Translating technological change – implementing technology into a hospital

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Abstract

Purpose – The purpose of this paper is to understand how changes in technological devices, implemented to increase productivity and enhance performance are translated by medical professions in their clinical work. As organizations become more technology dependent by digitalization, deeper understanding of change processes will enhance change outcomes.

Design/methodology/approach – A case study based on interviews, observations, on site and document analyses is undertaken to study the use of electronic speech recognizer (SR). An actor network theory (ANT) approach is used to address practice.

Findings – Doctors diversely adjust to the new technology. The use of the SR technology was negotiated and translated by the doctors. The technology was continuously re-designed and interacting with the human actors. In the translation process, powerful actors (doctors) influence outcome of changes, and thus, they affect the effectiveness of the change initiatives.

Research limitations/implications – The theoretical approach enables a detailed and rich understanding of the sociology of technology. Future research should go deeper into case studies in other contexts.

Practical implications – Technology is not deterministic entities, and politicians and managers should pay attention to how technology interact with key actors in implementation of system (technology) changes. The design and use phases implicate on the effect of such changes.

Social implications – In order to successfully manage change processes, powerful actors should be motivated to actively participate in the design and the implementation phases in order to design and redesign the functions and roles of technologies.

Originality/value – The theoretical approach (ANT) addresses technology according to the concept of sociomateriality. This approach enables understanding technology, people and organizations as entangled (integrated). The theoretical concepts developed knowledge to gain deeper and wider understanding of the role of technology in managing of performance and productivity initiatives.

Keywords Hospitals, Implementation, Productivity, Technological change, Actor networks

Paper type Research paper

1. Introduction

During recent decades, the hospital sectors in many countries have undergone reforms changing organizational structures and creating innovative boundaries. These reforms focused extensively on improving management control structures such as financial responsibilities and autonomy within medical units, within management at different levels and within hospital governance structures (Grafton et al., 2011). The overall visions for these changes are rooted in demands to increase effectiveness, quality and safety in medical health care. However, the practical implications of the reforms often change when moving from vision into practice when reform ideas are implemented in daily practices in the hospitals. Due to complexities, the outcomes of the reforms are difficult to predict in advance (Christensen and Lægreid, 2011; Lapsley, 2007; Pettersen, 2001).

Many reform initiatives involve technological mediators, which reorganize organizational structures and have implications for practice. In particular, technological changes may have profound effects on daily practices. However, the huge literature within the field of public sector management reforms has paid little attention to the connections between technological changes and organizational outcomes (Broadbent and Guthrie, 2008).
There is a need to fill this knowledge gap by studying the role of technology in the reform of public sectors. The technology concept is widely defined within management control literature, including systems of calculation and accounting (Justesen and Mouritsen, 2011; Barter and Bebbington, 2013). As systems and communication become more technology dependent by digitalization, theoretical frameworks should include these technological innovations as important actors when studying reforms.

To study the interconnection between technological changes and performance outcomes, the research question is:

RQ1. How are changes in technological devices, implemented to increase effectiveness and enhance performance, translated by medical professions in their clinical work?

Hospitals are complex organizations and measuring performance and effects of innovations to increase effectiveness are difficult tasks (Simonen et al., 2012). Accordingly, this study sets out to give a focused and detailed discussion of technological changes undertaken to enhance performance.

A more practical operationalisation of the research question is: how the visions set by the hospitals’ owner, in this case, the Ministry of Health in Norway, to increase effectiveness, quality and safety are translated by medical professionals when they use new technical devices such as the speech recognizer (SR). Norway is an interesting context for studying this topic, as the reorganization of the public activity in Norway over the last ten years is characterized by a move away from an integrated to a more fragmented state. However, Norway is still lagging far behind the typical new public management (NPM) countries like the UK and North-America in this respect (Christensen et al., 2008). In contrast to many countries, the main trend in Norway has not been privatization but transforming central agencies into state-owned companies. The government implemented an NPM-inspired reform of the hospitals, as the ownership of Norwegian hospitals was transferred from the counties to central government. From 2003 and until today, the reform set up new management principles for the hospitals based on a decentralized enterprise model (Laegreid et al., 2005).

Consequently, the context of our study is a hospital under high pressure to adapt to management reforms asking for effectiveness and quality in medical health. We discuss the process from the Ministry’s vision into practice by using a theoretical framework that includes technology as an explicit actor in change processes (Justesen and Mouritsen, 2011). This approach is developed from actor network theory (ANT), as it visualizes the complex relation between technology and human beings (Callon, 1991).

This paper is organized by first presenting the theoretical perspectives in the study. Then a brief presentation of the research design is given. Thereafter, the empirical context of the study is described with a focus on the introduction of the SR technology. The research findings are discussed through the lenses of ANT and the process of translation. At the end, the findings are discussed with reference to the theoretical framework, and implications are given for future research.

2. Theoretical perspectives
In this part of the paper, the theoretical approach is presented. First, a review is presented of literature on technological innovation and its implementation in hospital contexts. Thereafter, we proceed by presenting the actor network approach (ANT) used in the empirical study.

2.1 Research on technological innovations and implementation in hospital settings
There is a huge literature on innovations in medical technology presented within the medical sciences. In the last decade, the pace of innovations in medical technology has
accelerated, and studies are focusing on identifying and understanding the forces behind the adoption and diffusion of medical technology innovations in clinical practice (Cappelaro and Anessi-Pessina, 2011). A literature review indicates that despite their apparent promise, health information technologies have proved difficult to implement, and implementation barriers are found to be associated with organizational management and their interrelations (Lluch, 2011).

Studies have emerged to identify and characterize enabling factors that support adaptation of technology and work practices in the health care sector (Boulus and Bjorn, 2010). Based on ethnographic studies of managing the gradual adaptation of electronic patient records, one in Canada and one in Norway, the researchers found that understanding the technology-in-use practices had to be based on what they called “reflection-on-practice activities” to construct the meaning of new technologies. In their research, Boulus and Bjorn (2010) argued that one must recognize that it is impossible to predict and fully plan the socio-technical changes and the overall effect of the technology (Boulus and Bjorn (2010, p. 98). Such unpredictability is due to the emergence of new possibilities and unanticipated patterns of use that are created by the new technologies and the impact of new technology emerges only in use. Further, adaptation of technology is highly influenced by peoples’ perceptions (Jensen and Aanestad, 2007). Technology-in-use practices comprise people’s understandings of the technology-use on a daily basis and the consequences of such use (Orlikowski and Gash, 1994). Our study departs from such reflections on studying technology-in-use by including technology as key, non-human actors in change processes.

2.2 Technology and management reform ideas
As the research referred to above recognizes the link between technology and everyday practices, this approach enables the acceptance of technology devices as non-human actors that meet human actors when being introduced into social contexts (Orlikowski, 2002). Management accounting research has introduced ANTs as a framework and method for understanding the translation processes of management accounting changes and innovations into organizations (Justesen and Mouritsen, 2011). Just as technological devices are seen as non-human actors, also accounting technologies, including digital devices and practices, enable particular kinds of action when they become part of a larger network, consisting of both humans and non-humans.

When following these arguments, we may view material technologies as devices, which make it possible to translate “programmatic” ideas of government into practice because inscriptions (see definition of this concept in the next paragraph) in these devices allow government to “govern at a distance” and realize their political ideas (Miller, 1990; Latour, 1987, 2005). In the studied case, the new technology was implemented to realize the Ministry’s efforts to increase efficiency and patient quality. Consequently, the technological innovation acted as a non-human actor in the reform efforts. This theoretical approach enables a combination of technology and social practices to understand how reforms are translated into changed performances.

2.3 The actor-network approach and the translation of technologies
ANT is an approach, which can stimulate new knowledge on the relations between actors and technologies and between humans and non-humans in organizations. Images of what a device can “do,” are translated, and expected patterns of use are, through the process of inscription, inscribed into the device by the actors.

In the ANT framework, technology is understood as being bound up to the specific, material discursive practices that all together constitute the technology. The framework focuses on the concept of translation of technological change. Emphasis is here put on the
term sociomateriality of technology, that joins social interaction in the organization with the new technology.

To understand the process of translation from the introduction to the practical implementation of new technology, we can view both humans and technology as actors, who both participate in creating local practices, where the meaning of what the technology is and can do, is negotiated and translated by these same actors. Orlikowski (2010) referred to this as entanglement in practice, where technology is understood as having no inherent limits, abilities or meanings. Technology is rather bound up to the specific material and discursive practices that constitute the technology. According to this perspective, our perceptions of the use of the new technology depend on the actors performing local practices, very close to where the technology is introduced. This approach implies that we have to understand how the main human actors perceive their interaction with the technological devise.

Wenger (1998) contributed to this approach with the concept of communities of practices. Professionals can participate in various communities of practices and thus be part of different transformative processes that can lead to different translations. The introduction of new technology can disturb the established division of work and responsibility between human actors comprising the communities in organizations (Barley, 1986), and, thus, the actors may be forced to interact in new ways (Black et al., 2004).

2.4 The sociomateriality of technological changes

Orlikowski (2000) developed the understanding of translation by introducing sociomateriality, which indicates an inseparability between the technical and the social. According to Orlikowski et al. (2012) sociomateriality implies that entities (technology) have no inherent qualities, but acquire their form and attributes only through their relations with others in practice, and that technological artifacts should be treated symmetrically to humans. This means, so to say, that human actors and the technology become united; it is difficult to separate the effect of the humans’ actions and the technology in the outcome of the processes.

Earlier research on technology, work and organization has mainly focused on technology as deterministic entities with artifacts that constitute what the technology can do, how it should be used and the skills required to use it (Bijker et al., 1987). Here, the human actors have little or no influence on the technology as such. This view is problematic, because technology was viewed as designed and determined by the designer(s) who is supposed to know how the technology is going to function in every social setting. One study by Barley (1986) demonstrated the inadequacy of this approach by showing how the use of technology is transformed according to social practice. The introduction of two completely similar CT scanners in two different hospitals was studied. The study demonstrated that identical technologies showed different patterns of use and constituted different social structures.

Inscription and translation are ongoing processes in which actors negotiate their opinions and perceptions about the technology, which transforms the technology’s use and the actors’ understanding of the functions and artifacts in the technology (Barley, 1986; Orlikowski, 1992, 2000). Orlikowski (2000) referred to this as the interpretive flexibility of technology, meaning that technology holds a flexibility in how features of the technology are interpreted. The flexibility of technology also depends on the extent to which the actors can return back to previous solutions with the old technology, which indicates the irreversibility of technology (Latour, 1987; Callon, 1991).

Studies show that the inscriptions in the technology are diversely used, depending on who is using the technology and depending on tasks and aims/politics (Monteiro, 2000; Barley 1986). Following the concept of sociomateriality, technology refers to what the
technology can do, and as such, socially constructed according to practices. This approach can inform us why the structural features of the technology are perceived and used differently by humans. The technical artifacts are relatively stable, like a material state of art, but human actors can translate in different ways, the use and the roles of the technology. Thus, the interpretive flexibility of technology (Orlikowski, 2000) implies that actors can change the way the technology is used according to how the spirit and the features of the technology are interpreted. Consequently, technologies, people and organizations are constitutionally entangled, and that we can separate them only analytically (Orlikowski, 2010).

3. The context and the technological change

3.1 The Norwegian hospital sector

The Norwegian hospital sector has been reforming according to international agendas for the last 20 years (Pettersen and Nyland, 2012; Nyland et al., 2009). To ensure control over the hospital sector, every year the government sets goals to increase efficiency, perform high-quality care and secure safety for patients in medical health care treatments. These annual steering documents transfer authority to the managers to run the hospitals according to guidelines and detailed performance measures. The regional health authorities, which govern the hospitals on behalf of the State, allocate funding resources to each hospital within the region and assign duties according to the guidelines provided in the steering documents.

One important performance measure set by the Ministry of Health in these steering documents to the hospitals, is the time needed to update and finish patient journals when patients are transferred across hospital departments and between the hospitals and other health care institutions (in municipalities mostly). Timely and correct information in patient journals, made up as discharge summaries, are fundamentally important for securing high-quality patient flows through the treatment processes. The measure set by the Ministry of Health in the period 2010–2014 was that 100 percent of the discharge summaries should be finished within seven days after transferal.

Our case hospital is one of five large university hospitals in Norway, and it was chosen for this study as it was very early in introducing new technology to deal with the aim of reducing the time needed for finishing patient journals. Although the hospital aimed at reaching the Ministry’s goal, the measure was not reached in the period between 2010 and 2013, as the percentage stayed between 70 and 76 percent between 2010 and 2012 (annual reports from the hospital). The hospital had for years made strategies for increasing the number of discharge summaries to be finished within seven days. In 2008, it was stated that at least 80 percent of the summaries should be sent out to the general practitioners in the patients’ municipalities within seven days. The annual reports in the years to follow showed that the hospital did not succeed in fulfilling the measures set by the Ministry.

The Ministry argued in the steering letters in this period that the delay of the discharge summaries could have negative implications for patient safety (Ministry of Health, Steering letter, 2009, p. 32). The reason is that the doctors in charge of the patients after they are discharged from the hospital are not able to access an updated patient journal. Further, the Ministry emphasized that the quality of the patient journals was not satisfactory due to several mistakes made in the processing of information. A demand was made to the hospital to improve the efficiency of the discharge summaries. A main productivity problem was that too many resources were spent on writing the journals, as the process also included several people handling each journal in different phases.
As a response, the hospital decided to introduce the SR to most of the departments in the hospital, as stated in the Annual Report Hospital (2009, p. 7):

It is expected that the requirement (discharge summary sent out within seven days) will be achieved by the introduction of the SR that eliminates the bottleneck of getting the journal written.

It is expected that the indicator is stable on 80% by the end of 2009.

The regional health authorities and the management of the university hospital considered the SR to have potential to improve the efficiency of the discharge summary process according to the Ministry’s demand. The SR technology was also considered to change the doctors’ practical work, as stated in the Annual Report Hospital (2009, p. 10):

Speech recognition is one of the largest projects of restructuring in 2009. The project started in 2008, while the implementation was completed in 2009. Over 600 doctors have undergone training and are now using the new tool, which is expected to streamline the work of recording patient journals. It is estimated a workforce reduction of 55 secretarial positions when the introduction is complete.

As can be seen from the references to the hospital’s annual reports, this aim was not reached, although the SR technology was formally introduced from 2008. This paper seeks to understand more about why this aim was not reached; more precisely, what happens in the transformation from introduction to use of technology.

3.2 The SR

The SR records the doctors’ voices directly to digital text. This improves quality and safety, as the patient journal can be ready some minutes after the patient has seen the doctor. Further, the SR has the potential to increase productivity as the number of secretaries can be reduced, and thus, the cost of reporting could accordingly be reduced. The functions and artifacts of the SR technology imply that what were formerly secretarial tasks have to be added to the doctor’s daily work. Consequently, this change in technology implies a change in the practices for both doctors and secretaries.

Before the SR was introduced, the patient journals were developed in a production chain of several sequences between the doctor and his or her secretary. Before 2007, all the doctors used analog dictation where the doctor spoke details about the patient’s treatment and medication on to a tape recorder. The tape was then handed to the secretaries, who were located in the clinical departments close to the doctors. The secretaries then transcribed the recorded information, and thereafter a draft of the journal was sent back to the individual doctor for proofreading and approval. During the analog dictation period, doctors and secretaries often had been working together for a long time. The secretaries were familiar with the specialties and medical practices in their departments, and they had developed tacit knowledge of the doctors’ writing habits. One of the secretaries (Secretary 2) said in the interview “I liked the old times with the analog dictation, because I felt involved with the doctors and the patients.”

Digital dictation was introduced in 2007 to all clinical units at the hospital. Now the records were sent electronically. Through this reorganization, the hospital centralized all the secretaries into one common unit, the managers could reduce the number of local secretaries, and cost efficiency in the clinics was increased. When the secretaries physically moved out of the clinical departments, the close work-relationships between the doctors and the local secretaries ended. As the secretaries now did not write for doctors in a specific department, they consequently did not learn the special terminology in each medical specialty. The quality of medical records was therefore observed to be significantly reduced during the transition from analog to digital dictation.

The SR was formally introduced to almost every clinic by fall 2009. The SR software consists of a dictionary with common, medical terms and day-to-day terms in the
Norwegian language. The dictionary has to be updated and adjusted to each doctor’s own words based on the doctor’s use of the SR. The SR is expected to be calibrated and to function well after approximately eight hours of individual training.

Although the top managers in the hospital at that time were aware of some problems with the practical use of SR when introducing the device, informants in this study stated that the managers decided to introduce the SR to the doctors in quite a speedy way. The decision was made despite startup problems. Our respondents claimed that the SR functioned badly in day-to-day communication terms, and that the SR system easily mixed up common words, such as unpredictable/predictable, he/she, etc. The doctors in our study also felt that the technological startup problems were a potential high risk to patient security.

4. Research methods
The main aim here is to gain new insight into the bumpy road of translating technological devices into a complex organization with the focus on the changes involving doctors. We followed the introduction of the SR among doctors in order to understand how the translation of functions takes place during the technology introduction. The study follows the early period of the introduction.

A case study design is chosen, which provides rich data (Scapens, 2004). To narrow down the study, we chose two clinical departments that were early adopters in the case hospital: the orthopedic department and the rheumatic department. Later, a doctor from the cardiology clinic was included as this clinic also was an early user of the SR. These three departments have quite different mix of patients, and therefore they give contrast to our findings. The doctors were invited to participate based on their early involvement in the SR project, as they were the first doctors to implement the new technology in practice. All participants were key informants, and they had different roles in the project, thus giving us broad access to practices. Altogether, 16 interviews were conducted, where some interviews were follow-up talks. Further, informal discussions took place during 2010–2013. Please see interview statistics in Table I. The respondents’ involvement in the project was diverse. The project manager was responsible for training, information and practicalities in how to organize the project. Two instructors and super-users were interviewed, and these were also responsible for organizing courses. We used mainly semi-structured interviews, where we focused on how the respondents perceived the technicality of the SR devices, and how they used them in their daily practices. Our questions were centered on the technology and how the persons described its practical uses. Most questions were open, like how often do you sit with the SR to dictate [...]? How much time do you take to correct the texts [...]? Do you also use the secretaries to document the patient journals [...]? The interviews were digitally recorded and transcribed, and transcriptions were confirmed by the respondents.

We undertook comprehensive documentary studies to understand the inscriptions in the SR. The list of the formal documents is included in the references. In these official documents from the Ministry, all the main hospital performance measures were listed. These measures include quality indicators such as number of patients to be treated, number of acute patients to be admitted and other indirect quality measures. One such indirect measure is the number of production days of the patients’ discharge summaries, which the Ministry considered an important productivity measure. The aim was to obtain a considerable reduction of the days needed to produce these summaries. We also studied power point presentations used at information meetings and documents on the vision of the SR from the producer/designer.

We observed the SR devices in practice mainly to understand how the system was operating. As participants in an introductory course for three days, we were able to use the
system by operating on the device (2009–2011). We also had informal talks with the participants (doctors, instructors and super-users). We also presented our findings in discussions with the participants in follow-up meetings during 2013 to confirm and validate our interpretation of data.

This case study is based on a triangulation of methods, which allows us to interact personally with the technical devices and also to translate the meaning produced by the technology to the users. Through interacting with the participants we were able to understand more about how they translated the meaning of the technology into actually using the devices (Latour, 2005). This approach visualizes how agendas were inscribed and translated among a network of actors. Through interviews with key persons, participating in training courses, observations of practical uses of the technology and by reading documents, we could understand some main elements of the actor networks. Although we have used several sources of data, our qualitative research approach permits subjectivity in interpreting and analyzing information (Scapens, 2004; Yin, 2013). We have interviewed a limited number of persons, and our informants do not represent the whole hospital. Consequently, our arguments and conclusions will be based on these actors and based on our interpretations, using theoretical concepts to strengthen our findings. This design is in line with the ANT approach, which acknowledges research based on individual experiences which are not necessarily representative of the whole population of actors.

**Table I.**

<table>
<thead>
<tr>
<th>Interviews</th>
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<tbody>
<tr>
<td>Spring</td>
<td>The hospital director (one interview February)</td>
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<td></td>
<td>Project Manager SpeechRecognizer (two interviews March)</td>
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<td>2010</td>
<td>Two representatives for the management (two interviews March)</td>
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<td>Two secretariats (two interviews March)</td>
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<td>Two super-users (two interviews April)</td>
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<td></td>
<td>One instructor (one interview April)</td>
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<td>Doctor 1, Neurological Clinic (two interviews June)</td>
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<td>Doctor 2, Rheumatic Clinic (two interviews June)</td>
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<td>2011-2012</td>
<td>Doctor 3, Rheumatic Clinic (one interview June)</td>
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<td></td>
<td>Doctor 4, Cardiology (one interview August)</td>
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<td></td>
<td>Informal talks with key informants (several discussions)</td>
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<tr>
<td>2013</td>
<td>Follow-up meeting (February)</td>
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</table>

**Observations**

| Autumn 2009         | Participated on a three-day training course for the Speech Recognizer |
| Autumn 2012         | Observations in practical use of the Speech Recognizer (three days) |

**Documents**

| 2008                | Annual report from the hospital |
|                     | Evaluation Report Speech recognizer (Slides) presented on an information meeting at the hospital |
| September 2, 2009   | Steering document from Regional Health Enterprise to Hospital 2009 |
| November 16, 2010   | Evaluation report Speech Recognizer by former Director of the IT—department (preliminary report) |
|                     | Questionnaire about the use of the Speech Recognizer |
|                     | Feedback from participators in an evaluation |
| October 26, 2010    | Power point presentation meeting about experiences in use of the Speech recognizer |
| October 10, 2011    | Abstract meeting about experiences in use of the Speech recognizer |
| February 9, 2011    | Short note from Clinics that did not participate in meeting the about the Speech recognizer |
| 2012–2013           | Follow-up on Speech recognizer from producer |
|                     | Steering document from Regional Health Enterprise to Hospital 2012 |
|                     | Annual report 2012 |

Translating technological change
5. Empirical findings
Here, we give a picture of the expectations of the Ministry of Health and the manufacturer of the SR technology as to what goals the SR was expected to achieve. The second part of this section investigates the actors’ perceptions of practical uses of the SR. These perceptions reflect the translation of the meaning and function inscribed into the SR by the users.

5.1 The intended use of the SR
Before the SR was introduced to the hospital, several actors expected increased effectiveness from the introduction of the SR device. The manufacturer, Max Manus, outlined the vision for the SR in an ambitious way:

Imagine a system where the doctor starts a dictation after the patient leaves the examination room. Using speech recognition and his customized auto texts the doctor is able to finish and approve the patient record in good time before the patient has left the hospital. The patient record is already available for further processing. (Max Manus, 2010)

The SR technology was developed according to the specifications from the regional health authorities in cooperation with the top management of the hospital. A project group consisting of five doctors from the hospital was established to resolve technical challenges. The hospital manager stated in the interview, that they had formulated three main goals for inducing the SR:

“We aim at improving quality of the patients’ journals, increase safety in patient care and increase effectiveness.”

One main goal was to reduce the number of secretaries by 80 persons, in order to compensate for the increased costs of the new technology. The hospital expected that the physical work of writing the journal was to be reduced comprehensively, and accordingly, the SR was expected to give positive return on investment after five years. In particular, the number of persons who were handling the patient journals could be reduced, and the quality would be increased. Some of the secretaries had to stay in the clinics as local super-users to assist the doctors in their SR training.

The doctors were offered training courses to learn the practical use of the SR (2009–2011). Here, the doctors were also informed about the potential benefits of the SR technology. All doctors in the clinical departments were expected to participate in the training course, and many doctors, but not all, did come. After the courses, the doctors were supposed to be able to record directly in the SR system, and they were also expected to know the technology well enough to use it in daily work with patients.

5.2 The doctors’ use of the technology
The doctors were supposed to use the SR technology immediately after the training courses. We interviewed doctors on their perceived benefits after the courses. The comments were mostly negative:

I think only a few of us use the SR to enter information about the patients in the emergency department records. I will simply not risk it when the tempo is high. (Doctor 1)

SR is very good on technical terms, but when it comes to everyday prose the technology understands little. (Doctor 2)

The technology seems immature and unstable. (Doctor 3)

Although the doctors were expected to have been using the SR for some time when we visited them, the SR technology turned out to neither operate according to the doctors’ expectations nor according to expectations stated in the documents from the producers or the aims from the Ministry. We observed that the doctors did not easily adjust to the new technology:

The doctors do not believe fully in the technology -they come and ask us. (Secretary 1)
In discussions with the super-users, they also stated that they seldom, or not at all, heard from the doctors. At that time, the doctors did not believe in the potential gains from the technology as they were presented in the introductory courses. The doctors held on to the old system.

Another observation was that the doctors did not refer to the super-users when they faced problems in using the SR. They stated that they did not use the super-users at all, because they did not think the super-users could help them at all. Others had tried to contact the super-users, but they did not get any response from them:

I might not be a good user of the super user’s services, and it is perhaps poorly communicated who they are. For there are various super users per system, and this is difficult to keep track of. (Doctor 1)

Even though it was expected by the project group that the super-users should help the doctor’s use of the SR, several practical problems made the doctors reluctant to use the new technology. When we interviewed the super-users, they said that they had problems in getting the services “on line”: “It does not function” (Super-user 1). Because of this, some doctors asked the IT department for help (as they had been used to during the digital dictation phase). However, the IT department did not have the capacity to help these doctors.

One of the main problems with the SR was that the technology did not recognize everyday language very well. This problem could be numbers such as 0.1 and 1 that easily were mixed up by the SR system. When a doctor was describing a medical prescription and if he did not pay full attention to what the SR reported, the SR could mix up doses of medicine. Such mistakes could in some cases imply a deadly dose for a patient. These failures in the SR technology reduced the patient safety, and could in the worst cases cause unexpected deaths if the mistake was not discovered. Many general practitioners outside the hospital encountered problems when seeing the patients after he or she had left the hospital. One respondent said:

Was the doctor drunk when he/she wrote the patient journal- the GP asked me. (Doctor 2)

This statement was based on the fact that the patient journal could contain many wrong words, definitions and sentences. Another doctor added:

When it comes to everyday speech, prose and dialects and especially these small words, all the prepositions, all prefixes, all inflections of nouns and verbs. That he (the SR) does not understand. (Doctor 4)

Because of the problems with the SR, the hospital sent out letters to warn the general practitioners, stating that the new system had trouble in recognizing words, and therefore the journals could contain mistakes.

The hospital doctors were told in the introductory courses that the estimated time for speech training and calibration to the SR was about eight hours. This estimated time shows that the SR technology was dependent on the doctors’ actual training in order to operate as planned. According to the doctors, eight hours of speech would on average mean approximately three weeks of daily use in the clinics. In other words, when the doctors used the SR for three weeks, the SR was still not functioning well.

The adjustment to the new SR technology was more time consuming than planned. Some doctors said that they sometimes needed on average 20 more minutes to record one patient journal by using the SR in the training period compared to the digital dictation method:

The SR is much more time consuming. Today I spent about 20 minutes on a fairly short clinical report, before I’d spent 5min on it. (Doctor 3)

Consequently, doctors had to spend extra hours at work after the ordinary working day was formally finished to cope with the workload generated by the new dictation technology.
The doctors and the managers had different understanding of the motivation behind the new dictation technology. Some of the doctors (three of five) expressed that they were not personally motivated by the demand to increase efficiency, as communicated by the hospital management. They were more upset about the lack of personal motivation to make use of the SR:

The reward for me for using the SR is really very small. The SR program implies that the doctor becomes his own secretary. So, all the tasks we used to give to the secretaries, of which we now more or less even have to do our self. As for the hospital instead of paying a secretary 150 NOK a day, they pay the doctor 550 NOK an hour for the same job. It also reduces the efficiency since we now have to spend longer time on all this. (Doctor 1)

All the doctors we interviewed had in some ways adjusted to and (more or less) used the SR technology for some months after the introductory courses. However, our respondents had not adjusted to the new technology according to the project plans, and they were not satisfied with the SR technology. The main problem was the possibility of fatal mistakes due to defects in the SR system, which was a potential threat to patient safety and quality of the health care provided.

6. Discussion
When discussing the actors’ statements and our observations presented above, we will elaborate on the theoretical concept of sociomateriality, the notion of translation and entanglement. These are the main concepts discussed in the theoretical framework on ANT. These concepts enable us to understand how individual actors relate with new technologies, which are considered as non-human actors. First, we show how human actors (the doctors) translate the actual use of technology (the SR-actor) differently from the designers’ perspectives by using the concept of sociomateriality. We have shown how actors create their local practices with technical devices, which the ANT terminology refers to as entanglement in practice. Our case also illuminates patterns of design and redesign, which evolve over time as interaction among networks of actors (consisting of human and non-human actors). Using the ANT terminology, these changes show how the key actors, the doctors and the technology (SR) and the organizing of work processes are continuously entangled.

6.1 The translation and actual uses of the new technology
The individual adjustments by the doctors to the SR technology, which were different from the management’s expectations, changed the implementation of the initial goals for the SR-project. The doctors’ perceptions of what the SR technology could do and how the technology could be used, were diversely negotiated and translated among the doctors as they interacted in the introductory phases.

During the former system many doctors used to sit in a relaxing position in their chairs (in their office) when dictating as they then could pick up the digital dictation device and record details about the patients. The dictated files were then sent to the secretary, who transcribed and corrected the text. With the SR the doctors had to do the corrections themselves, sitting at the computer desk. This major change of daily practices meant that the doctors became their own secretaries. The individual doctors found different ways to handle the new situations. In principle, the doctors were supposed to correct the text immediately after having recorded it. However, the doctors did not transcribe and correct the documents as expected. They said that they most often would wait some days before they made the corrections, as they found it convenient to put the document away for a while to read it later with “clear eyes.” Consequently, the document could stay for several days at the doctors’ office before being corrected and completed. Doctors also pointed at the fact that
they had to stay longer at the office to finish the document, and these extra hours were not paid duty. The transformation of the technology was inter-twined with the doctors’ social practices, implying that doctors and technology were forming actor-nets of intended and un-intended actions. Orlikowski’s (2000) sociomateriality expresses how doctors’ social actions and their use of technical devices are diverse and interacting over time. Most doctors said that they understood that effectiveness is important to keep in mind. Nevertheless, they did not understand the argument for effectiveness when it came to situations directly related to their individual patients. They noticed that the number of secretaries was reduced, but they did not agree with this process. The doctors felt that the secretaries were still necessary because many of them often or occasionally used the digital dictation method (because of troubles with the SR), and therefore the secretaries’ work was important for the quality of journal dictation. Accordingly, the hospital management’s aim to increase effectiveness, quality and safety was not harmonized with the doctors’ own goals to provide good patient care. Consequently, the doctors’ own interpretations were not included into the new technology. They made their own translations into actions, which were different from the top management.

Following ANT terminology, the spirit (vision) of the SR technology was translated from the Ministry to the top management in the hospital. Then the visions were translated into the clinics. The interaction between the SR and the doctors became a kind of negotiation process between the individual doctors as actors in interaction with the SR, as non-human actor. The intention to increase effectiveness was, however, not the main goal for the individual doctors, as they were much more concerned with the quality of care. Since the SR technology in fact was associated with high potential risk in making mistakes in the transcription of patient journals, the doctors’ interaction with the technological devices became partly built on dis-trust during the introductory phase.

Doctors expressed that they did not take the chance to use the SR in acute situations where the transcription by SR had to be made very quickly. In these situations, the doctors’ habit to keep the journals several days before correcting and finalizing the documents really challenged the SR technology. Especially so as the doctors’ themselves decided on the practical way to translate the new technology into finalized patient journals. The acute situations and the habit to keep the journals for days show how the doctors diversely translated the spirit and the features in the new technology according to their own professional and social practice. Our case illuminates how the human actors (the doctors) are involved in the use of technology and how they translate technology differently from what the top management was aiming at.

6.2 The design and redesign of practices
During the implementation phase, actors began to problematize the motives for introducing the SR technology. Contrary to the Ministry and the top management, the doctors did not consider the reduction of the number of secretaries (effectiveness and safety) as a main driver for using the SR. Consequently, they kept on using the secretaries to transcribe the dictation.

The doctors in our sample stayed with the old digital dictation technology as it was still available to them. The managers’ intention, however, was to keep the old system for those doctors either on short time employment or doctors who due to other reasons (language, age, handicaps and so on) were not able to use the new system. Also, the digital dictation technology had to be operating as a back-up if an emergency or technical problem happened, as the SR technology then would not function properly.

The irreversibility of the SR technology was low and enabled the doctors to use the old technology and thus, enforce earlier practices. Accordingly, the inscriptions in the SR technology from the hospital managers were not strong enough, and the doctors could use...
the SR technology in their individual ways. These diverse individual ways affected the translation of the managers’ intentions, and the use of the new technology differed from the initial plans. Following the ANT approach, we have shown how non-humans—the SR technology—interacted with the humans—the actors using the technology. The SR technology acquires its form and attributes in relations with the actors (mainly doctors). Images of what this device can do, which we call inscription, are translated by the actors in ways we have presented above. According to Orlikowski (2010), we can refer to these processes as entanglement in practices. Our case describes some quite simple processes. In general, these processes of translations and entanglement will be much more complex.

The doctors differed in their interpretations of the technology’s inscriptions, and the doctors’ patterns of use differed a lot from the managers’ intentions. This diversity illuminates the modifiable character of technology after introduction, and diversity may create a distinctive separation between the different practices. When doctors adjust individually to the new technology and define their own practices, the power balance between the doctors and the managers favors the doctors. The doctors experienced the SR to threaten the patients’ safety, and these experiences interrupted the translation process of the SR technology. The managers and doctors related differently to the purpose and functions of the SR, and then the practices also turned out to become distinct and different (Orlikowski, 1992; Wenger, 1998).

The doctors are the primary users of the SR technology, and the SR device had inscriptions to change the work practice for these primary users. As the doctors have professional autonomy to make important decisions about practices, they are in charge of the decisions taken in the places where clinical work is done. Clinicians have traditionally a high degree of freedom in creating their roles in the clinical departments, and thus we may find a variety among doctors in their adaption to managerial reforms (Pettersen and Nyland, 2012, p. 18). Our study shows how the key actors (the Ministry, the top managers) can redesign technology to change the practices of doctors. However, our study also shows how the doctors as strong professionals are actors with the power to redesign the technology into their own inscriptions. Patterns of design and redesign are evolving over time, and the actors; the human and the non-human are organizing work processes in continuously entangled practices.

7. Conclusion and implications
We have discussed how demands for productivity, quality and safety were inscribed into the new technology by key actors like the Ministry, the manufacturer, the managers and translated into diverse practices by the doctors. We defined the introduction of new technology devices as practical elements in a national policy for increasing hospital effectiveness. We show how the new technology is introduced by the Ministry and translated further into the hospital.

Our study contributes to fill a knowledge gap in the literature within the field of public sector management reforms, as this literature has not focused on the connections between technological changes and organizational outcomes (Lluch, 2011; Broadbent and Guthrie, 2007). The ANT-framework allowed us to include the technology concept to get a more detailed understanding of the relations between human and non-human actors (Justesen and Mouritsen, 2011; Barter and Bebbington, 2013). As systems and communication become more technology dependent by digitalization, our theoretical frameworks include these technological innovations as important predictors of changes.

Earlier research on managerial reforms within the hospital sector most often has focused on the organizational and aggregated levels (Pettersen and Nyland, 2012). Our data in this study are based on individual actions and interpretations. This detailed focus enables us to understand more of the network of actions close to the actual changes.
This study also highlights the role of the professionals in translating new technology devices and how they themselves interpret, modify and redesign the inscriptions of the technology. The government by the Ministry of Health had explicitly expressed their intentions as to why the new technology was to change practices. However, the ideas behind the technology were translated by several actors and modified and re-designed by doctors in the work places of the hospital.

The concept of entanglement in practice visualizes that the meaning of what technology can do, is translated and negotiated by actors. The spirit (vision) of the technology (SR) is translated and changed several times during the implementation journey. Our study contributes to the knowledge on how technology is adopted into local practices and how the translation process by powerful actors influences the outcome of the changes.

We have used ANT to approach a deeper understanding of the relation between technology as non-human actor and doctors as human actors in change processes. Technology is in this paper addressed according to the concept of sociomateriality, and we understand technology, people and organizations as entangled/integrated. We have shown that images of what a device can “do” are inscribed into the technical device.

As the doctors were able to use the old technology and enforce earlier practices, the irreversibility of the technology was low. Accordingly, the inscriptions in the technology from the managers were not strong, and the powerful actors could use the new technology in their individual ways. According to Orlikowski (2010), the interpretive flexibility of the SR device was high, motivating design and redesign. These diverse ways affected the translation of the intended uses, which differed from the initial plans.

The findings in this study should remind managers and policy makers that reforms including technological changes may take many forms during translation processes. As digitalization now is having profound effects on organizations, implications of these effects should be studied in detail. Our study includes a small sample of actors within one organization. We may therefore not generalize from our findings, as these can be affected by other factors such as local culture, traditions and contexts. However, our conclusions focus on the more general aspect that technology is not deterministic entities, but is designed and redesigned in relations with human actors. Our findings should motivate further studies on how human actors influence functions and roles of technology. Consequently, studies, which include more actors and longer periods of observations, are needed. Especially, the translation phases from intention to implementation should be studied and focus placed on the human actors that are involved in the technology and the social structures that evolve.

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**Further reading**


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