Improving Patient Flow Through Lightweight Technology

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Abstract. Public sector IT systems tend to become vertical IT Silos, a number of poorly integrated systems which constitute a barrier towards organizational change and innovation. One way to understand this tendency is to see silo systems as function oriented, not process oriented. Lightweight technologies have proven promising in introducing a process view of patient and information flow in hospitals. We are interested in the effect lightweight technologies have on the process flow, but also how organizational change is organized when improved processes are needed. Our research questions are what organizational activities are initiated when an organization has a goal to improve patient flow? And how can lightweight technologies improve patient flow? Our empirical evidence is a case study at a primary care emergency service in Oslo. We identify three main areas where lightweight technology introduces a process view on patient flow, first internally within the emergency unit, then externally in cooperation between the emergency unit and the city district. Our findings show that introduction of lightweight technologies give collective energy to identify areas of improvement. Second we find that lightweight technologies enable a horizontal process view of organizational activities, and we give insight into areas for improved interplay between lightweight and heavyweight technologies.

Keywords: Heavyweight and lightweight IT, information infrastructures, eHealth innovation, electronic whiteboards, Process change

1. INTRODUCTION

Our interest in this paper is to understand organizational change and improvement activities when innovative technology is implemented into a health institution. We are studying this from a process perspective. Public sector IT systems have in many cases turned into IT silos, IT systems where logics and functions are enmeshed in a way that make change and innovation difficult (Bannister 2001, Bouwman et al 2011). One way to understand this tendency is to see silo systems as function oriented not process oriented. The health sector can be seen as a professional bureaucracy (Mintzberg 1983) and the complex organization of medical knowledge, and the IT appropriation of the use of this knowledge, can be seen as one of the reasons of function orientation. The installed base consists of a large amount of medical systems, equipment, techniques and regulations that has turned into a fragmented system portfolio, and although the EPRs are seen as a way to connect these systems, they have paradoxically become IT silos which often fit badly with practice (Ash et al 2004, Berg 1999). The problems related to the lack of “process support” have been addressed for some time through clinical pathways or other ways of appropriating the patient trajectory using IT (Grimsmo et al 2007), but with limited success. Technologies like smartphones, tablets and whiteboards have shown promising tendencies when
it comes to logistics and support of mobile processes. One way to understand these technologies is to see them as lightweight IT. This in contrast to the classical IT systems based on software engineering with its comprehensive acquisition, implementation and security processes, which we can understand as heavyweight IT (Bygstad 2016, Willcocks et al 2015). While heavyweight systems like EPRs often are badly accustomed to practice (Berg 1999), lightweight IT have shown promising customization to work practices (Hertzum 2011, France et al 2005). It still remains to see, however, in what ways lightweight IT makes an impact on the logistics, the patient flow within departments and between health units, and also what organizational factors lies behind such improvements. Based on this, our research questions are:
- What organizational activities are initiated when an organization has a goal to improve patient flow?
- How can lightweight technology improve patient flow?

Our goal is to contribute to the field of Information Infrastructure. This literature primary focus is the dynamics of large networks rather than stand-alone applications. We are investigating the interplay between lightweight and heavyweight technology, and especially the role of lightweight technology in introducing an end-to-end process view of patient treatment.

We proceed by discussing a particular type of lightweight technology, electronic whiteboards, and their ability to introduce a focus on patient flow. To develop our argument we use process theory as a lens both to understand organizational change, and to investigate the whiteboard technology’s ability to improve interaction within and between health units.

2. THEORETICAL FIELD

We see information systems as information infrastructures (Hanseth and Lyytinen 2010) and are interested in the principles behind their growth. Health systems are examples of Information Infrastructures. As Health systems tend to favour the functional perspective more than the process perspective, they often make innovation and change difficult. A way to improve the process is to integrate silo systems, but this is very time consuming and complex (Bygstad et al 2015). An emerging stream within IS research is the field on digital innovation, like tablets, smartphones and whiteboards. Bygstad (2016) call this “lightweight IT”. The key aspect of lightweight IT is not only the cheap and available technology as such, but the fact that its deployment is frequently done by users or vendors, bypassing the IT departments. Use of lightweight technology to improve health system processes has been successful in several cases (Bygstad 2016). Our interest in this paper is how lightweight IT, in our case Electronic Whiteboards, enables a process view of organizational activities. Electronic Whiteboards and their
implications on the health sector are only scarcely investigated in the IS and Information Infrastructure literature. In other fields like e-learning several (Smith et al. 2005, Higgins et al. 2007, Kennewell et al. 2007) has looked at how electronic whiteboards improve learning processes. In the literature on computer supported cooperative work, human-computer interaction, medical informatics and health informatics electronic whiteboards is brought in from several angels. The debate regards the need for coordination between different practices performing patient treatment within the hospital, and the mediating ability of whiteboards (Fitzpatrick and Ellingsen 2013, Aronsky et al. 2008, Bardram et al. 2006), through enabling “information spaces” (Bannon and Bødker 1997), social, spatial and temporal awareness (Bardram et al. 2006) or visual overview (Hertzum and Simonsen 2015). Whiteboards serves a coordinative function (Tang et al. 2009), between different aspects of the treatment process (Bjørn and Hertzum 2011), enabling a synthesized aggregate of a complex amount of information (Wong et al. 2009). This has led to investigation of the practical implications of using whiteboards in clinical departments (Hertzum and Simonsen 2015, Hertzum 2011). Further, whiteboards bridges information gaps between complex amounts of information (Chen 2010), and they facilitate the coordination of upcoming activities (Bardram et al. 2006, Hu et al. 2006). The findings from these studies are often that whiteboards are embedded into social and practical activities as parts of practice phenomena (Bjørn and Hertzum 2011), i.e. the whiteboards benefit is basically based on their adaptability to a complex practice. We are not only interested in particular departments but the flow of patients and information across different departments, and how technological interaction between different systems may be established. Studies concentrating on a “vertical” practice perspective within departments, isolating it from the surrounding context, have limited impact (Fitzpatrick and Ellingsen 2013). We investigate the electronic whiteboards role in improving organizational processes across departments through being an integrated part of the information infrastructure. This is important as time is liberated when technology like whiteboards provide an improved flow (Hertzum and Simonsen 2013, France et al. 2005).

3. THEORETICAL LENS

Business Process Reengineering’s (BPR) main message was that organizations have to remove outdated organizational processes, and use information technology to innovate the processes (Hammer and Champy 1993, Hammer 1990). The post-war period introduced rigid structures of control and discipline which led to an organizational “installed base” very difficult to escape from. Organizations had taken a submissive role optimizing isolated functions and neglecting end-to-end processes. Hammer (1990) outlines six principles for obtaining a process-based paradigm using the power
Hammer and Champy emphasized the need to understand the services delivered to the customer in their totality, and modern technology’s ability to exceed existing barriers in enabling organizational change. BPRs lack of organizational dimensions and the tendency of top down managerial sidedness was, however, a shortcoming. As processes are complex organizational phenomena where workers attached to different parts of the organizations are performing and participating, a more nuanced view of processes, and a more methodological approach to understand them, was needed (Iden 2013). Later the bottom-up analyses of the organization complemented the top-down analyses, seeing organizational change as a common approach to obtain collective self-understanding. In the field of Information Infrastructures the installed base - the existing practices, processes, technologies, routines etc. – are a central point of departure (Hanseth and Lyytinen 2010). Theories with “installed base hostility” challenge the step-by-step emergence of collaborative networks (Hanseth and Monteiro 1998, Hanseth and Aanestad 2003). The collective approach becomes valuable when changing from functional to horizontal focus, and Melao and Pidd (2000) build on BPR in their four perspectives on business processes with a combination of soft and hard perspective. Their framing of processes has similarities with the focus from Information Infrastructures in the combination of a top-down management perspective with the more heterogeneous and bottom-up understanding of organizational change.

The first perspective Business processes as deterministic machines is about breaking tasks into well-defined operations that can be performed rigorously without deviations. This focus is most useful when the processes are very well understood, and when human intervention and decision making based on human knowledge is reduced to a minimum. While the machine perspective on business processes gives a static and predictable understanding of processes, the second perspective, Business processes as complex dynamic systems, puts faith in the dynamics and interactive features of processes. Also this perspective has a mechanistic flavour in that human characteristics and human communication is not seen as important feedback mechanisms when adjusting system performance. It is thus most appropriate on well-defined processes and tasks which require minima of adjustment. The third perspective, Business processes as interacting feedback loops relates performance to a wider set of interactions and includes adjustment according
to policies and other parts of the wider environment which may affect the processes. Decision making based on feedback gives a more bureaucratic approach where human actors has to intervene in particular situations to ensure that processes go ahead according to policies and other criteria. This perspective fits well to foster learning in that understanding of information flow and critical decision points, as well as the activities that go along with it, are identified. The fourth perspective, Business processes as social constructs emphasize processes as made and enacted by people with different values, expectations and (possible hidden) agendas as well as actors with special knowledge. The knowledge related activities requires wider value-related frames of interpretation. Although some standardization is necessary, the autonomy of work is important to enhance learning and improved understanding. Changes and improvements in health and educational institutions should result from negotiations and compromises (ibid, Iden 2006).

4. METHOD

4.1 Data Collection

The case study was performed at the emergency KAD unit (Kommunal Akutt Døgnenheter) at Aker in Oslo. This emergency unit relieves hospitals and primary sector units by taking care of emergency cases. From November 2015 to July 2016 we collected data using qualitative methods and performed in total 20 interviews; 9 with clinicians, 6 with project leader, and 5 with technical expertise. In addition we performed 3 whole day observations. We analysed around 25 documents on patient treatment regulations, clinical standards and political requirements as well as technical “white papers”.

4.2 Data Analyses

The broad range of collected data was systematized through establishing a matrix where situations, quotes and observations was registered. This process led to the identification of 3 themes (table 1 gives examples and themes).

<table>
<thead>
<tr>
<th>Example</th>
<th>Theme</th>
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<tbody>
<tr>
<td>Visual notifications when patients are arriving.</td>
<td>Whiteboard technology remove manual routines</td>
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<tr>
<td>Visual notifications when patients are discharged.</td>
<td></td>
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<tr>
<td>Functionality to identify available resources</td>
<td></td>
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<tr>
<td>Use of whiteboard technology during meetings</td>
<td>Whiteboards visual aspects regarding treatment</td>
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<tr>
<td>Whiteboard technology highlight patient conditions</td>
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<tr>
<td>Use of whiteboards to change responsible clinician from patient A to patient B, or to attach a new clinician to a patient.</td>
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</table>
First version of Whiteboard technology acquired and implemented after three months

Whiteboard supplier available for fast implementation and updates

“We have a high degree of employee involvement. This is tremendously challenging, but it raises the quality of our services.”

Improve comprehensive messages

Enable more efficient communication between health units

<table>
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<th>Table 1: Emerging themes</th>
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During the study the effect of the whiteboards on the organizational processes showed that there were several improvements where manual work was removed. In addition the extensive map (figure 1) was a collective endeavour. In Hammer and Champys (1993) original scope, information technology is central in removing bottlenecks, manual work, and double work in order to establish work processes which facilitate improved flow. Hammer and Champys work is extended in Melao and Pidd (2000) four perspectives on improvements on business processes which take the impact of organizational and technological legacy into account. Melao and Pidd does also add a view of organizational differences, and accordingly that they have to be analysed towards a more nuanced framework. Further we will now describe our case study, before we analyse the case in light of the lens of process theory.

5. PROCESS MANAGEMENT AT AKER

5.1 Complexity and interaction at Aker

In the Norwegian health system primary care is governed by municipalities, while secondary care is provided by four health regions - South-East, West, Mid and North - governed by the state. Work improving interaction between primary and secondary care has been going on for years, and IT is central in these initiatives. The emergency KAD unit at Aker in Oslo receives (mainly elderly) patients living at home with need for immediate treatment. Aker collaborates with 15 city districts and 4 hospitals. The patients arriving at Aker often receive homecare from the city district they live in. The city districts and Aker exchange information, but Aker is also sending patients and documentation to other health units.

At Aker they had difficulties in keeping up with the pace of arriving patients and treatment requirements. The tasks piled up during the day leading to a massive amount of activities in the afternoon. They also had difficulties in maintaining overview of activities and resources across Aker departments. The busyness and stress of clinicians and caregivers affected the quality of the treatment and the documentation. A project called SAMKAD (Interaction at KAD) was established in 2014. The projects focus was to improve the
treatment processes at KAD and the interaction with city district and other health units; to focus on process instead of product(s) by working digital.

KAD and SINTEF developed a detailed analysis of the treatment processes and called it “døgnrytmeplan” (Oslo Kommune 2016, Sintef Teknologi 2016). The result is a very impressive description of what is happening at AKER during 24 hours mapped horizontally against a timeline, and vertically against treatment processes their activities and requirements (figure 1). In addition, the work on the map enabled a better understanding of the reasons for the occurrence of what is called “the mountain”, where the amount of activities and requirements reaches a “peak”, and where treatment quality is threatened by a vast number of tasks. Identifying the processes shed light on the actual deviations, difficulties and shortcomings of the existing information flow and the patient treatment. It was a collective effort to unite around a common understanding of challenges and difficulties, in order to agree on what needed to be done. The project leader emphasizes the collective effort: "We have a high degree of employee involvement. This is tremendously challenging, but it raises the quality of our services." Examples of findings during the work with the map was difficulties in managing newly arrived patients, difficulties related to patients discharge, challenges related to work shifts, and the problem of exchanging effective information between Aker and city district health centers. Figure 1 shows all the processes. There was a significant “accumulation” of activities and task just after noon. The work which led to the complex map enabled Aker to extract simpler singular processes.

Figure 1: 24 hrs at Aker (Oslo Kommune 2016, Sintef teknologi 2016)

5.2 Using Whiteboard technology to improve standard processes

After the comprehensive analyses of activities during 24 hours at KAD, Aker wanted to improve selected processes. The Imatis Whiteboard was installed after three months, and gave some immediate improvements described below. The whiteboard technology is seen as an agile contrast to the classic record systems. One doctor said “The classic systems are very slow” and “very
difficult to use to improve efficiency”. A nurse said that “they don’t harmonize with the way we are working”, and “are best to use when working with one patient at a time”. The doctor sums it up by saying “our challenges have different requirements. The classic record is no longer a good tool for process support,” while “the collaboration with Imatis gave benefits quickly”.

Figure 2 (left) shows that patients arrive at Aker from several sources. The physician on duty (“Vakthavende”) has the responsibility to decide if the patients should be admitted to Aker, and to the suitable KAD department. Two examples describe areas where whiteboard technology has influenced the process, how, and the result of this.

**Figure 2: Patient flow and technical regime**

**Logistics: admission and discharge**

I am sitting beside a doctor which is writing record notes in the SystemP. Her phone rings. It turns out that she this day is the “vakthavende”, and receives a request for admission to Aker. The doctor finds the patient in SystemP, asks some questions about the general condition of the patient, and chooses unit for the patient admission. She registers the information in System P and in Imatis. In Imatis the field “Meldt” (Registered) is marked. This information is read by the nurses at the receiving unit. The notification initiate a set of activities: clarify the room, be ready to receive the patient. The electronic notification is a big improvement the doctor tells me. Earlier, before Imatis, they had to write notes and give it to the caretaking nurse. If “Vakthavende” was positioned in another unit this activity could take time. Now the information is immediately displayed on the Whiteboard and visualized for everyone in the department to see. The same challenges and improvements apply to discharge of patients. Since Aker is an emergency unit, with short term admissions, there is a continual pressure to find places to send patients which has been there for three days or more. The whiteboard technology visualizes the internal availability of rooms and other resources. There is a “view”
accessible by cleaning and kitchen personnel notifying them when a room has
to be cleaned or food has to be made. This enables them to plan their day
more efficiently. This is an improvement also for management, the nurses and
clinicians including the “vakthavende” which now can answer incoming
requests right away. “This is a considerable improvement, especially the
registering and notification that a patient is arriving,” the doctor says. A
shortcoming in the Aker installation is the current lack of integration between
the record system(s) SystemG (city districts) and SystemP (GPs) and the
whiteboard. Main suppliers have refused to open up their interfaces for
integration with other systems. They are in fact refusing to talk to Imatis about
integration at all. Imatis was installed in the Oslo commune server
environment in 2015, and there is an ongoing work to enable integration
between the two record systems and Imatis, but this is provided by the
commune, not the suppliers (figure 2).
Since the whiteboards gives a very good overview of patients, responsible
clinicians and treatment status they are a central resource in the morning
department meetings. Both the meetings between management and employees
and between employees during work shifts. Management uses the meeting to
repeat general focus on treatment responsibilities. The night nurses uses
whiteboards to update the day shift on patient statuses, what has been done,
what should be done. The meeting can be used to switch tasks and
responsibilities between nurses, the whiteboard functionality includes drag
and drop which facilitates this switching. All the available nurses are
displayed in the upper part of the whiteboard, and can be dragged and dropped
on a particular patient in the vertical patient list. This switching should not be
done without it being communicated verbally to the nurse. When family
members are visiting the patients, the nurses use only one or two seconds
identifying the room where the patient is located.

5.3 Message interaction between Health units
The city districts have the caretaking responsibility for the citizen and
information of patients treated at KAD is sent back to the respective city
district. This is usually done by PLO-messages (Pleie- og omsorgsmeldinger)
through the record system. These messages are seen as comprehensive and
incomplete, and city districts have to call Aker several times in order to
understand what the message content really meant. There was a need for
improving the interaction through more effective and distinct messages. The
Imatis implementation enabled the emergency unit to reflect on the message
practice. In cooperation with two city districts Stovner and Østensjø, they
created a message structure using ADL-standard and are currently performing
a pilot-project on these messages. The ADL structure is simpler than the PLO
and easier to standardize using a numeric system to describe the condition of
the patient.
Several informants expresses positive attitude. “The standardization of ADL gives us a more systematic description, and less deviation.” Oslo municipality has established integration between city districts of Stovner, Østensjø and Aker so that they can use Imatis and real time information can be exchanged. In summary the collective organizational approach where the work processes was analysed made Aker identify areas of improvement. The improvements enabled “clarifications” on important logistical aspects both within and across hospital units. In the analyses we will elaborate on these issues.

6. **ANALYSES**

In this part we will analyse the case in the light of Melao and Pidds four processes of business process change. In 6.2 we also use some of the principles from the classic BPR literature.

6.1 **Improving complexity through understanding of processes**

At the Aker emergency unit they had big challenges handling the extensive amounts of patients arriving during the day. They were not able to treat the patients fast enough; they had great difficulties establishing overview over which resources – like clinicians, rooms and equipment - were in use, and which were available. They used a lot of paper notes to communicate, and walked long distance to deliver them. The improvement process started with establishing a detailed overview of all process related aspects. This was done together with SINTEF, an expert organization on industrial processes. The result is a comprehensive map which describes processes, activities and requirements, as well as notes, quotes and icons which depicts “strange” situations, deviations or possible improvements. The map became a fundamental and collective entity to identify areas of improvement in at least two ways. First as noted by Melao and Pidd (2000), business processes may be social constructs i.e. processes partly made by people with different values, expectations and (possible hidden) agendas as well as actors with special knowledge. Especially changes and improvements in health and educational institutions, where autonomy of work is important, should result from negotiations and compromises (ibid, Iden 2006). Akers strategy to identify the content of all their processes by engaging in a collective approach is aligned with these advices. The improvements rest on a collective process which is shared through analytical activities, not on some singular manager’s creative mood. Second, complex processes may consist of simpler elements which may be improved relatively fast. Melao and Pidds second perspective puts faith in the dynamics and interactive features of processes, but where
feedback mechanisms are standardized, systematized and automatized and needs a minimum of human intervention. It is thus most appropriate on well-defined processes and tasks which require little adjustment. At Aker the collective approach on the complex map, enabled them to identify simple areas of adjustment. The Electronic whiteboard was a central digitalized product in enabling process innovation.

<table>
<thead>
<tr>
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<td><strong>Business processes as social constructs i.e</strong></td>
<td><strong>The project “Døgnrytmeplan” is established to</strong></td>
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<tr>
<td>processes as made and enacted by people with</td>
<td><strong>identify and understand a complex mix of</strong></td>
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<tr>
<td>different values, expectations and agendas as well</td>
<td><strong>structured and unstructured, digital and manual,</strong></td>
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<td>as special knowledge.</td>
<td><strong>technical and social processes.</strong></td>
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<td></td>
<td><strong>As a result of this Aker identifies structured</strong></td>
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<td></td>
<td><strong>processes which may be improved.</strong></td>
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</table>

Table 2: Lens and case analyses

### 6.2 Lightweight technology to improve logistics and quality

At Aker the implementation of electronic whiteboards lead to improvements on several areas. First, the use of the whiteboard to make the registration of the admission or discharge of patients easier improved and made communication more effective. Second the use of the same technology for cleaning and kitchen personnel to dynamically gain information on what to do and when, improved the preparation of rooms and food. Lack of integration means however that some of the potential is not fulfilled. In addition, the visualization of the information on the electronic whiteboards gave a better overview of the patients and their treatment status. This was a huge improvement for communication during meetings. Relating to Melao and Pidds perspectives we see that the whiteboards has the ability to improve logistics through identification of relatively static operations, which may be improved using a logistical system where messages are sent to core actors when something has to be done. Cleaning and food services operate relatively independent of patient treatment processes, and may thus be planned separately. The focus on logistical improvements gained power through identification of time consuming activities during 24 hours and lightweight technologies enables a relatively fast establishment of systematics which deals with the problem. In relation to Hammer and Champys six rules for improvement, KAD is now occupied with the relation between tasks and outcomes; they have automated communication so that there is a better relation between who receives the output and who performs the process. Further KAD makes sure that decisions that are taken is registered at the same time and immediately displayed on the whiteboard. More distinct messages have reduced double work, and there is less manual communication on logistics something which enabled the clinicians to concentrate on treatment.
There is however a need for integration between whiteboard system and the record systems which is not yet established, but which may further reduce double work. In addition, electronic whiteboards provides a basis for improved communication during morning meetings.

<table>
<thead>
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<td>Business processes as deterministic machines: breaking tasks into well-defined operations that can be performed without deviations.</td>
<td>Improvement in logistics: the admission and discharge of patients, as well as the cleaning of rooms and preparation of food.</td>
</tr>
</tbody>
</table>

Table 3: Lens and case analyses

6.3 Combination of efficiency and quality in message exchange

Efficiency and clarifications does not go on behalf of quality, one may obtain improved efficiency because of a more distinct treatment process, and improved quality because of more efficient communication. Aker found that the message exchange with city districts was inefficient. Messages were comprehensive, and thorough, but the city districts nevertheless had the need for additional information. The improved messages, which took the requirements in the interacting feedback loops seriously, led to fewer phone calls, a more standardized and distinct message format, and a clarification of the actual patient status when returned home from KAD. To see the collaboration as an interacting process of mutual gain and use of coordinative technology to improve the interaction may lead to releasement of important resources which may be used to patient treatment. Secondly, on a more general level, Akers Samkad project is about improving horizontal processes across hospital units. The complex map (figure 1) enabled the clinicians to see their role as an actor in a bigger and more dynamic system. The patients are moving and preconditions for interaction are an important aspect of system improvement. We see this point as related to the third process in Melao and Pidd: Elaborate on the feedback loops which are established in interacting systems. Akers collaboration with fifteen city districts and four hospitals requires a deep insight into internal and external conditions for dynamic interaction, and lightweight technology has a promising ability in facilitating this.

<table>
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<td>Business processes as interacting feedback loops relates performance to a wider set of interactions and includes adjustment according to policies and other parts of the wider environment which may affect the processes</td>
<td>Improve interaction loops through collaborations on standardization.</td>
</tr>
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Table 4: Lens and case analyses

In summary we can say that Akers combination of a collective approach to understand their complex dynamic reality (Melao and Pidds 2nd and 4th perspective) was a prerequisite to identify logistical and interactive improvements (perspective 1 and 3)
7. DISCUSSION

We return to our research questions:

- What organizational activities are initiated when an organization has a goal to improve patient flow?
- How can lightweight technology improve patient flow?

In this paper we build on a case from an emergency unit in Oslo to investigate how lightweight technology can improve patient flow, and the role of organizational processes in obtaining this. To develop our argument we built on insights from Melao and Pidds which claims that a combination of top down and bottom up approaches should be used when introducing a process view of organizational processes. The main point is that Aker combined collectivism to understand, and simplicity to improve organizational processes. 6.1 to 6.3 describes how. While 6.1 are occupied with research question 1, 6.2 and 6.3 demonstrates how Lightweight technology can improve patient flow. We add to the existing literature on information infrastructure by providing two insights. First we inspect the role of lightweight technology in enabling organizational change and improving organizational processes. We find that the installed base is an important prerequisite when using lightweight technology to improve processes, but also that heavyweight suppliers are hostile towards change. Our findings show that lightweight technologies give collective energy and inspiration to identify areas of improvement. This build on the insight from earlier literature in that processes of change in information infrastructures (Ciborra et al 2000), as hospital organizations (Berg 1999) are in its foundation a collective approach where organizational agendas, values and knowledge have to be taken into account (Melao and Pidd 2000). Second we find that lightweight technologies enable improved processes and innovation upon the installed base because they facilitate a horizontal process view instead of a product view of organizational activities. Then we give insight into possible areas for improved interplay between lightweight and heavyweight technologies. Our findings confirm the message from Hertzum and Simonsen (2015), about the necessary symbioses between technology, communication and practice. Our findings do, however, also shed light on the logistical ability of whiteboards to provide swift and elegant overview of patient status, their progress, and also their usability when information has to be acted upon and changed. We extend the insight from Bygstad (2016) where Lightweight technology have qualities to facilitate improvement by being easy to acquire and relatively easy to use. We also show how implementation projects are opening up for organizational change and lightweight technologies provides solutions to obtain process change. The interplay is enabled both through improving processes and
through establishing technological regimes which enables the use of a coordinative technology across departments and health units.

8. REFERENCES


