the ePPR user interface also gave rise to concerns over legal requirements. During interview, one paramedic explained that in cases where he had to balance patient treatment and documentation, he would do all the ABCDE assessments of the patients, but without necessarily registering all of them in the ePPR:

> Our minimum [number of assessments] is two, so I boiled it down to maybe only three instead of six. [...] In reality, I assessed the patient as many times, as I would normally do, but documentation-wise the intervals between the assessments were longer, because there were so much to be documented. One might say that is a bit undesirable, right?
>
> (Paramedic, Peter)

An undesirable outcome here would be that the undocumented assessments would not appear in the ePPR and hence also would not be transferred to hospital's patient record. Another and not explicitly mentioned longer term concern, which was addressed by other paramedics during our participation

in the ePPR project, was the fact that no documentation is the same as no treatment. In case of a patient complain, this could become a problem, because it would appear that the paramedic had not done a prober job of assessing the patient.

As the examples illustrate, the ePPR put the paramedics in a position, where they experienced that they had to give way to documentation over concerns of the patients. This experience can also be described as a tension between the short-term pilot use of the ePPR and the long-term perspective of the ePPR. The long-term perspective has two aspects, first, as part of the medical history of the patients' treatment and second, as a legally binding document. Thus, while the paramedics could only be held responsible for what was written in the ambulance record, they could also only defend themselves based on the very same documentation in case of patient complaints. While I did not find out how often it actually happened that a paramedic would appear for The Patients' Complaints Board, I clearly got the impression from talking with the paramedics, that it was an aspect of great importance. A paramedic for instance told how he saw the ambulance record as the paramedics' salvation, because it was their only documentation of what treatment was provided to the patients while in their custody:

> [...] our ambulance record is our salvation. If it is not filled out correctly, and if something happens and we are to appear for The Patients' Complaints Board, then it is us who are in trouble because of it, right. So it is equally important that we fill out the ambulance record properly and that we get to write down the things that we have done, so that we avoid being blamed in The Patients' Complaints Board at some point. Our manager could also use this, because then they can say: "What have you been doing there? Well, there is nothing [written] in your ambulance record, so we cannot help you", and it is my work then, which is hanging by a thread, right? Where I could be kicked out, because I might have killed a patient [...]
>
> (Paramedic, John)

The feeling that on the long run, the ambulance record was the paramedics' only defend and only mean to back up their work, put them in a vulnerable situation. They had the experience that the ePPR subverted their work rather than supported it by making it difficult to balance the pilot use of the ePPR (short-term project time) with the daily obligations of patient treatment and response time. Thus, at times, they ended up compromising documentation over concerns of the patients or response times. However, as shown, doing this had potential negative outcomes in terms of possible patient complaints (long-term infrastructure time). As I will show in the following section, they moreover felt that it became an attack on their professionalism as paramedics with consequences for their ability to genuinely participate in the pilot implementation.

Politics and (un)professionalism

> [Professionalism] is clearly a part of [pilot using the ePPR]. It is part of it in the sense that when you handover a patient, then you

> also have to handover an ambulance record, and some times, and this is also how it works with the current paper based record, you have to write parts of it after you have handed over the patient. But it may be that you have a cardiac patient, that you take directly to the cardiac intensive care unit, where you have to say: "I will be back with the record in an hour", because there is no printer and I have to walk to another unit to print it, and then [the staff at the emergency department] are thinking: "Where are these guys from?". [...] So you know, then you don't feel professional at all.
>
> (Paramedic, Esben)

As described in the beginning of the analysis, the paramedics had been welcoming the project with open arms when the project commenced. They were hoping that the ePPR would make it easier to document and share data about the patients' trajectory with the staff at the emergency departments. More importantly, they had been hoping that the ePPR would help proving their professionalism to their colleagues in the emergency departments. Among some physicians and nurses, on the other hand, there were great concerns that the pre-hospital plan would have adverse consequences for the patients. Hence, during the ePPR project there was a heated debate in the public media about the new pre-hospital plan under headlines such as "Akutbiler - Falsk tryghed i Region Sjælland [Emergency ambulances - False security in Region Zealand]" (Hansen, 2012), "Fem personer har mistet livet i akutbilerne [Five people lost their lives in the emergency ambulances]" (Rohde and Simonsen, 2012) and "Sjællandsk akutplan vil koste hundreder af liv [Emergency plan in Region Zealand at the cost of hundreds lives]" (Larsen, 2010).

During our observations, we noticed how this debate was being talked about at the ambulance stations and we could hear how it affected some of the paramedics. From our talks and interviews, we got the picture that being a rather new unit in the Pre-hospital setup[2] and in a lower position in the medical professional hierarchy, the paramedics felt that they had to prove their worth - especially to the physicians. Therefore they had been hoping that the ePPR could help them achieve this. However, as shown in the previous snippet the ePPR did not live up to the expectations. On the contrary, several of the paramedics explicitly expressed how it made them feel less professional. One paramedic expressed it this way in an e-mail to the Pre-hospital Centre:

> On the 22/9 we got an ambulance run, category A, to a heart attack. [...] When we arrived at the emergency department the nurse forwarded us to [the department]. I had to write an ePPR record and print it at the emergency department and therefore had to hurry up. The patient had to wait 20 minutes for me to finish and the record I made was to my opinion not very good. I felt being under pressure by the patient lying there [at the stretcher] waiting for me.
>
> We have to emphasise that if we have to write down everything [in the record] (which is impossible) before arriving at the hospital,

[2]The first class of paramedics were educated in 2004.

> then there is no contact with the patient, there is no focus on the patient and supposedly that is why we are here [to treat the patient]. We believe that [using the ePPR] affects our professionalism and that the patient does not get the optimal treatment.
>
> (Paramedic, Bent)

Thus, the pilot implementation created a tension between the getting work done and pilot using the ePPR, on one hand, and becoming recognised as a new unit in Danish health care, on the other. To investigate this tension and what professionalism meant for their participation in the pilot implementation, I will apply the notion of *genuine participation* (Robertson and Simonsen, 2012). Even though the ePPR project did not start out as a participatory design project, it took shape as such over time. Encouraged by the enthusiastic super users, who were merely testing the ePPR in the beginning of the project, management from the Pre-hospital Centre decided to directly involve them in the re-design of the ePPR user interface. Despite being more actively involved in the pilot implementation there were tensions evolving around the paramedics participation in the project. Below, I will investigate the tensions and demonstrate that while the paramedics felt both limited in participating as themselves and for themselves, the social arrangement of health care and the existing work practices were to some extend also obstacles for their participation.

If we look back at the contractual relationship, as described in the first empirical example (Collaborators and foot soldiers), it is clear that the paramedics felt that they were not fully able to participate as themselves. Not necessarily because they could not sense how they felt about the issues arising during the pilot implementation, but rather because the contractual relationship prevented criticism or because the paramedics were simply not heard: "in the end we simply just had to back down and surrender. It wasn't possible to come and say: 'It simply doesn't work'. They simply didn't wanted to listen to us, right? Instead they insisted that we had to use it" (Paramedic, Anders).

If we look at the paramedics concern to establish themselves as a profession within the field of health care, we can see it as an attempt to participate as themselves representing a genuine interest of the community: to be acknowledged for the work that they do. While the paramedics had been hoping that the ePPR would support them in their work, they experienced that it made them appear unprofessional. With the prospect of being able to electronically share data directly with the staff at the emergency departments, they saw it as way to make their efforts visible through some well-written ambulance records. Suffice it is to say that this efforts were being obstructed by a poorly designed user interface and because they had to prioritise patient treatment and response times over documentation. In several cases, the struggles made the paramedics want to give up the project, because, in the words of the paramedic Johan, the ePPR emphasised the feeling of being defenceless to critic of their profession altogether:

> So we are in a situation where we are a new unit in health care. And we are kind of defenceless but still being shot at right? And we cannot fight back, right? We can try to rescue some people and we can do whatever it takes to do our best by writing some good ambulance records to show our worth. And then we get a tool that

> makes us even more defenceless. So obviously it is not difficult to dismiss the ePPR, it isn't. On the contrary, you feel like saying: "The electronic? The electronic what? Oh yes, that's right, we had the ePPR with us at the start of our shift, but we lost it somewhere - in the harbour I think".
>
> (Paramediciner, Johan)

Thus, although not a part of the pilot implementation and usage of the ePPR, the social arrangement of health care played a role in the paramedics' perception of the pilot implementation. The experience that the ePPR prevented them from pursuing their ambitions to be recognised as a new unit in health care, prevented the paramedics from participating as themselves respecting their individual and community's genuine interests.

The importance of appearing and feeling unprofessional was key to this experience. As shown in the excerpt, some of the paramedics felt exposed to the scrutiny of the publicity with the assessment of the new pre-hospital plan and this increased their need for proving their worth as paramedics and to be recognised for their efforts:

> Interviewee: [...] and then you have two half products for the same patient and none of them are 100 per cent satisfactory. Oh, it just doesn't appear very professional to me. I mean there is a bit of professional pride lost here, there really is. With the publicity of our work, we are fighting against a huge pressure as paramedics. The university is going to look into the things we do, and then it is something so-so. This is really uncool.
> Interviewer: Have you felt afflicted?
> Interviewee: Yes, many times, many times. [...] I mean, every single time I hand over a patient, I am being examined [...]. Interviewer: So what did this [debate] mean to the project, while the ePPR was being tested?
> Interviewee: It had a great impact, because when my every step had already attracted wide publicity, then if I step five centimetres to the wrong side, the verdict is instantaneously. And then comes [the ePPR], which is not fully developed, where some of the things that I have to document are subjected to errors. [...]. Once [treatment is documented] it can't be [edited if necessary] and that's when I get really frustrated. That there is somebody who will read all this and a medical secretary who will enter all the shit [into the patient record on the hospital] and then it will follow the patient.[...]. Oh, that's when you really feel powerless to the situation, right.
>
> (Paramedic, Asger)

From one perspective, the excerpt emphasises how the poor usability of the ePPR made the paramedic feel powerless to the situation, because it did not help him defend his profession. From another perspective this excerpt also illustrates the same schism between different temporal scales in the project, as I have also illustrated in the previous snippets. Where the paramedics in many cases expressed long-term perspectives related to pilot use as a major concern,

the management of the Pre-hospital Centre primarily seemed to be concerned with the immediate use in the ambulances.

An emerging future

> *As I mentioned, there is the example with the sizes of the different devices, such as the size of the tubes and the laryngeal masks and the peripheral venous catheters. Suddenly the sizes [specified in the ePPR] were different from those used in the ambulance. Well, I simply didn't have the imagination to see this coming. I could only think that "Dammit', isn't that an EU standard, how can they deviate from the sizes we use", but they did. And I also didn't have the imagination to envisage the issues with the oxygen. It suddenly stopped. [The paramedics] couldn't give more than ten litres. [The specification in the ePPR] stopped at 10 litres, so then you couldn't give more, electronically at least. It may be that [the paramedics gave more than that] in practice, but it stopped [at 10 litres].*
>
> (Pre-hospital Centre, manager Arne)

In the previous snippets, I have addressed the second research question, 'When is a pilot implementation?' to inquire into the relational qualities of the ePPR pilot implementation. In this snippet I touch upon the third research "how is a pilot implementation?", but instead of focusing on tensions, I look at tensions (partly) resolved. During our participation in the ePPR project, we observed how the project participants engaged in activities to discuss and improve the design. In this final snippet I take a closer look at two such situations, which took place during the pilot use period, to investigate how the project participants orchestrated the pilot implementation.

The first situation took place during a training day for the super users in the beginning of the pilot use period and it evolved around a discussion on how to handle patient handover from a response unit to an emergency ambulance. The second situation took place at a meeting towards the end of the pilot use period, where a proposal for a re-design of the user interface of the ePPR was being discussed.

To analyse the two situations, I apply the salient dimensions of infrastructure (Star and Ruhleder, 1996): "learned as part of membership" and "becomes visible upon breakdown". Star and Ruhleder (1996) note that tensions resolve and infrastructure occurs when local practices are afforded by a large-scale technology in a ready-to-hand fashion (p. 115). This implies that the infrastructure becomes transparent and taken for granted as part of organised practice. Only during breakdown does it become visible. For newcomers to the practice, however, infrastructure is an object, with which they have to familiarise before they can use it in a naturalised fashion. In a similar way, we may regard the pilot system as a newcomer to practice that has to integrate (familiarise) with the organised practice and its technology. During this process the pilot system makes visible what is normally taken for granted and while familiarising with the infrastructure tension can be resolved.

THE SCOPE OF PILOT IMPLEMENTATION

During interviews with the participants, the printer issue was mentioned frequently in relation to the pilot use, both by the paramedics and managers from all three organisations. As described in chapter three, it was initially planned that the electronic data interchange between the ePPRs and the electronic whiteboards at the emergency departments would be included in the scope of the pilot implementation. For technical reasons this setup was never achieved and the project had to find another solution for handover to the emergency departments. Because the clinical staff at the emergency departments were still using the paper-based record during pilot use, it was decided that the paramedics would handover a printout of the ePPR record. Similarly, electronic data interchange between different ePPR units was not possible either. When patients had to be handed over from a response unit to an emergency ambulance at the site of injury, the paramedic from the response unit also handed over a printed version of the ePPR record to the paramedics from the other vehicle, who would deliver it to the hospital together with their own printed ePPR record[3]. Technical issues with the ePPR, slow printers, and the printout itself, which in many cases spread over 5-10 pages, made it a very time consuming task. Furthermore, it put the paramedics in a position, where they sometimes had to choose between legal requirements and patient treatment. In other words between finishing the ePPR record while the patient was waiting at the site of injury or sending the patient off to the hospital but without a printed ePPR record. As the following excerpt shows, the paramedics experienced that they had to bend the rules to avoid compromising the safety of the patient, knowing that this also had consequences for the information that would be handed over to the clinical staff at the hospital:

> *[...], when we for instance drive the response unit to the scene of injury to support the emergency ambulance crew we might tell them to take the patient to the hospital themselves. In principle, in these cases, we have to go through this 45 minutes long session of writing the ePPR record, printing it and give it to the emergency medical technicians for them to bring with them to the hospital. This means that we have to finish the record and patient treatment before the emergency ambulance can leave. That's if it's by the letter, right? But I said, and fortunately I know that all my colleagues said the same, that this isn't possible. It's not ethically justifiable to the patient that we have to withhold the ambulance until we have written and printed the ePPR record. So we let it go and then we stayed, at least I stayed at the address and finished the ePPR record and archived it. But then the emergency ambulance crew didn't get the printout with the treatment that I had done and the thoughts that I'd had about the patient.*
>
> (Paramedic, Esben)

During the training workshop, this issue was brought up for discussion between the paramedics, the management from the EMS providers, and the Prehospital Centre. Although they agreed that a solution had to be found, which

[3]Normally, the paramedic in the response unit only assist patient treatment at the site of injury and let the paramedics from the emergency ambulance bring the patient to the hospital.

would support a correct handover practice, management from their side argued that this practice had to stop because it was against the directives from The Danish Health and Medicines Authority. The paramedics from their side acknowledged this, but argued that these were the hard realities of doing ambulance work and that they would always put the patients first. Even though the discussion did not result in any concrete solution it broad about the different participants viewpoints on handover procedures. When we operate an infrastructural inversion and apply the salient dimensions from Star and Ruhleder's (1996) definition of infrastructure, we can see that there was a misalignment between the pilot system and the infrastructure. The practical arrangement of the scope of the pilot implementation – materialised by the printer in this case - as a newcomer, made this misalignment and thereby, also the taken for granted of daily work, visible. The tension caused by the misalignment resulted in a common discussion between the different project participants about how to respond to the situation.

Following the example, I will argue that the practical arrangement of the scope of the pilot implementations had an impact on what changes could emerge. Thus, it is not trivial how the scope of the pilot implementation is defined. In case of the printer, frustration was aired and it forced the three organisations to discuss handover handling, but it did not lead to any concrete decisions or solutions in the moment. A reason for decisions not being made, could be that the top management from the Pre-hospital Centre were not present at the meeting to take a decision, as is the case in the next illustration.

THE MEDICATION MODULE

During the super user training session, a small group of five paramedics[4] were asked to make a proposal for a re-design of the ePPR user interface to improve usability. Prior to the workshop, one of the paramedics had made suggestions to the entire content of the ePPR record, which were then discussed. Based on their experiences with the ePPR, the workshop gave rise to various discussions among the paramedics about the design and how it did or did not match current practices. The design proposals, vice versa, also gave rise to considerations of possible amendments to work practices and finally how they could make further changes to the user interface that would future-proof the design as far into the future as possible. One such discussion took place around the medication module.

The medication module was used to register any medication given to the patients while in the paramedics' custody. However, the paramedics were uncertain of whether to call the medications by their generic names or by their product names, as was the case in the existing work practice. Even though they could all see the rationale of replacing the product names with their generic names, they were also aware that this would imply a change to their work practice as well as the clinical staff at the hospital:

> *Paramedic Esben: The problem is that [the medication] may suddenly change name.*
> *Paramedic Kim: And that's why I ask: "What should we do henceforward"?*

[4] Two from one EMS provider and three from the other.

Manager from Pre-hospital Centre, Torben: Offhand, I would say that you have to get use to using the [generic] names.
Paramedic Kim: Well, then that's what we will do. Well, that was just what I was asking about. [...] The question is also what we do, when we drive to [the hospital]. Then the physicians also have to get used to [the generic names].
Paramedic Troels: But how do we check off [the new medication that we take] from the hospitals?
Paramedic Kim: Well, it's [the product names written on the list] in the medication cabinet when I take something.
Paramedic Troels: Also at the checklist?
Paramedic Kim: Yes.

(User driven design workshop)

As the excerpt shows, the taken for granted of their organisational arrangement was made visible by the ePPR as the misalignment between the pilot system and the existing infrastructure caused tensions during pilot use. More importantly, these tensions made the paramedics question the conventions of practice and make common reflections about their work practice and how to register medication in the medication module henceforth. Due to uncertainty of what would be the best solution, the participants decided to let top management make the final decision at a follow up meeting.

At the follow up meeting the design proposals were discussed in a bigger forum consisting of two of the paramedics from the design team, the EMS managers, two mangers from the Pre-hospital Centre and a developer from the IT-vendor. One of the central discussions evolved around how to register medications in the medication module. It became obvious that there were different understandings of the terminology used in the module and thereby different understandings of the amount of medication given:

[There is on-going debate about how to understand the term 'dose' for another couple of minutes before one of the Managers from Pre-hospital Centre intervene in the discussion]
Manager from Pre-hospital Centre: Well, what you are discussing here, is a problem also familiar in [other projects]. [...]. What you are asking for is basically also the relevant [thing to ask for]. The thing is, that the medication dispensation form of the medicament comes in tablets, millilitres and milligrams. So this is the dispensation form that you register [in the ePPR].
EMS manager Søren and Paramedic Esben: Yes
Manager from Pre-hospital Centre: What's written there [point at a field in the ePPR at a big screen] is a dose. So, in reality, this solution [suggested in the re-design] is less safe. Because it takes for granted that [the medication], is always given as 150 milligrams, which it never is in Denmark.

(Follow up meeting to the user driven workshop)

As shown, a part of the discussion centred on how to understand the problem of doses, the implications of the suggested solution, and how to design a solution that would leave out ambiguity. This was not a trivial question, since they had to take into considerations the many different types of medication dispensations forms and that some could to be given over a longer period of time.

If we again, apply the salient dimensions from Star and Ruhleder's (1996) definition of infrastructure, the tensions caused by using the ePPR first of all made it clear that the existing way of registering medication was not necessarily comprehensible. Moreover, the design-proposal sparkled a discussion between the project participants on how to solve this problem and thereby how to bridge the gap between current and future work practices. Based on, among other, the issues that came up during the workshop, top management from the Pre-hospital Centre decided to put the pilot use on hold, because of the risks that it implied to patients, as well as the legal issues regarding documentation.

Overall, the two illustrations show how the scope of the pilot implementation and the ePPR facilited the participants process in aligning the pilot system with the existing infrastructure. The examples also indicate that as long as decision makers are not involved in the discussions and are not informed about the problems which emerge, then the problems are not acted upon. In the first snippet, reflections were made among the paramedics, the EMS provider managers, and the health-care personnel managers, but it did not lead to any changes in the setup of the pilot use or to a decision to put pilot use on standby despite the legal issues. I explain this by the fact that they did not feel that they had the authority to make those decisions. In the second snippet, top management from the Pre-hospital Centre were represented and in this case the common reflections were turned into action.

7 | DISCUSSION

In the findings from the ePPR pilot implementation, I demonstrated how tensions transpired on the boundary between daily work and pilot use of the ePPR. With the concept "infrastructural inversions" I was able to show that the tensions were the outcomes of misalignments between the pilot system and the infrastructure[1]. Based on these findings, I propose, in this chapter, that we move from an understanding of pilot implementations as a sum of activities that leads to learning about the (mis)fit between the pilot system and the organisation to an understanding of pilot implementation as a relational concept.

To elaborate these points, I will use the concepts presented in the theoretical framework as a ground for further discussions of the relational qualities of pilot implementations. Towards the end of the chapter, I propose a tentative definition of pilot implementation. The chapter ends with a discussion of limitations of the study and implications for findings.

Pilot implementation as embedded intervention

Hertzum et al. (2012) describe pilot implementations as a supplement to prototyping and as an ISD technique which is performed to provide real-use feedback. On a further note, they point out that pilot implementations become subjected to the vagaries of organisational life and real-life technical systems. In relation to the findings from the ePPR pilot implementation, I argue that this description does not fully capture the relations between the ePPR pilot implementation and everyday work practice.

From one perspective, the work conducted during pilot use in the ePPR pilot implementation build on regional politics and political ambitions to impact the national ePPR tender. Moreover, the pilot implementation wrestled with the existing infrastructuring, the installed base, and the larger context of emergency medical services as organised in the region. Perceived this way, I therefore find it more accurate to describe the ePPR pilot implementation as being embedded or *sunk* (Star and Ruhleder, 1996) into the workaday of emergency medical services. From another perspective, the analysis of the ePPR pilot implementation shows that, being sunk into emergency medical practices, the realism of the pilot implementation had ramifications for the pilot users and their workaday. The contract illustrates this point well. The management of the Pre-hospital centre

[1] Recalling (Star and Ruhleder, 1996), infrastructure is understood as the relation between organised practice and the technologies supporting it.

did not recognise its role in the project and its impact on the collaboration with the EMS providers. One might say that the managers of the Pre-hospital centre were "blinded" by the conventions of practice. As they took the contractual relation for granted, they did not question the supply-and-demand relation as a ground for collaboration. The contract, however defined the collaboration in the ePPR pilot implementation and this collaboration in return affected the work practice during pilot use.

To capture this double realism of pilot implementation and move away from the connotations related to the words "approach", "technique", "trial" , and "test", and recognize the gravity of the ePPR pilot implementation, I therefore suggest that we regard it as an *embedded intervention*. 'Intervention' comes from the two Latin words *inter* – between and *venire* – come and it is described as an action or process of intervening possibly with the purpose to improve a situation[2]. The verb, to *intervene*, refers to the act of coming between so as to prevent or alter a result or course of events. Further the verb refers to an event or circumstance that occurs as a delay or obstacle for something being done[3].

These meanings resonate well with the implications of the ePPR pilot implementation. It is an act of placing a pilot system in daily work activities with the purpose to improve technical design and organisational implementation through lessons learned from the changes and tensions, which emerge from pilot use. Whereas some of the changes and tensions provide opportunities for the project participants to improve design and final implementation, others are regarded as obstacles, by the pilot users, for work being done.

As interventions, the ePPR pilot implementations are injected into daily work. Rather than only revealing potential areas of improvements in the technical design and the final implementation, they become embedded in practice and introduce new sets of tensions, because of the misalignment between the pilot system and the existing infrastructure. Even though the ePPR pilot implementations were conducted to address a limited set of parameters, they were not isolated events or trials. Hence, what I suggest in this study is that we regard them as interventions into daily work and into the participants daily life and should be titled and conducted concordantly.

The reach and scope of pilot implementation

Based on empirical findings, Bansler and Kensing (2010) and Hertzum et al. (2012) identify a number of challenges related to operating a pilot implementation. One of them is to define a proper scope of the pilot implementation, while at the same time accommodating for the users' work to extend beyond the scope. The challenge is crystallised into the questions: What scope of work practice should be scrutinized, for how long, and by how many people in order to secure that a sufficient ground of knowledge is provided without adverse consequences for real work and without exceeding costs?

The answer to these questions is often a matter of compromises. In their

[2]Oxford English Dictionary, Apple's digital version 2.2.3
[3]Oxford English Dictionary, Apple's digital version 2.2.3

study of an unsuccessful pilot implementation of a national electronic pregnancy record in Denmark (Bansler and Havn, 2010), we see that the organisation of work at the hospital with rotating shift-work and demands around-the-clock operation made it difficult to define a scope of pilot users across the health sectors. The organising of work at the hospital would result in sporadic use of the electronic pregnancy record, unless they dramatically increased the number of pregnant women participating in the pilot implementation. This, in turn, would require much more midwifes and general practitioners, making the pilot implementation very costly. Therefore, the project manager decided to limit the number of pregnant women. As a result, the electronic pregnancy record was only used sporadically at the hospital, and the pilot users never became familiar with it. Bansler and Havn (2010) conclude on this basis that evaluation was impossible and learning limited.

Hertzum et al. (2012) on the other hand report on a successful pilot implementation of an electronic patient record implemented at a stroke unit. In this case, integration to activities and systems outside of the scope of the pilot implementation were simulated to make it appear as an implementation of the final system. Thus, while the pilot implementation was deemed a success, extraordinary efforts also went into making the pilot system a seemingly ordinary part of daily work. In total, the four partners of the project spent 4249.5 hours in the course of the experiment, which lasted five months. Although this work may be only a fragment of the entire ISD project (Simonsen and Hertzum, 2008), it points to a paradox, which became apparent in my study of the ePPR pilot implementation: even though the pilot implementation only includes a part of the system, it may still require full integration into the existing infrastructure and its installed base, because it emerges through situated use.

As the empirical findings from the ePPR project show, the challenge pointed out by Bansler and Havn (2010) and Hertzum et al. (2012) is more complex than it appears at a first clance. What part of work should be accommocated during pilot use is difficult to define prior to use. That is because the question is tied to different temporal and spatial horizons and only becomes clear through use. For instance, the Pre-hospital centre was working with a shorter-term perspective confined to a focus on configuring the pilot system for use in the ambulances and for gathering data for the evaluation. The paramedics on the other hand, showed concern with the long-term implications of the pilot system on the quality of their ambulance records and the potential consequences for their everyday work beyond the scope of ambulance runs. These concerns were only partially recognised.

To elaborate this point, I will draw from Star and Ruhleder (1996) and Karasti et al. (2010). The configuration of the eight dimensions of infrastructure presented in (Star and Ruhleder, 1996) are conditioning for the main point that infrastructure is not a thing, but a relational concept, which occurs in relation to use. Infrastructures only become real infrastructures in organised practice, but this practice is embedded and constantly becoming (infrastructuring), rather being fixed. Followingly, infrastructures do not have boundaries a priori. On the contrary, infrastructures emerge *when* somebody uses them as such. Similarly, because the ePPR pilot implementations were being embedded in daily work and spanned several organisational units and professions, the scope was dependent on the temporal and spatial orientations of the different participants. This

made it difficult to confine the ePPR pilot implementations to clear-cut and well-defined boundaries. If we follow the work of Star and Bowker (2002), we are able to see that the scope of a pilot implementation for some may be a way to overcome the complexity of the work and break it into more manageable units for analysis and learning. For others, however, the limited scope becomes a difficulty to deal with, while trying to do the daily work.

In this section, I have discussed the challenge of defining a proper scope and argued that it is related to questions of perspectives. Thus, limiting the challenge of defining a proper scope to questions of what is (not) part of the pilot implementation reduces the challenges to mere practicalities. Instead, I argue that defining a scope is first and foremost related to profession, position, and exercise of power. In addition to the considerations of what is in or out of scope it is highly relevant to investigate who has the right to or can impact the decisions of what is a part of scope and who cannot.

Pilot implementation as enactment

Winthereik (2010) investigates the pilot implementation of a maternity record[4]. Drawing on the work of Mol and Law (2004), Winthereik defines pilot implementation as a *project multiple*. With the notion *project multiple*, she wants to foreground that the pilot implementation of the maternity record consisted of different realities, which co-existed in the project. In her description of the pilot implementation as a project multiple Winthereik uses the notion of *enactment* to make the point that the social is a fundamental characteristic rather than a factor in information systems development. She thus points out that the pilot implementation of the maternity record was not only a way to organise what was already there. Rather, the pilot implementation was enacted and continuously produced in multiple ways in accordance to the participants' access to knowledge about the project.

While Winthereik uses enactment to explain how a project consisting of multiple co-existing realities might hang together, I also find this concept useful for comprehending how the ePPR pilot implementation was unfolding in the intersection between the ISD project and day-to-day organised practice. To elaborate this point, I shortly turn to the work of Mol and Law (2004). Illustrated through the disease hypoglycaemia, Mol and Law (2004) notice that rather than understanding diseases as only clinical diagnoses or a state of the body, they are enacted by the diseased people in interaction with their surroundings and the available technologies. Similarly, we are capable of seeing that through the activities of designing, planing, configuring, adapting, and using the pilot system, the ePPR project participants were in fact enacting a new work practice, while trying to align the pilot system with the existing infrastructure.

In an Information Systems and Participatory Design context, Andersen et al. (2011) propose the notion of design interventions, as *'situations of enactment with opportunities to live out and explore change potential as well as "open new ways of conceiving the world"'* (p. 2). This definition to some extent describes the empirical findings from the ePPR pilot implementation. But where Andersen et al. (2011) see the design intervention as coming between what is

[4]The same maternity record also described by Bansler and Havn (2009, 2010).

already there and an emerging possible future, I will argue that the ePPR pilot implementation as an intervention necessitated the users to enact a possible future through their interaction with the pilot system.

Tensions and infrastructural inversions as opportunities for innovating

As mentioned previously, the existing literature on pilot implementations points out that the realism of pilot usage is a central dimension of pilot implementations. Hertzum et al. (2012) argue that the realism is the primary difference between pilot implementations and prototyping and point out that using the system in its intended environment allows for emergent changes to surface. These changes may be recognised as drawbacks or opportunities for learning about the fit between the pilot system and the organisation. Bansler and Havn (2010) similarly argue that the routinely use of the pilot system as part of daily work, is essential for learning about the strengths and weaknesses of the pilot system. On the other hand, they recognise that it is likely that technical and organisational problems and errors will occur during pilot use because the pilot system, still not fully developed, is malfunctioning and sometimes breaks down (Bansler and Havn, 2010; Hertzum et al., 2012). Interestingly, where the emergent changes can be opportunities for learning, the problems, which are related to the malfunctions and breakdowns, are considered as undesirable. Bansler and Havn (2010) point out that errors and breakdowns should be responded to as quickly as possible, because they complicate the pilot implementation, put extra demands on project management and support staff, and frustrate the users. A similar argument is put forward by Hertzum et al. (2012) who conclude that due to the occasional breakdowns, pilot systems require special precautions and therefore they are only suited for limited implementation.

While the findings from the ePPR pilot implementation support the importance of a quick response to breakdowns and tensions, they also suggest another understanding. Building on the finding that tensions, errors, and breakdowns are relative to use, we may first of all question the division between breakdowns and emergent changes by asking: When is a breakdown a breakdown and when does a breakdown become ground for emerging new practices? In the following, I will discuss this further, arguing for a view on tensions, errors, and breakdowns as occasions for enacted innovation through the operation of infrastructural inversions.

As illustrated in the four snippets from the ePPR project, the pilot system often caused tensions due to design flaws and malfunctions, which caused misalignments with the existing infrastructure. Occasionally, these tensions became the starting point for a socio-technical design process as they made the normally invisible quality of working infrastructure visible (Star and Ruhleder, 1996). The tensions thereby allowed for discussions to surface between the project participants on how to understand these tensions and how to align the pilot system with the infrastructure. In some situations, the tensions were addressed as technical matters, in which the project participant focused on a technical solution to make the pilot system function as part of the work practice

(retrieving the archived ePPR reports from the database). In other situations, the tensions were addressed as an organisational matter, in which the project participants considered organisational changes as the solution to secure that the pilot system would properly support work practice (registration of medication by their generic medical name instead of brand name). In other words, the users made an infrastructural inversion, de-emphasising the pilot system to focusing on the infrastructure that was to support it (Bowker, 1994; Bowker et al., 2010).

Following Neumann and Star (1996), we can further describe the tensions in the ePPR project as a way of dealing with the extant infrastructure (and the installed base), while innovating and projecting into an uncertain future. In recent studies there are similar examples of innovation, where breakdowns offer occasions for design-oriented infrastructuring activities. Pipek and Wulf (2009) study the introduction, appropriation, and removal of a groupware infrastructure in a German state government and show that naturally occurring breakdowns during these activities, created opportunities for transitioning from old to new routines through the matter of improving the infrastructure. Clement et al. (2012) similarly describe an action research study in North America about the design of an ID scheme. In this study, they carry out a line of Participatory Design inspired interventions in order to intentionally question the installed base and create alternative ID scheme solutions. Where Pipek and Wulf (2009) and Clement et al. (2012) propose a design-oriented take on breakdown and infrastructuring, Korn and Voida (2015) suggest that frictions are a source for various design strategies. Infrastructural inversion is one of them: "If appropriated for friction, moments of infrastructural breakdown can become moments of awareness, reflection, and questioning about the activities that infrastructures enable and the values inscribed in them, moving beyond the mere feedback cycles of 'users' of public services" (Korn and Voida, 2015, p. 9). I find that this quote describes well what thee participants in the ePPR project were doing, while trying to align the ePPR with the infrastructure.

To further discuss the notion of tensions as opportunities to operate infrastructural inversions, while innovating into an uncertain future, I will draw on Winthereik (2010). Winhereik argues that instead of viewing tensions as obstacles, which must be overcome, they should be regarded as potentials for developing the aim of a project by making the multiple co-existing enactments hang together-as-one. The important aspect of the project multiple here is the embedded normative position which is to try to find ways for the multiple versions of the project to co-exist and gain recognition in order to "hang together-as-one" coherent project (Winthereik, 2010). If we then apply the project multiple to the tensions as opportunities to operate infrastructural inversions, we are able to regard the operation of infrastructural inversions as a means to make the ePPR pilot implementation hang together by connecting the past (the installed base) with the present (the infrastructure being the relationship between the organised practice and the technologies supporting it) and the future (the pilot system being integrated into the infrastructure). But rather than viewing the moments as opportunities for projecting into an uncertain future, I argue that the project participants were in fact enacting the future by operating infrastructural inversions as a strategy to secure integration between the existing infrastructure and the pilot system.

The participant multiple

Another type of tensions, which emerged and were enacted during the ePPR project evolved around the pilot users (the paramedics). As we saw in the third snippet of the analysis, being a paramedic, who provides professional, sometimes life saving, and acute care under even the most impossible work conditions is an important aspect of doing ambulance work. The experience of the pilot system preventing them from doing their work in a satisfactory manner during pilot use inflicted a sense of unprofessionalism on the pilot users. From a Participatory Design perspective and by means of the concept "genuine participation", I was able to understand the sense of unprofessionalism as a the result of a tension related to the inability of the pilot users to participate in the pilot implementation as themselves, with themselves, and for the project (Robertson and Simonsen, 2012).

If we again turn to the notion "project multiple" we are able to describe the pilot users as more than just paramedics, who tested the pilot system to feed back learning to the overall ISD project and who participated in related design activities. They were always also paramedics with personal aspirations as well as ambitions for their professional community overall, but these were dynamic and relative to the situation and use.

Mol and Law (2004) notice that the body of hypoglycaemia comes with a set of tensions and that enacting this body multiple involves the whole body. In the same way, we may say that enacting a pilot user involves dealing with the tensions between different interests related to the different temporal scales. As a user-that-hangs-together, we can further say that the enactment of a pilot user is the enactment of a "participant multiple". For instance there were tensions between the interest to familiarize with the pilot system and thereby help improve the design on one hand, and the need to provide acute care to the patients on the other, while also complying with legal requirements.

Participation thus is to a great extend a matter of making the different coexisting enactments of pilot user hang together. Extending the notion of genuine participation presented by Robertson and Simonsen (2012), I argue that participation is both about transcending the users role from being mere informants to legitimate participants in the design process *and* about fundamental questions about being able to enact the user-that-hangs-together.

Towards a definition of pilot implementation

In the beginning of this chapter, I proposed shifting from an understanding of pilot implementations as a sum of activities that lead to learning about the (mis)fit between the pilot system and the organisation to an understanding of pilot implementation as a relational phenomenon. In light of findings from ePPR project, I have discussed different aspects of such a view on pilot implementations. To outline the main points made, I am proposing that a pilot implementation is more than mere field tests. It is an enacted interventions.

The term "enacted" emphasises that pilot implementations are not only an

approach that can reveal gaps between the technical design and the organisational context. Rather, the gaps are the result of a misalignment between the ePPR and the infrastructure on one hand, and the different enactments of the pilot implementation on the other hand. The term intervention further emphasises that the pilot implementation does something to day-to-day organisation of work and the working relations. The acts to plan and design the pilot implementation and the acts to configure, adapt, and use the pilot system are interventions through which the participants enact possible futures to embed the ePPR in the day-to-day organisation of work.

In this chapter, I further discussed the notion of tension and breakdown. In the existing literature on pilot implementations they are considered unavoidable yet undesired. I propose instead that tensions should be understood as opportunities for innovation. Through operating infrastructural inversions the ePPR project participants were paying attention to the things that had to be aligned in order for the pilot system to function as a stable-enough-technology and to be integrated into the existing infrastructural landscape of past, present, and future. Hence, I suggest that we conceptualise pilot implementations as an enacted intervention, in which the pilot implementation participants attend the needs of today while enacting the solution(s) of tomorrow, while trying to integrate the pilot system into the existing infrastructure.

Implications

The conceptual understanding of pilot implementations as a relational phenomenon has implications for how to studying them as well as carrying them out in practice.

A practical implication regards how we design and conduct pilot implementations. Bansler and Havn (2010) conclude that a systematic, methodical approach to pilot implementations is essential for ensuring success. This entails that the pilot implementation is "*planned and conducted in such a way that it is possible to systematically measure effects, capture the experience and lessons learned during the pilot, and collect feedback from users and other stakeholders. This implies among other things that one must define pertinent success criteria (e.g. productivity or quality effects); identify extraneous factors that may influence the findings and, if possible, control or minimize their effect; establish the means by which data and user feedback can be collected; and finally define the procedure for analysing the information gathered and interpreting the evaluation results*" (p. 645). In light of the findings, I will argue for a flexible approach, which takes into account that there be different enactments of the pilot implementation and that it, as a relational phenomenon, is something which is between people (Star and Bowker, 2002). This does not imply that pre-planning have to be abandoned altogether but it emphasises the great importance of a sensitivity to and a sustained view on effects, success criteria, feedback and learning as related to position and power, rather than being measurable, dry facts. Based on the study of the maternity record, Winthereik (2010) concludes that a project is not just a way of organising what is already there, it is doing something. Hence, she proposes that project managers, who regard a project as a generative framework, should dedicate attention to how the project is enacted while it develops to evaluate what is going on in the project.

Similarly, I propose that project managers should pay particular attention to tensions, emergent changes and breakdowns as way of allowing for reflections on how the design of the pilot implementation itself supports certain types of enactments and thereby certain types of possible solutions to the integration between the pilot system and existing infrastructures. Hence, extending the work of Hertzum et al. (2012) I propose that tensions and breakdowns do not only provide opportunities for bridging the gap between technical design and organisational use. They also provide opportunities to continuously question and reassess the design of a pilot implementation as it occur in practice.

Another implication concerns how we understand and facilitate learning. Learning in pilot implementation is closely related to participation, and as already pointed out in work from the field of Participatory Design, participation is more than to test the system and provide feedback. Building on this understanding, I have shown that in the ePPR project the users at times operated infrastructural inversions while trying to integrate the pilot system with the existing infrastructure. Based on this understanding, I suggest that projects conducting a pilot implementation should think of the pilot users participation ability to operate infrastrutural inversions and mutually shape and integrate the pilot system into the existing infrastructure, as learning. Findings from (Torkilsheyggi and Hertzum, 2014) show that it is important to create a space for reflecting on use in addition to the space for using the pilot system. Participating in the pilot implementation of a system for coordinating the transports of patients by hospital porters, the first author facilitated different activities to support a sustained focus on learning. During (the first week of) pilot use, this included that the first author would be present at dayshift to document work processes and lessons learned. As a space for reflection, these meetings provided the pilot users as well as the facilitator a deeper understanding of how their experiences could be used to drive further design (Torkilsheyggi and Hertzum, 2014). Thus, I suggest that in order to capture experiences and lessons learned, it is important that the resources in a project allocated to evaluate the pilot implementation is present during pilot use to keep an eye on the users and how they might operate infrastructural inversions. Moreover these resources should also be responsible for the creation of a space for reflection on use in order to keep a sustained focus on and to follow up on the processes initiated by infrastructural inversions.

Bansler and Havn (2010) ask why pilot implementations sometimes fail and confine the success to a matter of learning. In line with the findings in this study I argue that we need a more nuanced grasp rather than a dichotomous view on success versus failures, when studying pilot implementations. Taking that the success is measured as a matter of what has been learned, it is necessary to keep in mind that there can be different enactments of a pilot implementation and that learning is relatively to power and position (Bowker and Star, 2000; Star and Bowker, 2002). Thus, what is considered learning for some, may be rejected by others and following, what is a successful pilot implementation for some, may be a failed pilot implementation for others. Reminded by Karasti et al. (2010) and Ribes and Finholt (2009), we can further see that success, failures and learning are related to the temporal scale, by which project participants orient their participation. This view is supported by other work, which shows that

failures and success are relative phenomena that change over time (Rolland, 2014) and that users' expectations in an ISD project are dynamic and change over time in reaction to the various actions and events in the project Hansen (2014). Thus, from a research point of view, I find that academics should be more cautious to deem a projet a success or failure. From the point of view of practice, I suggest that projects conducting a pilot implementation should pay careful attention to importance of power and position for the claim of something being identified and acknowledged as learning. This require an openness to the different enactments co-existing in the pilot implementation.

Limitations

In this thesis, I have proposed a framework for studying pilot implementation and a conceptual understanding of pilot implementation. Since the work is based on a single study it is difficult to conclude on its wider application. I therefore suggest that the framework would be used in further studies of pilot implementations - within as well as outside health care to assess its usefulness and the work on pilot implementation as a relational phenomenon.

The ePPR pilot implementation commenced prior to our participation in the project and naturally, we were not a part of the initial process of planning and designing the pilot implementation including the process of choosing the pilot system. Moreover, as I already reflected upon in chapter four, our primary contact was with the EMS-providers. Our participation in meetings with the Pre-hospital Center managers were conditional on being invited by the EMS-provides. Therefore my understanding of the ePPR pilot implementation as a relational phenomenon is primarily based on activities related to pilot use including the training session and the user-driven re-design workshop.

A final note on the limitations of this thesis is related to the practicalities of the ePPR project. As I noticed in the literature review in chapter five, pilot implementations are often conducted as a means to achieve something else. In this case, to gather data for the evaluation of the new pre-hospital plan in Region Zealand. This purpose might have shaped their approach to the problems and discussions that occured during the project. Their main focus was to solve the problems to provide data for the evaluation while the paramedics also expressed concerns for the longer term effects of using the ePPR on their work. If the Pre-hospital center did not have this focus or the pilot implementation was only conducted for the sake of the ePPR, they might also showed greater concerns for the long-term consequences of pilot using the ePPR.

It could have been that some of the problems emerged or became bigger due to our participation. We asked questions about the observations that we did and this made the participants reflect upon the project. While it is a moot point, whether the problems would have had the same gravidity, if we had not asked about them or had not participated, it could be that we helped enacting these problems through our participation

Future research

Based on the findings from the study of the ePPR project, I propose areas for further research. A pertinent question is related to the relational qualities of pilot implementations. When we regard pilot implementations as a relational phenomenon it is relevant to investigate how they should be planned and carried out. How is it possible to facilitate a process, in which a project has to deal with the complexity of the project setting and at the same time attend the pilot implementation as a constantly emerging phenomenon? What measures should be taken to facilitate a process, where the project is enacted, where the enactments are related to different temporal scales and where the project participants not only have to look for the future but also the past to develop a sustained solution?

Another question is related to the misalignments between the pilot system and the scope of the pilot implementation on one hand and the existing infrastructure on the other. From one perspective, the literature points out that the pilot system has to be robust enough to be used in real practice. From another perspective, the tensions emerging from the misalignments can provide opportunities for the project participants to make common reflections and operate infrastructural inversions. Thus, if a certain degree of tensions are required to make infrastructural inversions, the robustness of the pilot system and the arrangement of the scope of the pilot implementation becomes a delicate matter of finding the right balance between robustness and flexibility. This paradox leads me to propose more research on the actual design of the pilot system and the arrangement of the scope of the pilot implementation. One way of thinking about them may be as boundary objects. *Boundary objects* are not given objects but emerge from collisions between different social worlds and they possess the qualities of being plastic enough to adapt to local needs yet robust enough to maintain a common identity across these social worlds (Bowker and Star, 2000; Star and Griesemer, 1989). Thus, one proposal to further investigate, possibly action research studies, if and to what extent it is possible to purposefully design the pilot system and the scope of the pilot implementation as boundary object that support opportunities for conducting infrastructural inversions.

A related area is the relative importance of the design of the pilot system as well as the practical arrangement of the scope of the pilot implementation for the type of tensions and changes that may emerge during pilot use. The findings indicate that it is not irrelevant, how the different functionalities are presented in the user interface and what solution is chosen for the practical arrangement of the scope of the pilot implementation. I therefore propose the need for further research on the matter of the materiality of the pilot system and the scope of the pilot implementation.

Research on user participation is far from new to Information systems development, especially not those schools drawing from Participatory Design. Information systems development offers different tools and methods for involving the users, but they are rather scarce in the field of pilot implementations despite being based on real-use feedback from users. The findings from this study indicates that there are several aspects of participation that should be taken into consideration, when working in a highly hierarchical environment such as

healthcare and where the pilot users are lower ranking in the hierarchy. A possible area of future research is to investigate how it is possible to support the users in operating infrastructural inversions. Another area is, how it is possible to make the users' operating infrastructural inversions more visible and acknowledged as a contribution to pilot implementations? Finally, the findings indicate the importance of infrastructural inversions being a common endeavour between the pilot users and the decision makers. It is therefore relevant to investigate how infrastructural inversions can become a common endeavour between pilot users and managers.

8 | CONCLUSION

In this thesis, I have been working on the fringes of pilot implementations, focusing on tensions between everyday work practices and pilot use. The purpose has been to contribute with a conceptual understanding of pilot implementations as an approach in Information systems development. At present, research on pilot implementations is in an early stage and there is a lack of conceptual work.

To pursue a conceptual understanding of pilot implementations, I have studied a project pilot implementing an electronic pre-hospital patient record (ePPR) for emergency medical services in the ambulances. The project was conducted in the Danish health care over a period of almost two years. During this period, the project participants encountered many problems and they perceived is overall as unsuccessful. Some of the problems seemed to be consequences of conflicting interests related to everyday work practice and the organising of the pre-hospital sector in the region. They were, however, not necessarily acknowledged or visible to all project participants. Other problems were related to poor usability and bad performance of the system. These problems had a detrimental impact on the ambulance work that was otherwise excluded from the pilot implementation scope.

Examining the pilot implementation literature, I have not found work that could help me explain these observations. Existing literature is primarily concerned with identifying and describing the activities and elements of pilot implementations. Therefore, to analyse the empirical material, I have created a theoretical framework revolving about infrastructure as a relational concept. With infrastructure, I understand the relation between organised practice and the technologies supporting this practice (Star and Ruhleder, 1994, 1996). As a relational concept, infrastructure has offered a means to attend the relation between the pilot system and the established work practices as that which must be aligned to carry out the ePPR pilot implementation. Moreover, it has allowed me to investigate the pilot implementation as a relational phenomenon, which emerges through practice and between people.

Using tensions as point of departure, I have operated infrastructural inversions to further investigate some of the problems encountered in the ePPR project. Infrastructural inversion offers a methodological gestalt switch to foreground the relation between the pilot system, organised practice, and the technologies supporting practice. Hence, rather than focusing on the activities that go into conducting a pilot implementation, I have focused on these relations, normally taken for granted, which sunk into the organised practice and

become invisible to the project participants.

Through four snippets from the ePPR project, I have illustrated that some of the problems can be understood as the outcome, consequence, and sign of the pilot implementation being fundamentally relational. The relational qualities became visible in different ways. The first snippet shows how the project participants experienced the scope of the collaboration in the pilot implementation differently. The second snippet shows how the project participants experienced the scope of pilot use differently. In the third snippet, I have shown how the project participants had different experiences of relevance of the organisation of the pre-hospital sector for their participation in the project. Finally, in the last snippet I show how tensions in the project provided opportunities for project participants to discuss the problems encountered. In particular, the pilot users were capable of operating infrastructural inversions as means of solving the problems and align the pilot system with their existing work practices.

In all the examples, the relational qualities emerge as tensions on the fringes between day-to-day organised work practice and pilot use. To further investigate what they might mean for a conceptual understanding of pilot implementations, I have discussed the findings in relation to the theoretical framework. The main points here are that pilot implementations, as a relational phenomenon, emerge with thee dimensions embedded, enacted and multiple: (i)*Embedded*. Pilot implementations and day-to-day organised practice are imbricated and the reach and scope of pilot implementations emerges between people and through practice; (ii) *Enacted*. Rather than merely being test or a technique with which it is possible to extract lessons learned, pilot implementations are enacted as a means to overcome tensions. Being embedded in practice, pilot implementations, however, also introduce new sets of tensions as the pilot system is aligned with the existing infrastructure; (iii) *Multiple*. Pilot implementations are not a whole, but a co-existence of different enactments, which causes tensions to emerge. These tensions are inscribed with issues of power and position.

Extending this understanding, I contend that tensions are fundamental to pilot implementations. The tensions are signs of an infrastructuring process in the making rather merely failures. From this perspective, the tensions become indicators of the efforts that go into integrating the pilot system with the existing infrastructure. Hence, I propose that we conceptualise pilot implementations as interventions into organised practices, by which the pilot implementation participants attend the needs of today while enacting the solution(s) of tomorrow as an extension of the installed base through the operation of infrastructural inversions.

This work is to serve as a basis on a better understanding and utilisation of pilot implementation to improve information system development.

A | Pilot Implementation Literature

Ahmad et al. (2002)
Akl et al. (2007)
Alavi (1984)
Allen et al. (2012)
Alles et al. (2006)
Aziz et al. (2005)
Babar et al. (2006)
Bansler and Havn (2009)
Bansler and Havn (2010)
Bernstein et al. (2005)
Beynon-Davies et al. (1999)
Bossen (2007)
Broering et al. (1989)
Chin and McClure (1995)
Colombet et al. (2003)
Feil et al. (2003)
Floyd (1984)
Fortin et al. (2001)
Fullerton et al. (2006)
Gell et al. (2000)
Glass (1997)
Gogan et al. (2004)
Gogan and Gelinas (2007)
Gogan and Rao (2008)
Gogan et al. (2010)
Gogan and Rao (2011)
Halamka et al. (2005)
Hansen and Pedersen (2011)
Hansen and Simonsen (2012)
Hertzum and Simonsen (2008)
Hertzum and Simonsen (2010b)
Hertzum and Simonsen (2011)
Hertzum et al. (2012)
Iredale et al. (2002)
Janson (1986)
Janson and Hammerschmidt (1990)
Kieback et al. (1992)
Lancaster et al. (2004)
Liang et al. (2006)
Lichter et al. (1994)
Lim et al. (2008)
Markus (2004)
Mason and Carey (1983)
Miller et al. (1995)
Naumann and Jenkins (1982)
Pal et al. (2008)
Peute and Jaspers (2007)
Ross (1999)
Rzevski (1984)
Samoutis et al. (2008)
Simonsen and Hertzum (2008)
Simonsen (2010)
Simonsen and Hertzum (2010)
Simonsen and Robertson (2012)
Turner (2005)
van Teijlingen and Hundley (2001)
van Teijlingen and Hundley (2005)
Winthereik (2010)
Xu and Quaddus (2005)
Yang et al. (2013)

B | Infrastructure literature

Aanestad and Jensen (2011)
Bietz et al. (2010)
Bossen and Markussen (2010)
Botero and Saad-Sulonen (2010)
Bowker and Star (2000)
Edwards (2003)
Edwards et al. (2007)
Edwards et al. (2009)
Grisot and Vassilakopoulou (2013)
Hanseth et al. (1996)
Hanseth and Monteiro (1997)
Hanseth and Braa (2001)
Hanseth and Lundberg (2001)
Hanseth and Lyytinen (2004)
Hanseth and Lyytinen (2010)
Hepso et al. (2009)
Jackson et al. (2007)
Johannessen et al. (2012)
Karasti and Baker (2004)
Karasti et al. (2006)
Karasti et al. (2010)
Kee and Browning (2010)
Lee et al. (2006)
Monteiro and Hanseth (1996)
Pipek and Wulf (2009)
Pollock and Williams (2010)
Ribes and Finholt (2009)
Ribes and Lee (2010)
Rolland and Monteiro (2002)
Sahay et al. (2013)
Simonsen and Hertzum (2008)
Star and Ruhleder (1994)
Star and Ruhleder (1996)
Star (2002)
Star and Bowker (2002)
Pedersen et al. (2012)
Monteiro (1998)
Monteiro et al. (2013)
Star (1999)
Star and Bowker (2002)

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