Scandinavian Journal of Information Systems, vol. 29, no. 2 (2017), article 2
Author version

Incomplete by Design: A Study of a Design-in-Use Approach to Systems Implementation

Arnvør á Torkilsheyggi

Roskilde University, Denmark
arnvoer@ruc.dk

Morten Hertzum

University of Copenhagen, Denmark
hertzum@hum.ku.dk

Abstract. In complex work settings the design of a system, including the associated work practices, must be completed in use to derive full benefit from the system. We investigate the introduction of an electronic whiteboard throughout a hospital in which management substituted a local design-in-use process, driven by super users, for a centrally organized implementation process. The aim of this study is to investigate the design-in-use approach to systems implementation with respect to the tension that ensued between hospital management's expectations to the process and the goals pursued in the individual departments. On the basis of interviews we find that many users, including some super users, were skeptical toward design in use, that the process was better suited for intra- than interdepartmental change, and that simultaneous evolution in management's expectations and the locally pursued goals aggravated the tension. We discuss the circumstances under which a local design-in-use process may, partly, replace conventional

systems implementation.

Keywords: design in use, super users, organizational implementation, change management, healthcare.

1 Introduction

Work settings such as engineering, healthcare, and public administration are complex and dynamic. Under such circumstances the introduction of new information systems does not, in any simple way, mark a shift from design to use (Aanestad et al. 2017; Henderson and Kyng 1991; Orlikowski 1996; Pipek and Wulf 2009). Rather, design continues into use because users configure the system for their ways of working and adapt their ways of working to benefit from the system. To be ready for use in complex and dynamic settings, an information system must be incomplete by design. Designing for incompleteness (Garud et al. 2008) means that the system must be configurable and extensible and that the implementation process must be improvisational and extend design into use. In this study we investigate the organization-wide implementation of an electronic whiteboard intended to support communication and coordination in a hospital.

Management in the studied hospital designed for incompleteness. Rather than a centrally run implementation process that stipulated up front how to use the whiteboard, the management tasked the individual departments with exploring and embracing the possibilities afforded by the whiteboard. That is, the implementation of the whiteboard was organized as a local design-in-use process, driven by super users. We investigate the design-in-use process at the hospital with respect to the interactions between management's expectations to the process and the goals pursued in the individual departments. While we acknowledge that some research on knowledge management addresses how organizations evolve through bottom-up redesigns (e.g., Nonaka 1994; Orlikowski 1996; Willcocks and Smith 1995), the aim of the present study is to contribute to design-in-use research. Previous studies of design in use (e.g., Folcher 2003; Park et al. 2015) mostly approach it as an activity performed by motivated users and unrelated to management. By analyzing design in use in relation to managerial expectations we ask the research question: *Under which circumstances may a local design-in-use process, partly, replace conventional implementation?*

Three interrelated aspects of the circumstances are particularly prominent in our analysis. First, the simplicity of the whiteboard stands in contrast to the complexity of the hospital. The whiteboard is an example of a lightweight technology (Bygstad 2017), which can be configured and reconfigured at low

cost. Conversely, the hospital is a complex and safety-critical organizational setting with many interdependencies. That is, the hospital setting does not invite quick changes. Second, the design-in-use process may target local changes within a department or changes in the coordination between departments. Sanchez and Mahoney (1996) emphasize that changes at these two levels require component-level and architecture-level learning, respectively. This makes changes in the coordination between departments more difficult to accomplish. Third, design in use is shaped by how the involved people perceive the process and their role in it. At the hospital the departments appointed super users to drive the design-in-use process. Super users are regular staff who receive extra training in the use of a system and then become responsible for championing it (McNeive 2009). That is, they know the work domain and the system. We investigate whether this double competence facilitates design in use, creates role tension, or both.

Figure 1. The electronic whiteboard (to preserve anonymity some of the content has been blurred)

The electronic whiteboard was originally developed for emergency departments. At the studied hospital, the emergency department got an early version of the whiteboard in 2009 and took part in evolving it into a mature product (Rasmussen et al. 2010). The whiteboard was a success in the emergency department (Hertzum 2011) and on that basis it was introduced on all departments in the hospital in December 2012. An important reason for the design-in-use approach adopted by management in the organization-wide implementation was the success of the whiteboard in the emergency department. The whiteboard is accessible on all computers and permanently shown on large wall-mounted displays. It gives one row of information for each patient, including time of arrival, name, responsible physician, status of laboratory tests, transfer checklist, and next stop, see Figure 1. Configuring

the whiteboard for a department involves choosing the fields of information relevant to this department from a list of options. The options span both intra- and interdepartmental coordination, for example ‘transfer checklist’ and ‘next stop’ support the transfer of patients between departments. The use of these options presupposes that bilateral procedures have been established about how to negotiate when a patient is ready for transfer, when the receiving department is ready for the patient, and how the whiteboard is used in this negotiation.

In the following we review related work on design in use, describe how we collected and analyzed our empirical data, present our analysis of the design in use of the whiteboard, and discuss the circumstances that influenced whether the local design-in-use process succeeded in replacing conventional implementation.

2 Related Work

Design in use has been the topic of considerable research with the shared aim of capturing “practices of interpretation, appropriation, assembly, tailoring and further development of computer support in what is normally regarded as deployment or use” (Dittrich et al. 2002, p. 125). This definition suggests that design in use is a more informal and user-driven set of practices than system implementation, which is normally seen as a management-initiated and, at least partially, planned process. However, the definition also implies that the boundary between design in use and system implementation is permeable. The research on design in use demonstrates that users design, rather than merely adopt, their ways of working with a system and that system success is dependent on this designing (e.g., Balka and Wagner 2006; Dourish 2003; Henderson and Kyng 1991).

2.1 Design in Use

The Linux operating system and the Wikipedia online encyclopedia are prominent examples of systems that were initially incomplete but have grown and evolved massively through the work of their users (Garud et al. 2008). These systems show the potential of design-in-use type processes, if successfully managed. At a smaller scale, Aanestad et al. (2017) analyze how the use of videoconferencing at a rehabilitation hospital has evolved through a participatory design-in-use process that has continued for more than a decade. They emphasize the importance of balancing here-and-now considerations against later-and-larger considerations in decisions about the direction and scope of design-in-use work. This requires, among other things, a long-term managerial commitment. While these examples emphasize the role of management in providing organizational support for design in use,

previous research finds substantial differences in managerial involvement. We distinguish three broad classes of design-in-use processes with respect to managerial involvement.

First, multiple studies have analyzed how design in use happens in situations with no formal organizational procedures to support it. Consistent with the above-mentioned definition of design in use (Dittrich et al. 2002) these studies suggest that design in use is an inescapable aspect of starting to use a new system. That is, use involves design because action is situated (Suchman 2007). Practices emerge locally when actors respond to situations and successful responses get repeated. The resulting practices, designed in use, blend the use of the system as planned with adapting and working around it. For example, the POLITeam project (Pipek and Wulf 1999) resulted in an improvement of the process of vote preparation. Neither project members nor interviewed users had, however, recognized this improvement opportunity prior to the introduction of the system. It was realized, "rather accidentally" (Pipek and Wulf 1999, p. 207), after the system had been in use for several months and, then, led to a redesign of the workflow. Relatedly, Park et al. (2015) studied how an electronic medication record could not support emergency-department doctors' bedside documentation the way paper charts had done. The electronic record required doctors to recall the information gathered at the bedside when they were later in the charting room to enter the information in the electronic record. To remember the bedside information the doctors started making personal notes on pieces of paper. This example illustrates that design-in-use activities may also serve to work around the limitations of a new system. In addition, the personal notes necessitated further design in use because they contained sensitive patient information and, therefore, had to be discarded in a safe manner.

Second, design in use has been studied in settings with organizational support for the users' tailoring activities. Studies differ with respect to whether such support has been sufficient to encourage and enable users to design. Trigg and Bødker (1994) investigated how templates for standard forms started to emerge at the studied labor inspection agency after the introduction of a text processing system with comprehensive template facilities. Some labor inspectors started making templates, initially for personal use only. In addition, local support staff made templates for others to use. Gradually, the templates evolved from tools for individual use to organizationally reviewed templates distributed to all inspectors and important to how they conducted their work. Similarly, Dittrich et al. (2002) analyzed how a user in close cooperation with a systems developer made templates that enabled municipal staff to access and edit documents on the municipal website. The cooperation with the systems developer was decisive to this design-in-use process but unevenly available to users. The authors conclude that a better organizational infrastructure for supporting design in use was necessary to achieve the vision declared for the website. They term

this infrastructure 'shop floor IT management' (Dittrich et al. 2002; Dittrich et al. 2003). A shortage of another kind of support is analyzed by Hartswood et al. (2002) who describe how the evolving use of a speech-recognition system shifted additional workload to the secretaries, who had to handle speech-recognition errors left uncorrected by the clinicians. After the secretaries raised the problem about their increased workload, the ward agreed on a work procedure where the secretaries returned letters with uncorrected errors to the clinicians. This procedure stipulated how to use the opportunities afforded by the system and rebalanced the workload.

Third, design in use may be a planned extension of the design-before-use process and directed at realizing the benefits that were specified before the system was taken into use. In these situations the ends are prespecified but it is recognized that the means necessary to reach the ends must, at least partially, be devised in response to local circumstances. Markus (2004) terms this phase shakedown. It is the phase during which an organization starts using a new system and "troubleshoots problems associated with technology and new processes" (Markus 2004, p. 11). More broadly, system lifecycle models refer to this phase as implementation. In a review of the factors critical to implementation success, Nah et al. (2003) emphasize issues such as taking advantage of the best practices offered by the system, being prepared to fit work practices to the system to minimize the customizations needed, and managing resistance by championing the system. These issues recognize the importance of design in use but largely restrict its scope to achieving the changes that were planned ahead of deploying the system. In contrast, Orlikowski and Hofman (1997) highlight the limitations of planned change and the importance of identifying and embracing emergent change. In their approach to improvisational change management, change often happens as a result of unplanned design in use and may provide hitherto unrecognized benefits and opportunities.

2.2 Configurability: Enabling Design in Use

Henderson and Kyng (1991) analyzed the possibilities for end-users to shape their technological environments by tailoring their systems and evolving their ways of working. A conclusion from that study was that for tailoring to succeed systems must support design in use; that is, they must be configurable. Direct activation (Wulf and Golombek 2001), placeless documents (Dourish 2003), and ERP systems (Robey et al. 2002) are examples of how systems may be designed to encourage and enable configuration. As an example, Dourish (2003) proposed a technology – placeless documents – that could evolve with the needs of individual users to organize their documents in personal ways while, at the same time, keeping the entire document space mutually intelligible to all users. This way, placeless documents seeks to enable the effective retrieval of documents across evolving and personal ways of organizing the documents. Facilities for

configuring systems to local and evolving needs have become an increasingly prominent part of many systems. Bygstad (2017) argues that lightweight technology provides better support for such flexibility and evolvability than heavyweight technology. Lightweight technology exploits networked hardware such as mobile phones and electronic whiteboards to provide front-end solutions that present information from existing systems in new ways. Because its technical complexity is fairly low, lightweight technology invites innovation and experimentation – also from users. In contrast, heavyweight technology consists of fully integrated architectures, bears the cost and complexity of back-end development, and is the realm of IT professionals.

Balka and Wagner (2006) extended the perspective on configurability from changes of the technology to changes of the environment in which the technology is embedded. To enable design in use the environment, not just the technology, must be configurable. On this basis Balka and Wagner (2006) identify five dimensions of configurability: (1) organizational relations, (2) space and technology relations, (3) connectivity, (4) direct engagement, and (5) configuring as part of technology use. While the three first dimensions delineate the multiple aspects of the work environment that can be targeted by design in use, the two last dimensions call attention to aspects that determine the extent to which it is likely to succeed.

If an organization lacks knowledge of the components of which it consists or the ways in which they interact then design in use becomes a process of organization-wide learning and experimentation. Sanchez and Mahoney (1996) emphasize the role of information structures in defining the boundaries of components as well as in gluing them together by specifying their interactions. When information structures define the components and their interactions then a component can be changed locally as long as its interactions with other components remain unchanged. This makes intra-component changes easier to accomplish than inter-component changes, which presuppose knowledge of the larger architecture that contains the components (Sanchez and Mahoney 1996). Thus, design in use is greatly facilitated by an architecture in which most of the desired changes are reconfigurations internal to components. At the same time, many large systems are in use for extended periods, often decades, and go through both component-level and architecture-level design in use to remain useful (Karasti et al. 2010).

With respect to electronic whiteboards most previous studies of this information structure have focused on how whiteboards facilitate the coordination of work. For example, Wong et al. (2009) found that the whiteboard in the studied hospital department transformed the morning rounds by communicating more information and stimulating more consolidation of the issues raised. Hertzum and Simonsen (2013) found that the whiteboard in an emergency department enabled the nurses to spend more time with the patients, presumably because the whiteboard supported the nurses in maintaining an overview of when they could stay in the patient rooms and when they were needed for activities elsewhere. Whiteboards produce these effects by visualizing the current state of the patients in their trajectory through the hospital. This way, they also map out the current

coordinative interactions among the clinicians. To produce these effects across differences in departments it must be possible to configure whiteboards for local needs. This possibility is improved by the lightweight nature of whiteboards (Bygstad 2017), which means that they can often be configured by people other than IT professionals.

2.3 The People Involved

It is uncontested that the users are central to design in use. For example, Maceli and Atwood (2013, p. 21) argue that design in use requires that systems "have end users willing and able to be active contributors". In order for users to be willing and able to contribute, multiple authors have pointed to a need for local intermediaries skilled in configuring systems and tasked with supporting design in use (e.g., Dittrich et al. 2002; Hartswood et al. 2002). The presence of such intermediaries may engage users in design in use, but Torkilsheyggi and Hertzum (2014) note that it also incurs a risk of creating another layer of separation between users and design activities, thereby introducing additional challenges to end-user involvement. Extending Pipek and Wulf's (2009) discussion of the relationship between designers and users, these challenges include that the intermediaries may attain a large say in scheduling when design in use can get done, and this schedule may not match the times at which possibilities for improvements become salient to users.

Candidates for intermediaries to support design in use are the staff that already supports the use of systems, such as IT support and super users. Kanstrup and Bertelsen (2006) studied how IT supporters, normally tasked with providing technical assistance on the use of systems, took on a design role that led to better integration of the system in local practices. Åsand and Mørch (2008) found that super users filled an important niche between end-users and technical IT staff and that this niche was important to the success of design in use. The super users were local staff who received training in the use of a new system and, then, became responsible for training their colleagues. End-users frequently preferred to interact with the super users, rather than with technical IT staff, because the super users had local and domain knowledge. This preference points to another set of criteria for selecting intermediaries to support design in use than the need for intermediaries skilled in configuring the new system. In many situations, local intermediaries are however not available. In these situations users' design-in-use activities are, instead, supported by systems developers (Dittrich et al. 2002), consultants (Haines and Goodhue 2003), or peers (Henderson and Kyng 1991). For example, Henderson and Kyng (1991) describe how design in use was enabled by facilities that allowed users to copy and edit adaptations of their system, rather than create them from scratch, and how the copying, in turn, was supported by sharing adaptations locally among peers.

In previous research, management contributes to design in use by appointing intermediaries (e.g., Hartswood et al. 2003) and, more generally, by supplying an infrastructure for sharing and lending permanence to design-in-use outcomes (e.g., Aanestad et al. 2017). That is, management is in a

facilitating role rather than seen as a genuine contributor to design in use. When design in use is applied as an organizational approach to systems implementation – as in the present study – management's expectations to appointed intermediaries and other contributors become an important factor in the design-in-use process. For example, Pries-Heje and Dittrich (2009) analyzed how user representatives, consultants, and internal enterprise resource planning (ERP) experts – all appointed by management – contributed to the implementation of an ERP system compared to how the end-users contributed when they eventually started using the system. Management's expectations influence the other contributors, and vice versa. This process of mutual influence has hitherto not been the subject of much design-in-use research.

3 Method

This study was conducted at a medium-sized hospital in Region Zealand, Denmark. The hospital had 250 beds and its 1,140 employees served approximately 150,000 citizens. Each year about 35,000 patients were admitted at the hospital. The study was approved by the hospital management prior to the interviews. The interviewees were individually informed about the study and orally consented to take part.

3.1 Interviewees

To learn about the design-in-use process we interviewed 21 managers, super users, and end-users, see Table 1. We chose interviews as our method of data collection because we were interested in the clinicians' experience of the design-in-use process and because the process – though still ongoing – had been going on for one and a half years and was therefore to a substantial extent accessible only through the clinicians' descriptions of it. The interviewees represented eight of the hospital's ten clinical departments in addition to people from the hospital management and administration. To be able to crosscheck the interviews against each other, we interviewed two people from each included department. Apart from PM, HM, and SA2, all interviewees were clinicians directly involved in the day-to-day performance of the work that the whiteboard was to support.

3.2 Procedure

We conducted 22 interviews with 21 interviewees (SA2 was interviewed twice) in June-November 2014. At the time of the interviews the design-in-use process had been going on for one and a half years. The two system administrators and the project manager were contacted directly by the authors on the basis of our yearlong connection to the whiteboard project (Rasmussen et al. 2010). The remaining interviewees were identified in collaboration with

SA2 who, after we interviewed him the first time, received a description of our study with a request to interview about 20 people distributed across departments, staff groups, and roles in relation to the whiteboard. We included multiple departments because differences in medical specialty meant differences in the workflow and coordination practices in the departments and, thereby, represented different needs in relation to the whiteboard. Multiple staff groups were included because the whiteboard was intended to support coordination across staff groups. We were particularly interested in the super users' role in the design-in-use process.

Shorthand	*Role in relation to whiteboard*	*Job title*	*Department*
PM	Project manager	Regional project manager	Region Zealand
HM	Hospital management	Deputy Director	Hospital Management
LM1	Local management	Head of department	Gynecological and Obstetrical
LM2	Local management	Head nurse	Surgical
SA1	System administrator	Nurse	Hospital Administration
SA2	System administrator	Quality consultant	Hospital Administration
SU1	Super user	Social and healthcare assistant	Geriatric
SU2	Super user	Deputy manager	Gynecological and Obstetrical
SU3	Super user	Midwife	Gynecological and Obstetrical
SU4	Super user	Physician	Medical
SU5	Super user	Nurse	Medical
SU6	Super user	Head of department	Orthopedic Surgical
SU7	Super user	Nurse	Pediatric
SU8	Super user	Secretary	Pediatric
SU9	Super user	Physiotherapist	Rheumatology
SU10	Super user	Occupational therapist	Rheumatology
EU1	End-user	Chief physician	Emergency
EU2	End-user	Nurse	Emergency
EU3	End-user	Physician	Geriatric
EU4	End-user	Deputy manager	Orthopedic Surgical
EU5	End-user	Chief physician	Surgical

Table 1. The interviewees

After identifying the interviewees we initially contacted them by email. To give the interviewees a sense of the interview topics, the email included the guiding questions for the interview: (1) How do you, in your department, use the whiteboard, and for what? (2) How have you worked with configuring the whiteboard and incorporating it in your workflows? (3) What do you see as the biggest challenges in getting everybody in the department to use the whiteboard? (4) To what extent do you experience that the whiteboard, in its present configuration, supports intra- and interdepartmental coordination? (5) What would it take for the whiteboard to support intra- and

interdepartmental coordination better? The questions asked the interviewees to reflect on a process that reached back a year and a half. Because the authors had followed the whiteboard project since its start we were often able to ask concrete follow-up questions to the interviewees' initial answers, thereby alleviating the effects of forgetting. The interviews lasted an average of 55 minutes.

3.3 Data Analysis

The interviews were audio-recorded and all but one interview were transcribed in full. The audio-recording of the last interview (SU1) was defective, but a summary was written immediately after the interview. The transcripts were initially subjected to an open coding in Nvivo. In this line-by-line analysis the transcripts were read and annotated with codes derived from the transcript text. The resulting codes captured various aspects of the design-in-use process (e.g., super users' personal motivation, scaffolding activities, and support and barriers). Through a process of arranging and rearranging the codes were organized into a hierarchical structure with six main categories: (1) conditions for design in use, (2) appointing actors for the design-in-use process, (3) preparing actors for design in use, (4) design in use to support intradepartmental coordination, (5) design in use to support interdepartmental coordination, and (6) the results of design in use. To investigate the relations among the categories we wrote a memo, which led us to the identification of three key aspects of the design-in-use process: purpose, actors, and process. While the aspects were interrelated, the first of the six main categories was primarily about purpose, the second and third primarily about actors, the fourth and fifth primarily about process, and the sixth about purpose as well as process. The memo also pointed to a single overall theme. Across the six categories, the interviews described a tension between management's expectations to the design-in-use process and the goals pursued by the local actors in the departments. With this theme as our guide, the transcripts were reread to enrich our understanding of how the tension emerged and evolved.

4 Results

In the following, we present our analysis of the tension between management's expectations and the goals pursued by local actors in the departments. The analysis is structured into: the *purpose* of the design-in-use process, the *actors* tasked with driving the process, and moving from an intra- to an interdepartmental change *process*.

4.1 The Purpose of Design in Use

The basis for the decision to introduce the electronic whiteboard throughout the hospital was an expectation that the whiteboard could be used to improve

intradepartmental work practices, as in the emergency department, combined with an expectation that the whiteboard would allow for better communication and coordination across departments. These expectations were boldly stated by the hospital deputy director (HM): *"Improved work practices; the right information at the right time, at all times […]; improved decision-making processes; improved flow"*. To achieve this purpose hospital management felt that the introduction of the whiteboard should be driven by super users who were appointed locally. The expected benefit of this approach was that the process would be driven by clinicians who *"knew their clinical practice and knew and engaged themselves in the whiteboard and, therefore, could come up with visions" (HM)*. The project manager echoed this view by stating that she saw a user-driven process as an opportunity to *"exploit the enormous capital of knowledge, resources, and competences that had [hitherto] been lying unutilized" (PM)*.

Hospital management asked the management of each department to appoint two or three super users. Because hospital management felt that successful support of intradepartmental work practices was a prerequisite for improved support of interdepartmental work practices, the super users were initially presented with the task of configuring the whiteboard to support intradepartmental practices. However, hospital management expected that the process would, subsequently, move on to improve coordination across departments. Rather than setting specific goals for how the whiteboard should be configured and used, management gave the super users the freedom to envision and decide, in collaboration with their colleagues, how their department could benefit from the whiteboard. The basis for this approach was a firm belief in the clinicians' ability to reflect constructively on their work practices: "*If you sit down and listen – and encourage them to reflect – then they will provide the solution themselves, they will tell you what they need*" (PM). There were two components of this belief. First, management believed that the clinicians' first-hand knowledge of their daily work was necessary to set visionary goals while at the same time remaining realistic. Second, preset goals would work against engaging the users because the clinicians would perceive preset goals as an indication that management did not consider the clinicians capable of identifying how the whiteboard could improve their work practices.

In our interviews, several of the super users mentioned that they had not felt sufficiently informed about what management expected of them. Shortly after the super users had been appointed, they were invited to an introductory meeting. In subsequent workshops, they received training in configuring the whiteboard. In the super users' recollection very little was said, at the introductory meeting or following it, about the purpose of the process they were tasked with driving or about the expectation of improved work practices: *"We received very little information about the whiteboard before it arrived. It was more a matter of practicalities: find a place to mount it. That was it" (LM2).* As a result, the super users were largely left to their own devices with respect to defining the scope and content of the activities they initiated to introduce the whiteboard in their departments. We identified three different understandings of the purpose of the design-in-use process.

The first category of super users shared hospital management's intention to use the whiteboard as a vehicle for improving work practices. One super user, a nurse from the medical department, stated that: *"The important thing is to see the whiteboard as an opportunity to build on something that has worked really well, to get it developed further so that it gets, well, relevant for 2014, 2020, and 2030" (SU5).* For this super user, the whiteboard and the design-in-use process was an opportunity to seek better ways of working. She gave several examples of how she continually refined the configuration of the whiteboard and found new ways of using it in her department. Another super user, a head physician from the orthopedic surgical department, expressed similar views when he explained his excitement about having an impact on what the whiteboard should look like and be used for: *"What is new about this system is that all the way down to, well, at least down to super-user level, but almost also down to user level, you could say: I want it [i.e., the whiteboard] to look like this. We have never done that before. Previously we have been told: 'This is the system. This is the way it is. There are things that can be criticized, and you are welcome to do so, but we won't bother to listen because there won't be any changes made'." (SU6).* The super users in this category spent a lot of time configuring the whiteboard and working out how it could be used to improve departmental work practices.

The second category of super users understood the purpose of the whiteboard as one of replacing the department's dry-erase whiteboard and minimizing the number of paper sheets that were used to coordinate work. About half of the interviewed super users felt that because the electronic whiteboard had, in their opinion, replaced the dry-erase whiteboard in a satisfactory manner, they had fulfilled their responsibility as super users. For example, a physiotherapist among the super users stated: *"I have stepped down. You could say that we [i.e., the super users] have been resource persons who have been there to say: 'How do we do this?' Now we are all doing it" (SU9).* In other words, this super user felt that the implementation of the whiteboard had been completed. Another super user explained that because the whiteboard had been successfully integrated into their daily practice, her responsibility was now simply to introduce new colleagues to the whiteboard. In addition, the super users from the pediatric department declined invitations to meetings with the other super users to discuss the ongoing work of configuring and improving the whiteboard: *"We actually feel that it is going well. There is really no need" (SU8).* These super users felt that they had successfully introduced the whiteboard in their department and were not inclined to continue the process by extending its scope.

The third category consisted of super users who struggled to see how their department was going to benefit from the whiteboard. A head nurse from the surgical department expressed her reservations like this: "*What was the purpose? Where should it lead? And, where could we see a benefit, for the patients and for the staff?" (LM2).* Such reservations were mostly voiced by super users from the medical and the surgical departments. The reasons for the struggles experienced by this category included that hospital management had not clearly stated what they wanted to achieve with the whiteboard. While the super users had received training in how to configure the

whiteboard, they had not in the same way received support in envisioning how the whiteboard could be used for improving work practices and coordination. Without external input to help identify how they could benefit from the whiteboard, these super users kept struggling to see the point of introducing the whiteboard. As a result, these departments had not succeeded in integrating the whiteboard into their daily work. At the time of our interviews, the whiteboard was rarely used in these departments.

The three categories show increasing tension between what hospital management expected from the super users and how the super users perceived and practiced their role. Because the super users were the main actors in implementing the whiteboard, their perception of their role was central to how the whiteboard came to be used.

4.2 The Actors Tasked with Driving Design in Use

The conventional super-user role at the hospital meant that super users were required to become proficient users of the system and to support their colleagues in using it. With respect to the whiteboard, the project manager took pains to identify clinicians with innovative ideas and encourage them to volunteer as super users. However, the additional expectation of configuring the whiteboard and improving work practices was novel and not clearly understood by the departments: *"I suspect that the super users have been assuming: Well, it is probably the same as being super users on any other system" (SA1)*. In addition to the super users, hospital management appointed a system administrator to support the super users and a steering committee to ensure managerial commitment from the departments. The super users, system administrator, and steering committee all experienced a gradual shift in their role from configuring the whiteboard to coordinating its utilization for improving clinical work practices. For example, the system administrator experienced that the super users needed considerable support in areas other than technical configuration: *"I realized that the IT part was not the most demanding. It was all the other things: work practices, how to use the whiteboard in a sensible way […], what resources we have available, and all these things" (SA1)*. In fulfilling this role, the super users negotiated with their local management about how to make time for the super-user activities in between their normal clinical duties.

In relation to the expectation of improving clinical work practices, it was a problem that most of the super users did not have a position that enabled them to set the agenda for a change process. This problem came about because the department managers were not aware of this part of the super users' role when they appointed the super users. For example, the system administrator (SA1) stated that, at the time, department management had not realized the importance of appointing super users from all staff groups. As a result, most of the super users were nurses and secretaries. Several interviewees noted that the physicians had not been interested and had not been appointed as super users. A physician explained his lack of interest by stating that: "*We – the clinicians – take an interest in the patients. We do not take an interest in IT" (EU5)*. He considered it an error in the implementation

of the whiteboard to assume that the clinicians would be interested in participating. Subsequently, some physicians were appointed as super users. One of these physicians explained that he had been chosen by his department management, because he had voiced criticism against the whiteboard: *"I was probably the one, who had shown most interest in what this was about, how it should work and how I thought it did not work. I have been asking many questions. So when meetings [about the design-in-use process] were announced, my leader felt that I should participate" (EU5).* Without physicians who advocated the role of the whiteboard in changing work practices it became difficult to make changes happen. In some departments the physicians remained reluctant to use the whiteboard at all. Several of the interviewed nurses and secretaries among the super users mentioned challenges in driving the implementation of the whiteboard from their position lower in the hospital hierarchy. The hospital deputy director (HM) acknowledged that the implementation process had suffered from multiple situations in which they had had either innovative super users or support from local management, but not both.

4.3 From Intra- to Interdepartmental Change

Initially, the super users in at least three departments configured the whiteboard to look like existing artifacts: "*We started working on how we could get the [electronic] whiteboard to look like the dry-erase whiteboards we used to have in our conference room. We got it to look like them*" (SU5). After the whiteboard had been taken into use, most of the super users had configured it further, on their own initiative and on request from end-users in their department. These configurations included adding columns, removing columns, changing the attributes of columns, and defining views that, when selected, showed a specific subset of the columns and patients. A chief physician stated that it was important that the end-users had someone close to them in the department that they could go to if they wanted changes in the configuration of the whiteboard because "*along the way, you discover things that you want to see: Hey, we should have that or we want that removed because we do not use it*" (LM1). In spite of some difficulties, especially with finding the time for exploring and configuring the whiteboard, the super users gradually tailored it to their departments.

While the design-in-use activities to make the whiteboard support intradepartmental coordination depended on the motivation of the super users, it proved more challenging to use the whiteboard for interdepartmental coordination. Interdepartmental coordination required that several departments agreed on the configuration of the whiteboard as well as on the associated work practices. Because the super users were initially free to configure the whiteboard in the way they saw fit, the process of configuring the whiteboard for supporting intradepartmental coordination resulted in different whiteboard configurations across the hospital. These differences became a challenge when the focus of the process gradually shifted toward interdepartmental coordination: "*Because the system enabled everyone to configure it, they [i.e., management] allowed every single ward to do so. It*

ended badly. The whiteboard could not be used for communication among departments" (SU6).

Hospital management and the system administrator gradually realized that if the whiteboard were to support interdepartmental coordination, they needed rules for how the whiteboard should be configured in the individual departments. A prime example of the difficulties was that the clinicians could not assume that the whiteboards in other department were configured to display the same information about a patient as the whiteboard in their own department. Thus, it was not possible to communicate information about a patient to another department simply by adding it to the whiteboard. To address these difficulties management enforced a set of rules that restricted the super users' freedom in configuring the whiteboard for their department. Many of the super users had put considerable effort into tailoring the whiteboard to departmental needs but now experienced that they were instructed to roll back some of their work to allow for interdepartmental coordination. This rollback caused frustration and created tension between super users and hospital management. Several interviewees found, in hindsight, that hospital management should have restricted the super users' freedom from the start. While the hospital deputy director tended to agree that clearer goals should have been stated up front, the project manager (PM) argued that the gradual shift from freedom toward rules had been a necessary and worthwhile process. Her argument in favor of the gradual shift was that it had fostered involvement and innovation when that was the top priority and enforced standardization when that became the top priority.

One of the successful examples of using the whiteboard to support interdepartmental coordination was the practice of requesting therapists. By configuring the whiteboard it became possible to use it for requesting an examination of a patient by a physiotherapist or occupational therapist. When a request was made an icon appeared on the whiteboard and the patient automatically appeared on the therapists' whiteboard. In spite of this configuration of the whiteboards, many departments continued to request therapists the way they did before the whiteboard. That is, the nurses requested therapeutic examinations during the nursing reports, which were attended by the therapists. To enforce the new procedure, the therapists decided to stop participating in the nursing reports. At the time of our interviews, all departments used the whiteboard to request therapists. The therapists had, however, continued the design in use of their work. The departments often called them to inquire about the conclusion of their examinations, although they had written their conclusion in the patient record. To avoid these phone calls the therapists started summarizing their conclusions in brief whiteboard messages, which were readily visible. A physician explained how these messages helped her in her work by, for example, informing her that a patient used a walker: *"Before I see the patient, I look at the whiteboard. I do not have to look in the patient record. I glance at the whiteboard and then I know that the patient can walk with a walker" (EU3).* The departments started using the same column on the whiteboard to write back to the therapists. Thus, while management decided that therapists should be requested via the whiteboard, the super users extended the way in

which the whiteboard supported this interdepartmental coordination. Our interviewees were pleased with the resulting work practice, and the two interviewed therapists stated that it had improved their overview of which patients to examine.

5 Discussion

In the majority of the departments the local design-in-use process resulted in regular use of the whiteboard for intradepartmental coordination. The design-in-use process also transformed a few interdepartmental coordination tasks by replacing ephemeral oral communication with whiteboard recordings, which provided improved overview. In spite of these successes considerable tension arose between hospital management's expectations to the process and the local activities in the departments. We discuss two reasons for this tension:

- Management's expectations to the process were subject to design in use; thus the local design-in-use process in the departments had to meet a moving target.
- The design-in-use approach to the implementation of the whiteboard was contested, especially by the physicians who were a more powerful group than the super users.

We end this section by considering the answers the present study provides to our research question.

5.1 Management's Expectations and the Local Process

Previous studies of design in use construe it as an activity performed by users, possibly with organizational support (e.g., Dittrich et al. 2002; Park et al. 2015). We find that design in use also happened at the managerial level. Management's expectations to the super users and the design-in-use process evolved as management learned more about how the whiteboard was used, what issues the super users faced, and why changes in work practices were difficult to accomplish. The project manager provided a vivid illustration of design in use at the managerial level when she expressed that the gradual shift from freedom toward rules had been a necessary and worthwhile process. Rather than believing in the possibility of a preconceived plan, she saw it as her role to respond in an opportunity-based manner to the events of an evolving process. That is, she continually strove to learn what was currently needed to move the process forward.

At the managerial level, design in use was closely linked to the gradual shift from a focus on using the whiteboard for improving intradepartmental coordination to one on improving interdepartmental coordination. Table 2 summarizes this evolution in terms of its consequences for the purpose, actors, and process in the early, respectively later, stages of the organizational implementation of the whiteboard. It appears as if management underrecognized, at least initially, the increased complexity of improving interdepartmental coordination. However, approaching intra- and

interdepartmental improvements as similar processes amounts to disregarding the difference between component-level and architecture-level learning. Sanchez and Mahoney (1996) contend that over time organizations tend to lose their ability for architecture-level improvement because they focus on component-level activities and develop structures that stifle architecture-level change in order to accelerate activities within components. They also argue that architecture-level learning is a longer-term process that fits poorly with the time pressures of most development and implementation projects.

	Early managerial expectations	*Late managerial expectations*
Purpose	Configure and introduce the whiteboard (in place of the dry-erase whiteboards) Focus on intradepartmental coordination	Coordinate the process of utilizing the whiteboard to improve work practices Focus on interdepartmental coordination
Actors	Super users set the direction (on the basis of their predominantly intradepartmental outlook) and drive the process System administrator facilitates super users in their local initiatives	Super users drive the process but interdepartmental concerns override intradepartmental needs System administrator enforces hospital-wide commonalities in the configuration of the whiteboard
Process	Direction set locally by the super users, in dialog with their department colleagues Seeks to configure the whiteboard for use in the individual department	Direction set by super users in some departments in dialog with management Involves rolling back some of the configurations made in individual departments

Table 2. Design in use at the managerial level

The simultaneous presence of design in use at two levels – the managerial level and locally in the departments – aggravated the super users' sense of being insufficiently informed about what was expected of them. At the outset the super users interpreted their task in accordance with the conventional super-user role at the hospital. Later, they gradually learned that they were assigned a more extensive task in the implementation of the whiteboard and that their degrees of freedom in configuring the whiteboard were being cut back. The main evolution in the super users' task was, however, not the decrease in IT-related freedom but the increase in organizational complexity. This increase was experienced as a need for standardization. Standardizing the configuration and use of the whiteboard across departments involved negotiating hospital-wide agreement about standards that accommodated existing practices or changed them in mutually acceptable ways, followed by the implementation of standard-compliant practices. When it turned out that configuring the whiteboard for intradepartmental coordination did not proceed smoothly into improved interdepartmental coordination,

management's focus gradually shifted toward standardization but the super users' task shifted from configuring a lightweight technology toward changing a heavyweight organization (cf. Bygstad 2017).

At a modest scale the tension between the local and managerial levels resembles how information infrastructures struggle with finding the balance between sensitivity to local context and standardization across contexts (Rolland and Monteiro 2002). What our study emphasizes is that the managerial level of standardization across contexts is also designed in use. In this sense, design-in-use activities occur simultaneously at two levels and involve continually aligning two streams of activity that evolve independently as well as in response to each other. The simultaneous presence of design in use at the managerial and local levels resulted in frequent misalignment, which was a source of confusion and tension. However, the fluid expectations from management also meant the absence of a strong managerial vision about which direction to take. Aanestad et al. (2004) argue that vague visions can be productive, because they allow the users to influence, transform, and contextualize the visions in their efforts to realize them. The vagueness of the task assigned to the super users was productive for the super users who embraced the intention of using the whiteboard as a vehicle for improving work practices but it caused uncertainty and frustration for the super users who expected a well-defined task. Attempts to substitute a local design-in-use process for a centrally organized implementation process must continually align the two levels of design in use. Achieving this alignment may involve presenting some users with clearer tasks than others.

5.2 Design in Use as an Approach to System Implementation

Wagner and Piccoli (2007) contend that design projects become salient to users when the project output starts to affect the users' daily lives and require them to change their work practices. This contention suggests that engaging in design in use will make more sense for users than engaging in design before use because design-in-use activities engage users exactly when a design becomes salient to them. However, the tension between hospital management's expectations and the scope of the super users' activities shows that a locally organized design-in-use process may stop short of delivering, or even exploring, the full potential of a system. Table 3 summarizes the design-in-use process, which may be contrasted with the implementation process the interviewees talked about as the conventional way of implementing systems at the hospital. The conventional process is management-driven and seeks to complete implementation as quickly as possible. Design in use seeks to address the limitations of conventional implementation by deliberately reversing the approach. For example, the scope of conventional implementation is frozen ahead of use – only errors and breakdowns are fixed. Conversely, the scope of the design-in-use process was determined locally during use and it evolved as opportunities were seen and seized. Furthermore, it is a frequent problem in conventional implementation that the

specialists driving the process have inadequate knowledge of the work domain (Pries-Heje and Dittrich 2009). The design-in-use approach addressed this problem by having local super users drive the process.

Aspect	*Description*
Purpose	Utilize local knowledge to configure system and improve work practice Finalize the design on the basis of input from real use Make change relevant and unintimidating by means of a user-driven process
Actors	Management delegates control and designs for incompleteness Super users drive the process; they know the work but are neither specialists in the system nor in design processes End-users face the uncertainty of starting to use a system while it is still malleable
Process	Locally organized and user-driven Scope depends on local input and evolves as opportunities are seen and seized Process may run continuously to get still more benefit from the system

Table 3. The design-in-use approach to implementation

Several super users among the interviewees embraced design in use and saw it as a novel opportunity to make the whiteboard truly useful to their clinical work. These interviewees preferred the malleability of design in use over the rigidity of the conventional implementation processes they had previously experienced. Other interviewees, particularly end-users, expressed the expectation that the whiteboard should have been ready for use when deployed and felt, correctly, that they had received an incomplete system. These interviewees were not prepared to engage in design in use. Rather, they asked for design to be completed before use, followed by a quick and preplanned implementation process. The reservations that these interviewees expressed against design in use can be summarized in three points. First, they perceived design in use as a prolonged process that delayed the point in time at which the clinicians started to benefit from the whiteboard. Second, they experienced considerable uncertainty about what types of changes it was possible to make to the design of the whiteboard and what types of activities the whiteboard was intended to support. Third, they contested the assumption that clinicians are interested in spending time on designing systems such as whiteboards at the expense of having less time for their primary work, the treatment of their patients.

The organization of the design-in-use process around local super users enabled the clinicians to tailor the whiteboard to the local practices of each department. The locally organized process ensured a short distance between end-users and super users and it ensured a process that was driven by people

with thorough knowledge of the work performed in each department. Similar advantages of super users have been emphasized by Åsand and Mørch (2008). In addition, Halbesleben et al. (2009) find that the more hours super users spend in their super-user role, the more positively their colleagues perceive the system that the super users are championing. In our study the relation between super users and whiteboard success broke down when the focus of design in use gradually shifted from intra- to interdepartmental change. We see two reasons for this. First, lightweight technology such as the whiteboard is dependent on information infrastructures for data communication and storage and on negotiated agreements about the meaning and use of the data. While similarly complex whiteboard changes were needed for intra- and interdepartmental change, the associated changes in information infrastructures and negotiated agreements were larger for interdepartmental change. Their larger magnitude made them much more complex to perform because infrastructures and agreements are heavyweight (Bygstad 2017) and architecture-level (Sanchez and Mahoney 1996). Second, the super users were mainly knowledgeable about the clinical work in their department and they mainly had their network in their department. That is, the organization of the design-in-use process around the super users meant that interdepartmental communication about design in use was more constrained than intradepartmental communication. Conway (1968) finds that such bottlenecks in the communication structure are reproduced in designs, which disintegrate at the points corresponding to the communication bottlenecks. In our case the whiteboard design disintegrated at the boundaries between departments, and the disintegration was aggravated by the physicians' reluctance to be super users. In the hospital hierarchy the super users lacked the position necessary to make hospital-wide decisions and the power necessary to drive changes that affected the physicians.

5.3 Implications

We see four implications of our study for the circumstances under which a local design-in-use process may, partly, replace conventional implementation. First, design in use happens at the managerial level of formulating expectations toward systems as well as at the local level of concrete system use. A design-in-use approach to systems implementation must maintain alignment between these two levels of design in use because misalignment fosters uncertainty, frustration, and other sorts of tension. However, maintaining alignment is difficult. One source of misalignment is failing to recognize that design in use also happens at the managerial level. For example, practitioners at the local level, including many of our interviewees, often expect up-front clarity about managerial expectations to the use of new systems. Expectations of such clarity work against a design-in-use approach to systems implementation.

Second, a configurable technology is necessary for a design-in-use approach to implementation but it is not sufficient: the organization must also be configurable. While technologies such as whiteboards are lightweight and thereby easy to adapt to local circumstances, organizational reconfiguration

involves negotiated agreement. The complexity of renegotiating such agreements increases drastically with their scope, thereby making changes to the interactions between multiple organizational components much more difficult to accomplish than changes within a single component. In our study standardization became one of the means to accomplish interdepartmental change. Standardization consists of reaching negotiated agreement; it is not an alternative to negotiated agreement. More research should look into design-in-use processes that concern lightweight technology in heavyweight organizations.

Third, design in use may be a useful approach to the implementation of department-internal systems. It was however a mismatch to extend the responsibility of the super users, who had their network and authority locally in their department, from configuring the whiteboard for intradepartmental coordination to configuring it for interdepartmental coordination. This extension created additional tension between hospital management and super users. And it created additional reservations toward the process and whiteboard among the end-users due to uncertainty about the direction, duration, and scope of the design-in-use process.

Fourth, to succeed as an approach to implementation, the people appointed to drive design in use must, collectively, be able to champion the system, configure it, envision how it can improve work, negotiate these improvements, and train their colleagues. Practitioners should realize that the required competences are scarce, thereby making it critical who is appointed. Without an externally supplied rationale for adopting the whiteboard even some of the appointed super users lacked the inclination to envision how the whiteboard could help improve work practices. While design-in-use research has flagged the need for providing users with technical support, it has tended to neglect the need for organizationally powerful allies to make change happen. A likely reason for this technical focus is that the previous studies have concerned design-in-use activities that were already under way. The requirements are different when design in use is to replace conventional implementation. Unless management is prepared to ensure the involvement of powerful user groups, such as physicians, design in use is not a feasible approach to systems implementation.

5.4 Limitations

Three limitations should be remembered in interpreting the results of this study. First, the study is based on interviews at a single hospital. We acknowledge that the results may be influenced by local particulars and by the Danish healthcare system in general. It would be valuable to replicate the study in non-Danish hospitals and in non-healthcare settings. It would also be valuable to complement interviews with other means of data collection. Second, we have more interviews with super users and end-users than with management. Thus, our analysis is most detailed in its coverage of how the super users and end-users perceived the design-in-use process. It is less clear why management, apparently, did not supply plenty of information about their expectations to the super users and the entire design-in-use process.

Third, our study does not provide a how-to guide for practitioners who want to adopt a design-in-use approach to systems implementation. We encourage future research toward devising such a guide, including advice on when a design-in-use approach is not applicable.

6 Conclusion

In complex work settings, designs are still incomplete when taken into use because the mutual adaptation of system and local work practices cannot be fully anticipated ahead of starting to use the system. The studied hospital aimed to design for this incompleteness by adopting a design-in-use approach to the organization-wide implementation of an electronic whiteboard. Super users were tasked with driving the local design-in-use process in the departments but hospital management's expectations to the process, and the super users' understanding of their role in it, were also subject to design in use. Misalignment of the simultaneous design-in-use efforts at the managerial and local levels created tension between management's expectations and the goals pursued by the super users in the departments. For example, some of the work done by the super users to configure the whiteboard for intradepartmental coordination had to be rolled back when management's focus gradually shifted to interdepartmental coordination. It added to the tension that the overall rationale of completing design during use was inadequately communicated. Consequently, a sizable number of clinicians expected to receive a finalized whiteboard and remained skeptical toward the design-in-use approach to system implementation. In spite of the tension the design-in-use approach was partially successful in employing the whiteboard for intradepartmental coordination. The principal limitation of the approach was in relation to interdepartmental change because the super users, as a group, lacked the authority, network, and skills to make changes that reached beyond their own department.

Acknowledgements

This study was co-funded by Region Zealand as part of the Clinical Communication project, which was a research and development collaboration between Region Zealand, Imatis, Roskilde University, and University of Copenhagen. We are grateful to Claus R. Mortensen for his support in identifying interviewees from across the hospital. Special thanks are due to the interviewees.

References

Aanestad, M., Driveklepp, A. M., Sørli, H., and Hertzum, M., (2017). Participatory continuing design: "Living with" videoconferencing in

rehabilitation. In: *Participatory Design and Health Information Technology*, A. M. Kanstrup, A. Bygholm, P. Bertelsen and C. Nøhr (eds.), IOS Press, Amsterdam, pp. 45-59.

Aanestad, M., Henriksen, D. L., and Pors, J. K., (2004). Systems developmnt in the wild: User-led exploration and transformation of organizing visions. In: *Information Systems Research: Relevant Theory and Informed Practice*, B. Kaplan, D. P. Truex, D. Wastell, A. T. Wood-Harper and J. I. DeGross (eds.), Springer, New York, Vol. 143, pp. 615-629.

Balka, E., and Wagner, I., (2006). Making things work: Dimensions of configurability as appropriation work. In: *Proceedings of the CSCW 2006 Conference on Computer Supported Cooperative Work*, ACM Press, New York, pp. 229-238.

Bygstad, B., (2017). Generative innovation: A comparison of lightweight and heavyweight IT. *Journal of Information Technology, (32*:2): 180-193.

Conway, M. E., (1968). How do committees invent? *Datamation, (14*:4): 28-31.

Dittrich, Y., Ekelin, A., Elovaara, P., Eriksén, S., and Hansson, C., (2003). Making e-government happen: Everyday co-development of services, citizenship and technology. In: *HICSS2003: Proceedings of the 36th International Conference on System Sciences*, IEEE Press, Los Alamitos, CA, pp. 1-12.

Dittrich, Y., Eriksén, S., and Hansson, C., (2002). PD in the wild: Evolving practices of design in use. In: *PDC2002: Proceedings of the Seventh Conference on Participatory Design*, T. Binder, J. Gregory and I. Wagner (eds.), CPSR, Palo Alto, CA, pp. 124-134.

Dourish, P., (2003). The appropriation of interactive technologies: Some lessons from placeless documents. *Computer Supported Cooperative Work, (12*:4): 465-490.

Folcher, V., (2003). Appropriating artifacts as instruments: When design-for-use meets design-in-use. *Interacting with Computers, (15*:5): 647-663.

Garud, R., Jain, S., and Tuertscher, P., (2008). Incomplete by design and designing for incompleteness. *Organization Studies, (29*:3): 351-371.

Haines, M. N., and Goodhue, D. L., (2003). Implementation partner involvement and knowldge transfer in the context of ERP implementations. *International Journal of Human-Computer Interaction, (16*:1): 23-38.

Halbesleben, J. R. B., Wakefield, D. S., Ward, M. M., Brokel, J., and Crandall, D., (2009). The relationship between super users' attitudes and employee experience with clinical information systems. *Medical Care Research and Review, (66*:1): 82-96.

Hartswood, M., Proctor, R., Slack, R., Voss, A., Büscher, M., Rouncefield, M., and Rouchy, P., (2002). Co-realisation: Towards a principled synthesis of ethnomethodology and participatory design. *Scandinavian Journal of Information Systems, (14*:2): 9-30.

Hartswood, M. J., Proctor, R. N., Rouchy, P., Rouncefield, M., Slack, R., and Voss, A., (2003). Working IT out in medical practice: IT systems

design and development as co-realisation. *Methods of Information in Medicine, (42*:4): 392-397.

Henderson, A., and Kyng, M., (1991). There's no place like home: Continuing design in use. In: *Design at Work: Cooperative Design of Computer Systems*, J. Greenbaum and M. Kyng (eds.), Erlbaum, Hillsdale, NJ, pp. 219-240.

Hertzum, M., (2011). Electronic emergency-department whiteboards: A study of clinicians' expectations and experiences. *International Journal of Medical Informatics, (80*:9): 618-630.

Hertzum, M., and Simonsen, J., (2013). Work-practice changes associated with an electronic emergency department whiteboard. *Health Informatics Journal, (19*:1): 46-60.

Kanstrup, A. M., and Bertelsen, P., (2006). Participatory IT-support. In: *PDC2006: Proceedings of the Ninth Participatory Design Conference*, G. Jacucci, F. Kensing, I. Wagner and J. Blomberg (eds.), ACM Press, New York, pp. 87-94.

Karasti, H., Baker, K., and Millerand, F., (2010). Infrastructure time: Long-term matters in collaborative development. *Computer Supported Cooperative Work, (19*:3&4): 377-415.

Maceli, M., and Atwood, M. E., (2013). "Human crafters" once again: Supporting users as designers in continuous co-design. In: *Proceedings of the IS-EUD 2013 International Symposium on End User Development*, Y. Dittrich, M. Burnett, A. Mørch and D. Redmiles (eds.), Springer, Berlin, Vol. LNCS 7897, pp. 9-24.

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

McNeive, J. E., (2009). Super users have great value in your organization. *Computers, Informatics, Nursing, (27*:3): 136-139.

Nah, F. F.-H., Zuckweiler, K. M., and Lau, J. L.-S., (2003). ERP implementation: Chief information officers' perceptions of critical success factors. *International Journal of Human-Computer Interaction, (16*:1): 5-22.

Nonaka, I., (1994). A dynamic theory of organizational knowledge creation. *Organization Science, (5*:1): 14-37.

Orlikowski, W. J., (1996). Improvising organizational transformation over time: A situated change perspective. *Information Systems Research, (7*:1): 63-92.

Orlikowski, W. J., and Hofman, J. D., (1997). An improvisational model for change management: The case of groupware technologies. *Sloan Management Review, (38*:2): 11-22.

Park, S. Y., Chen, Y., and Rudkin, S., (2015). Technological and organizational adaptation of EMR implementation in an emergency department. *ACM Transactions on Computer-Human Interaction, (22*:1): 1:01-1:24.

Pipek, V., and Wulf, V., (1999). A groupware's life. In: *ECSCW'99: Proceedings of the Sixth European Conference on Computer-*

Supported Cooperative Work, S. Bødker, M. Kyng and K. Schmidt (eds.), Kluwer, Amsterdam, pp. 199-218.

Pipek, V., and Wulf, V., (2009). Infrastructuring: Toward an integrated perspective on the design and use of information technology. *Journal of the Association for Information Systems, (10*:5): 447-473.

Pries-Heje, L., and Dittrich, Y., (2009). ERP implementation as design: Looking at participatory design for means to facilitate knowledge integration. *Scandinavian Journal of Information Systems, (21*:2): 27-58.

Rasmussen, R., Fleron, B., Hertzum, M., and Simonsen, J., (2010). Balancing tradition and transcendence in the implementation of emergency-department electronic whiteboards. In: *Selected Papers of the Information Systems Research Seminar in Scandinavia 2010*, J. Molka-Danielsen, H. W. Nicolaisen and J. S. Persson (eds.), Tapir Academic Press, Trondheim, NO, pp. 73-87.

Robey, D., Ross, J. W., and Boudreau, M.-C., (2002). Learning to implement enterprise systems: An exploratory study of the dialectics of change. *Journal of Management Information Systems, (19*:1): 17-46.

Rolland, K. H., and Monteiro, E., (2002). Balancing the local and the global in infrastructural information systems. *The Information Society, (18*:2): 87-100.

Sanchez, R., and Mahoney, J. T., (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal, (17*:Winter Special Issue): 63-76.

Suchman, L. A., (2007). *Human-machine reconfigurations: Plans and situated action, 2nd edition*, Cambridge University Press, Cambridge, UK.

Torkilsheyggi, A., and Hertzum, M., (2014). User participation in pilot implementation: Porters and nurses coordinating patient transports. In: *OZCHI'14: Proceedings of the 26th Australian Computer-Human Interaction Conference*, ACM Press, New York, pp. 290-299.

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

Willcocks, L., and Smith, G., (1995). IT-enabled business process re-engineering: Organizational and human resource dimensions. *Journal of Strategic Information Systems, (4*:3): 279-301.

Wong, H. J., Caesar, M., Bandali, S., Agnew, J., and Abrams, H., (2009). Electronic inpatient whiteboards: Improving multidisciplinary communication and coordination of care. *International Journal of Medical Informatics, (78*:4): 239-247.

Wulf, V., and Golombek, B., (2001). Direct activation: A concept to encourage tailoring activities. *Behaviour & Information Technology, (20*:4): 249-263.

Åsand, H.-R. H., and Mørch, A. I., (2008). Super users and local developers: The organization of end user development in an accounting company. *Journal of Organizational and End User Computing, (18*:4): 1-21.