Using Cognitive Mapping to Represent and Share Users' Interpretations in Technology Adaptation – work in progress

Annemette Kjærgaard and Tina Blegind Jensen, Copenhagen Business School, Denmark

Abstract

An assumption implied by much of the literature in information systems (IS) research is that people's interpretations of technology at an early stage of use influence the way in which the technology gets adapted in the organization. Despite this acknowledgment, little insight is provided of how these interpretations can be elicited and only few studies suggest methods for doing so. In this paper we address this opportunity by (i) introducing cognitive mapping as a method to inquire into people's interpretations during technology adaptation; by (ii) highlighting how cognitive maps can serve as visual means of representation of these interpretations; and by (iii) discussing how the maps can be used to facilitate individual reflection and collective negotiation of technology adaptation. We illustrate the use of the cognitive mapping method by a case example of the introduction of an Electronic Patient Record (EPR) system. Our findings contribute to discuss the value of cognitive mapping as a facilitator of individual reflection and collective negotiation in relation to technology adaptation.

Keywords: Cognitive mapping, user interpretations, technology adaptation, methodology, healthcare

Introduction

In recent years, technology adaptation has continued to grow in importance as a topic of academic interest. A number of studies in Information Systems (IS) research emphasizes users' early interpretations as a way to investigate how well technology gets adapted to work procedures and become part of work routines [Vlaar et al., 2008, Vaast and Walsham, 2005]. Technology adaptation connotes how organization and technology *adapt* to each other in a reciprocal way during implementation and use [Henfridsson, 1999]. This implies a combined technical and organizational change process in order to reach a stage where the technology is more or less taken for granted and embedded in the organization's social practices [Silva and Backhouse, 2003]. Technologies in these studies are seen as emerging artifacts that are shaped by users' "early assumptions, expectations, and knowledge of the technology" [Orlikowski and Gash, 1994, p. 182]. Consequently, technologies become deeply entangled and embedded in organizational practice over

time while at the same time being influenced by organizational use [Orlikowski, 2010, Wagner et al., 2010].

Prior research has addressed users' reactions to new technologies [Davidson, 2006, DeSanctis and Poole, 1994, Orlikowski, 1992, Walsham, 1993, Weick, 1990], suggesting that the operating efficiency of the technologies is heavily dependent upon the users' modifications of the technology itself but also the physical and organizational context in which the technology becomes embedded [Orlikowski and Gash, 1994, Tyre and Orlikowski, 1994]. For example, focus has been on how users' meaning constructions and sensemaking structures [Bansler and Havn, 2006, Henfridsson, 1999, Weick, 1995], technological frames [Davidson, 2006, Lin and Silva, 2005, Orlikowski and Gash, 1994], and social representations and practices [Jasperson et al., 2005, Vaast and Walsham, 2005] influence the adaptation of technology. Common for these studies is the understanding that members' interpretations of technology are of great importance to how it becomes integrated into the organization. Within this stream of research, few researchers would argue that users' interpretations of technology are of limited importance to the adaptation of the technology.

To contribute to the existing knowledge base on how users' interpretations of technology relative to their work practices influence technology adaptation, researchers could benefit from research methods that elicit the interpretations and make them available for reflection and discussion [Orlikowski and Gash, 1994]. As noted by Griffith [1999, p. 473] "organizations that are able to determine which features users mentally bring to the social construction process should ultimately be able to improve technology design, implementation, use, and redesign. Without such knowledge, technology implementation (indeed, any organizational change) proceeds on limited information, and organizations, thus, can less proactively manage the implementation process". Although this statement is based on a somewhat deterministic assumption about the manageability of technology, it emphasizes the importance of the socio-cognitive aspects of technology as also emphasized by for example Orlikowski [2000] and Davidson [2002].

While there is quite extensive research on technology adaptation in the early period of use, little research has been conducted on how users' interpretations of technology and its implications for work practices can indeed be elicited in order to reflect upon problems and opportunities for the technology-in-use. A reason for this may be that organizational members' assumptions and interpretations of the technology are difficult to isolate, illustrate and understand as they manifest themselves in behaviors, rituals and values that are not easily explicated [Bartis and Mitev, 2008].

The objective of this paper is to pursue this methodological challenge by introducing cognitive mapping and illustrate how it can be used to represent and share users' interpretations in the initial period of intense activity which follows right after technology implementation. To do so, we introduce cognitive mapping as a method to *inquire into* how organizational members interpret new technology through visual representations. In addition, we investigate the use of *cognitive maps as representations* to increase users' awareness of their own and others' interpretations of and reactions to technology. Consequently, we set out to investigate how the maps can be used to share users' early interpretations and thereby serve as input for discussions about the adaptation of the technologies in the organizational context. More specifically, the research question we pursue is: *How can cognitive mapping facilitate technology adaptation by enabling representation and sharing of users' interpretations of technology during an early stage of use?*

We pursue this question by introducing the cognitive mapping (CM) method to show its potential in eliciting users' interpretations of technology. CM is a qualitative research method that is used to structure, analyze, and represent an individual's or a group's accounts of a specific situation or issue [Eden, 2004, Hodgkinson, 2004]. We argue that the use of CM can create a "window of opportunity" [Tyre and Orlikowski, 1994] for individual as well as collective reflection upon technology-in-use. To illustrate the use of the method in practice, we present a case example of healthcare professionals' adaptation of an Electronic Patient Record (EPR) system.

The contribution of the study is primarily methodological, and we suggest that CM is useful as *a method of inquiry* into users' interpretations of technology as well as a *method of representing and sharing* users' interpretations of technology. In this respect, the method provides important input to the adaptation process by enhancing individual reflection as well as collective discussion and negotiation of the technology in use.

In the next section, we introduce the theoretical background regarding the influence of users' early interpretations on technology and the method of CM. We then illustrate its use by a case example of the introduction of an EPR system. Based on the findings we discuss the value of CM to facilitate individual reflection and collective negotiation. We conclude the paper by emphasizing the epistemological, theoretical, and practical implications of its use.

Eliciting Users' Interpretations by Using Cognitive Mapping

Users' Interpretations of Technology

In the last decade a substantial stream of IS literature has focused on the role of users' interpretations of technology in relation to its implementation and use. This focus on interpretations

can be seen as a response to earlier criticism that much of the IS literature treats technology as separable from the social and organizational contexts in which it is instantiated, appropriated, and enacted. The tendency to focus less on technology development and more on the social context in which technologies are designed and used is also supported by a study of the core research areas of the IS discipline by Sidorova et al. [2008] which shows a decline in the number of articles about more technology-focused issues over a two decade period from 1985-2006.

Although studies of technology as inseparable from its social and organizational context provide different explanations of this relationship, they in general support the view that the meaning of the technology does not reside in the artifact itself but in the way it is interpreted by the relevant social groups that are going to use it [Barley, 1986, Leonardi, 2009, Pinch and Bijker, 1984].

Interpretations have been studied in relation to users' resistance of having to spend time and energy on learning new work practices or systems [Chu and Robey, 2008] or of users' resistance to the consequences of implementing technology for power balances and employment opportunities [Kim and Kankanhalli, 2009, Lapointe and Rivard, 2005].

The many studies on the implications of users' interpretations of technology show that interpretations are indeed considered an important influence on technology implementation and use; however, the existing literature does not provide much guidance on how researchers and practitioners can address users' interpretations.

In this paper our contention is that interpretations are continuously reconstructed and change in the course of time in relation to the users' conversations and use of the technology. As a consequence, we suggest that it is important for technology adaptation that interpretations are made explicit and can be discussed and shared among other stakeholders that influence the technology in use, and we argue for the need to establish methods for doing so. As a well-established method within other research fields, CM has the potential of providing a tool to make interpretations explicit and thereby facilitate technology adaptation. In the next section we introduce the method.

Cognitive Mapping

CM is a qualitative research approach for collecting and generating data of how an individual [Jenkins, 1998] or a group make sense of a situation [Ackermann and Eden, 2007]. It builds on the recognition that organizational members edit their experience into patterns of personal knowledge and the map serves as a representation of this knowledge [Weick and Bougon, 2001]. These representations are also known as mental maps, mind maps, cognitive models, or mental models [Walsh, 1995].

The process of CM does not refer to one specific approach but is a term used to address several ways of mapping cognition [Eden and Spender, 1998, Narayanan, 2005]. Some mapping techniques claim themselves to be largely content and theory free, while others are based on specific social or cognitive theories [Laukkanen, 1998]. Cognitive maps can be drawn on either an individual [Eden, 1988, Eden, 1992, Weick and Quinn, 1999] or a collective level [e.g. Langfield-Smith, 1992, Sheetz et al., 1994] and they can comprise many types of relationships among concepts, for example proximity, similarity, cause-effect, category, and contingency [Swan, 1997].

As a method for facilitating users' representation and sharing of their interpretations of technology, more recent use of CM differs from the original idea of Tolman [1948] who proposed the creation of cognitive maps as 'true' representations of cognition [Eden, 1992, Siau and Tan, 2005]. Where Tolman [1948] focused on the content of the maps, more recent CM approaches place emphasis on articulation and focus on the *process* of mapping as opposed to the *content* of cognitive maps [e.g. Swan, 1997]. In this sense, cognitive maps are representations rather than 'true' imprints of cognition and their purpose is to "represent subjective data more meaningfully than other models and so have utility for researchers interested in subjective knowledge" [Eden, 1992]. This is linked to the epistemological assumptions on which the use of CM is based.

Like other qualitative research methods as for example interviewing, the use of CM varies according to the underlying epistemological assumptions that guide it. Within the IS research field, we find a number of studies that build on a neopositivist perspective where CM primarily is used for conceptual modeling [Siau and Tan, 2005] and for requirement specification and analysis [Montazemi and Conrath, 1986, Zmud et al., 1993]. Other studies have an interpretive or symbolic-interactionist approach [Hatch and Cunliffe, 2006]. In these studies, the mapping process is seen as an occasion for the user to make sense of the technology in use and express his/her interpretations. Within this perspective CM is used to elicit technological frames [McKay and Marshall, 2005, Orlikowski and Gash, 1992] and to offer insights into the socio-technical problems experienced when various stakeholders or groups of stakeholders have to negotiate perceptions of a system or technological innovations [Swan and Newell, 1994].

Our use of CM in the illustrative case example draws predominantly from interpretive epistemological assumptions. However, in the discussion we will also draw from a localist perspective [Alvesson, 2003, Schultze and Avital, 2011] to critically reflect upon the use of the method and discuss its value and limitations. We question the fact that a map exists in the mind of the participant prior to the process of mapping. In other words, users' interpretations and use of technology are continually constructed and cannot be captured in one 'true' map [Narayanan,

2005]. The set of interpretations, which the map represents, is neither a precise reflection of what was in the mind of the person prior to the interview nor a new static construct. Instead, we see the map as created in the process of articulating meaning, as eloquently expressed by Weick [1995, p. 12] in the question: "How can I know what I think till I see what I say?" In this respect, CM as a *method of inquiry* acts as a tool for eliciting statements from the users in order to obtain subjectively meaningful concepts and relations regarding the technology adaptation process and to get a more in-depth understanding of their interpretations of the technology features. This is useful on an individual level, i.e. for each user to explicate and become aware of his or her perceptions and interpretations, but also on a collective level, i.e. where cognitive maps as *representations* can facilitate the representation and sharing of users' experiences with and reactions to the technology.

In the case example below, we illustrate the use of the CM approach for exactly these purposes.

Eliciting User Interpretations – a Case Example

Background Information of the Case Study

To illustrate the potential of CM in representing and sharing users' interpretations of technology, we report from an empirical study of the adaptation of an Electronic Patient Record (EPR) system in a hospital. Our case example centers on a clinical ward specializing in foot surgery and shoulder, knee, arm, wrist and hip alloplastics. It includes a standard ward, an outpatient clinic, a sports clinic, and a secretary office. At the time of our study, it employed ten consultant surgeons, one managing surgeon and 40 nurses with an average of 3,000 emergency and planned admissions a year.

In 2004, an EPR implementation was initiated in the ward as a pilot project. The use of the EPR system was mandatory and the system was introduced to provide a shared and interdisciplinary access to patient records, enabling healthcare professionals to access patient data and enter new data into the system from different sites. The EPR system comprised a wide range of clinical information such as nursing, progress, and physiotherapist notes, diagnoses, medicine schemes, historical data, information on patients' temperature and blood pressure, X-rays, and laboratory data.

The clinical ward is an ideal setting to study the use of CM as the doctors healthcare professionals were highly motivated to talk about their views, reactions, and immediate assumptions about the EPR system. Below we illustrate the use of CM in three steps: (i) First we introduce how the mapping technique was used to inquire into the doctors' interpretations of the EPR system; (ii) Second we highlight how cognitive maps served as visual means of representation of interpretations; and (iii) Third we discuss how the maps were used to facilitate individual reflection as well as collective negotiation.

(i) The Mapping Technique to Inquire into the Doctors' Interpretations

Preparation for the Cognitive Mapping Session

We entered the clinical ward four months after the initial implementation of the EPR system and when the doctors had already become relatively familiar with it. In order to gain contextual knowledge about the setting, we first conducted observation studies. We observed five shifts where doctors and nurses showed us how they used the EPR for preparation of ward rounds, medicine prescriptions, accessing and registering patient notes, medicine administration, etc. Based on this knowledge, we initiated the mapping technique through semi-structured interviews with 10 doctors.

Before the interview session, we prepared 21 inspiration cards as the focal point for creating the cognitive maps. Each inspiration card represented an activity or aspect of the EPR implementation, e.g. 'user training', 'support', 'selection of EPR', 'workflow analysis', 'information activities', etc.. The cards were prepared on the basis of the observation studies at the ward, an extensive literature study on EPR implementations, and various documents. In addition to initiating the interview, the cards helped doctors tell stories and talk about their daily work practices involving the new system.

Using the Laddering Technique to Elicit Interpretations

We initiated the interview by asking the doctor to prioritize the 21 cards according to importance. For every card chosen a so-called laddering technique [Bourne and Jenkins, 2005] was used to elicit the higher or lower level abstractions of the constructs or concepts mentioned by the doctors. The technique was performed by probing, which means to "peel back the layers" of the informant's experience [Woodruff and Gardial, 1996, p. 186]. We asked the doctor: "*What* do you understand by…?" or "*What* is implied by…?" for each construct he or she chose. For example, if the doctor considered 'EPR user training' to be a central aspect, he or she was asked "*what is implied by [EPR user training]?*" For each statement, we then continued by asking: "*Why* is this [aspect] important to you?", which allowed the doctor to reflect on each aspect and relate it to the work practices as well as mention other issues that came to mind. To decide when we had reached an appropriate level of abstraction and 'peeled back' enough layers, we used the criterion of reaching a point of saturation [Walsham, 1995]. This was achieved when the doctor either repeated him- or herself or when no further information was added to the *why* questions.

Constructing the Maps

Two interviewers were present during each interview: one conducted the interview while the other drew the map. Both interviewers were thus actively involved in constructing the cognitive maps during the interviews. For each interview passage, we aggregated the statements into constructs.

Figure 1 shows excerpts of the cognitive map based on constructs mentioned by two doctors during an interview. The concepts used in the map are based on the doctors' own expressions:

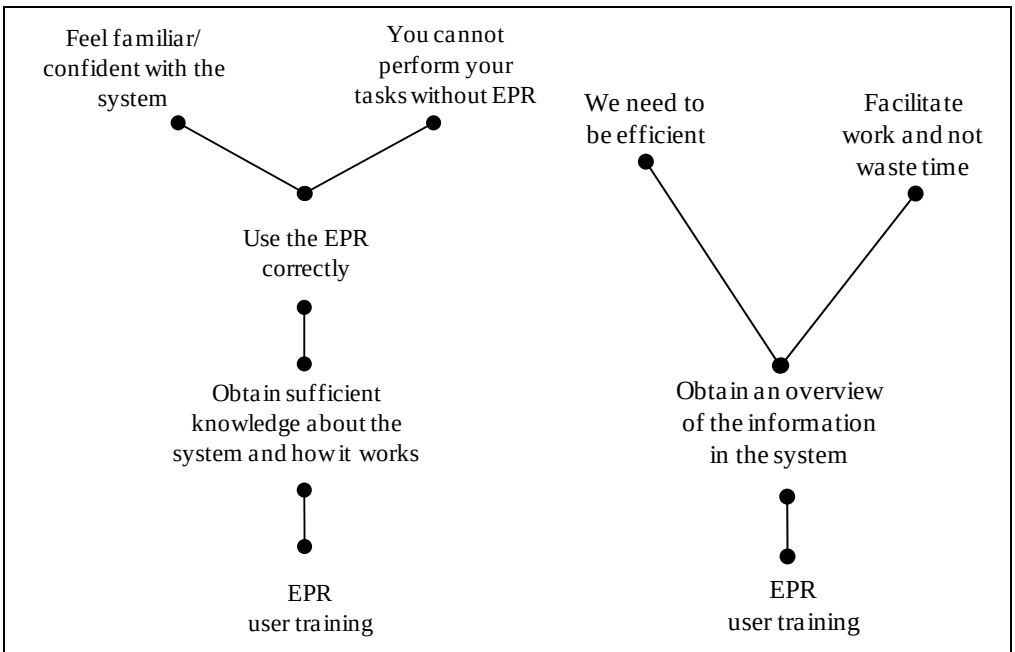

Figure 1. Creation of Ladders from Interview Transcripts

Each map was continuously extended to comprise new statements and new ladders, resulting in an individual map for each doctor as illustrated in figure 2:

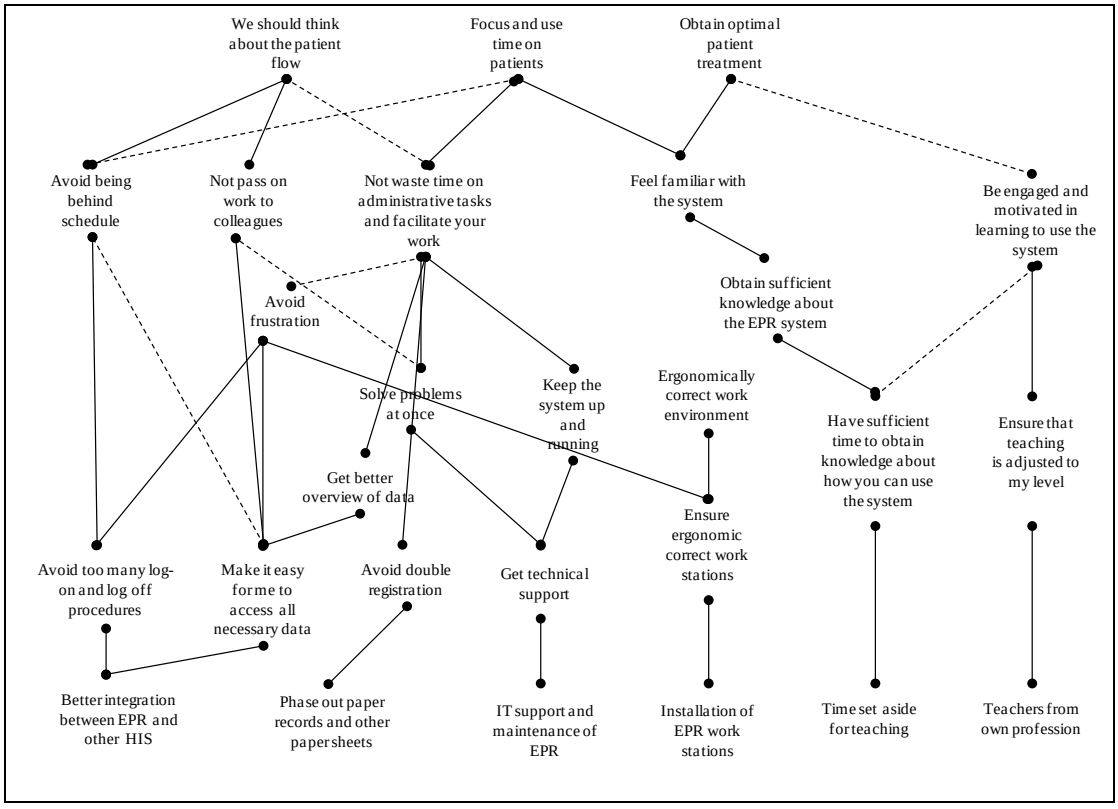

Figure 2. Individual Map for One of the Doctors

We will not describe the content in the individual map but rather highlight the dotted lines to indicate relations that were mentioned by the doctor and that were added to the map when he or she commented on the map *after* the interview.

(II) How Cognitive Maps Served as Visual Means to Represent Doctors' Interpretations

Initial Coding of Data and Building of Aggregated Maps

Although we drew a first version of the map during the interview session, we coded the interview transcripts more carefully after each interview. Inspired by grounded theory techniques [Strauss and Corbin, 1998], we categorized the different statements and observations into concepts, looking for relations between them. It was important that the categories were close to the expressions used by the doctors for them to recognize their own statements in the ensuing process. We compared the data with the emerging categories in a cyclical process inspired by Miles and Huberman [1994]. In order to ease the construction of the maps, we entered the categories and relations into a software program to automatically construct the maps. The maps, sketched by one of the interviewers during the interviews, were subsequently compared to the maps from the interview transcripts.

As a next step, aggregated maps were constructed across individual statements for different topics. One of these maps on 'Support' is illustrated in figure 3:

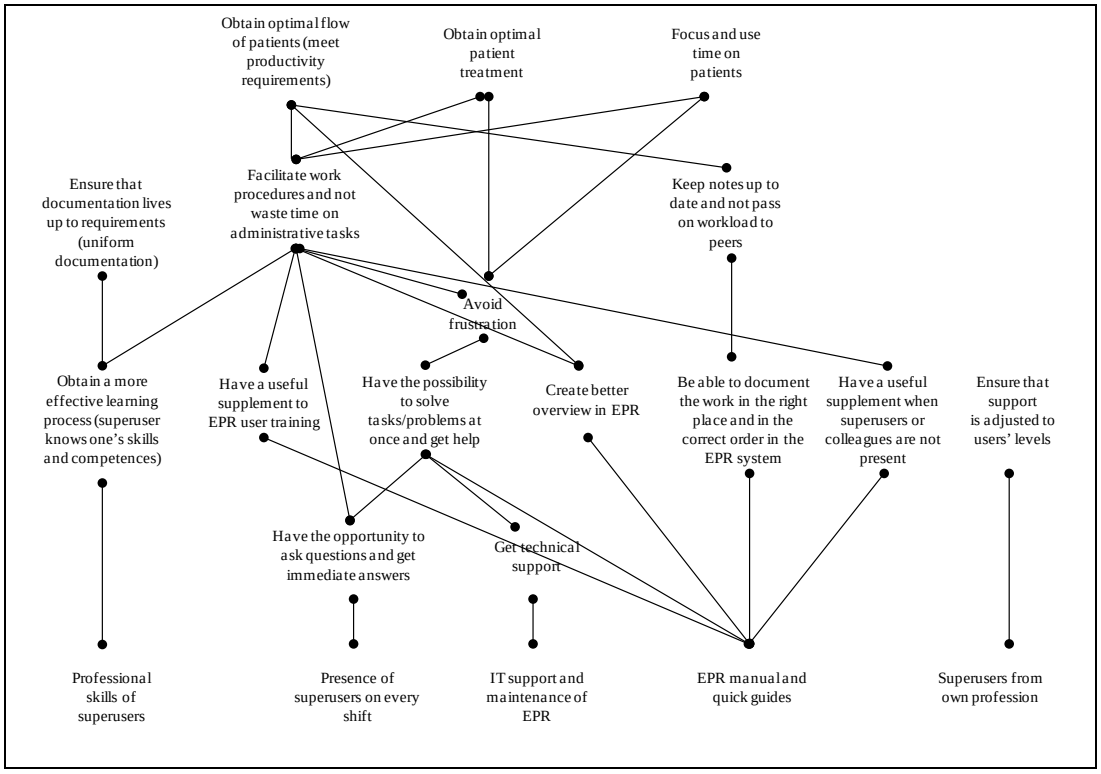

Figure 3. Aggregated Map on 'Support'

All the doctors (except one) talked about 'support' as an important aspect in the EPR implementation as a way to become familiar and confident with the system. At the bottom of figure 3, we see how 'support' is understood as comprising 'professional skills of super users', 'presence of super users on every shift', 'IT support and maintenance of the EPR system', 'the existence of EPR manuals and quick guides', and having 'super users from own profession'.

The topic maps were constructed in order to look at the data from different angles and to make sure that all the elements mentioned by the doctors were included in the maps. The topic maps were intermediary steps in the analysis process and were not used actively in the ensuing construction process. Rather we merged the individual maps into one single group map that included the entire pool of statements.

Constructing the Group Map

As illustrated in figure 4, the group map is very rich on concepts and relations and the purpose here is not to present and discuss it in detail. Instead, we have highlighted (with circles) some of the concepts that the doctors mentioned as important to show how the map can be analyzed. For example, the doctors believed that the 'selection of the EPR system' was an important activity in the implementation process. They believed that 'having professionals participating in the selection and development processes' and 'having the possibility to improve/upgrade the EPR system continuously' were key aspects because they 'wanted to ensure that the EPR system was adjusted to and supported their clinical practices'. Furthermore, it was important for the doctors to feel 'involved in the decision making' and they argued that if 'the EPR was adjusted to and supported their clinical work practices', they would 'avoid frustration' and be 'able to focus and spend time on patients'.

We have added number codes to the constructs that are shown on the higher levels in the map, e.g. 'focus and use time on patients', obtain optimal flow of patients', 'obtain optimal patient treatment', and 'ensure that practice lives up to high quality and security standards'. The codes indicate how many doctors actually mentioned these constructs as important for their professional identity and norms. This information was used for further discussion in the focus group interview.

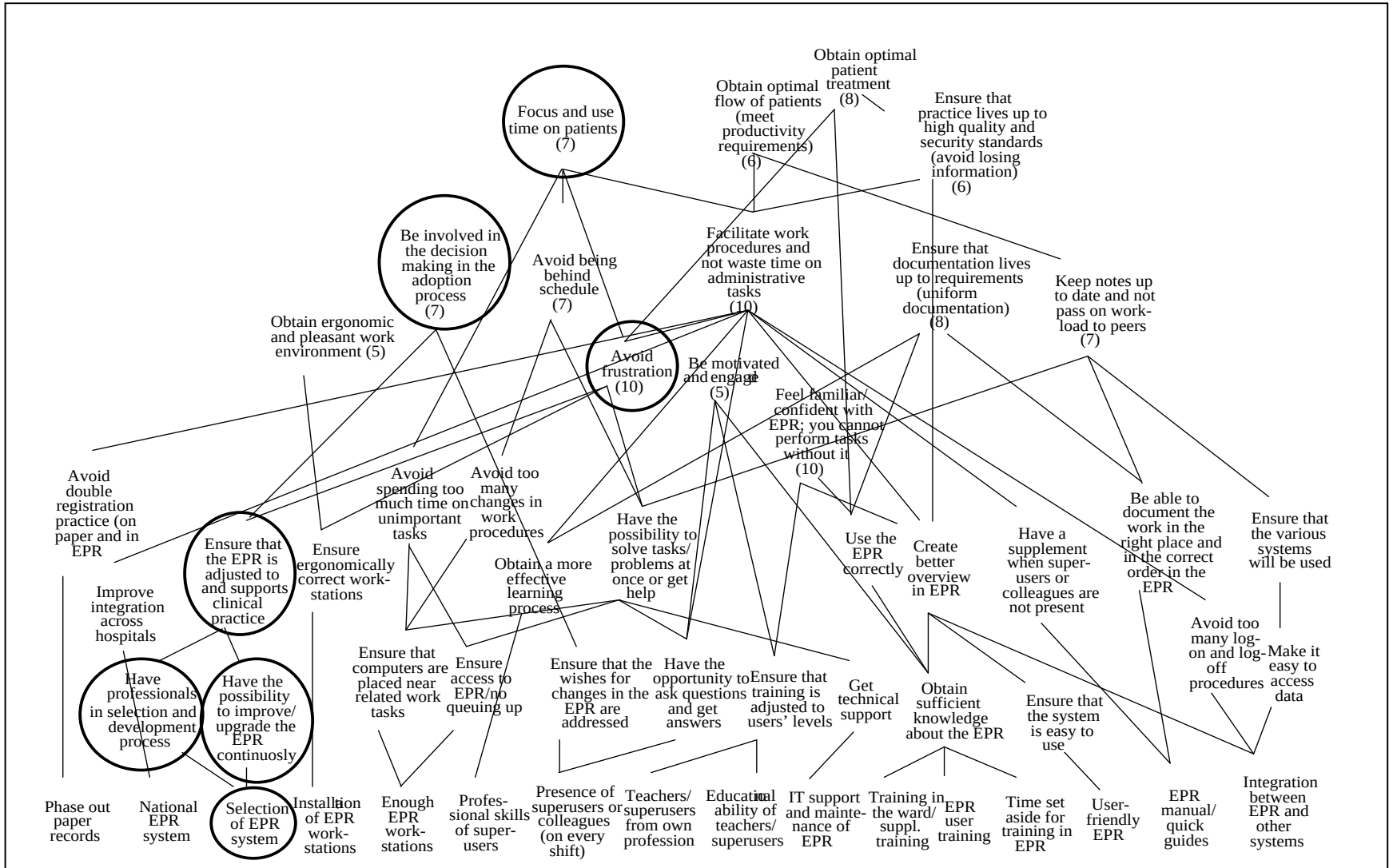

Figure 4. Group Map of the Doctors' Interpretations Relative to the EPR Implementation

(III) Cognitive Maps to Facilitate Individual Reflection and Collective Negotiation

A group session was conducted where four doctors and two researchers discussed the group map and its concepts in an open dialogue. The group session served three overall purposes: first, it was considered an important step in asking the doctors to verify the group maps created by the researcher based on the individual interviews. Second, the session was an occasion to ask the doctors to elaborate on aspects in the map that were not self-explanatory and self-evident. Third, the group session was used to observe the nature and extent of congruence and incongruence among the doctors, thereby observing the negotiation process among them. The doctors participated eagerly in the group discussion and contributed with both positive and negative statements of the EPR system.

The findings from the focus group interview indicate the usefulness of the map to establish dialogue and creating a common understanding of the constructs in the map as part of an analytical process. For example, an explanation of the aspect 'avoid frustration' was obtained by asking questions such as "what do you mean by frustration?", "how is frustration reflected in practice?", "why is it important to avoid frustration?" and "what consequences does this frustration entail?" This led to a prolonged discussion among the participants as they were now able to talk about this aspect and give different examples of what frustration actually meant for their initial work experience with the EPR system. One doctor mentioned how the system at times seemed to hinder, delay, and complicate their work, while another doctor argued that it was important for future adopters of the system to be aware that introducing a new technology is confusing and time-consuming before you get used to the new system and work procedures. Based on the map it was possible for the doctors to address the 'frustration' topic and give voice to an aspect that was otherwise not openly discussed. In this way, the map (i.e., the representation) facilitated a reflection of what 'frustration' meant for the individual doctor while at the same time engaging the doctors in a collective negotiation of this particular issue.

Some of the aspects in the map were quite isolated and the doctors were asked to elaborate on these matters. For example, the statement 'be able to document the work in the right place and in the correct order in the EPR system' was not related to any other aspects at a higher level in the map. We therefore asked the doctors about the implications of this statement and they elaborated that they were able to ensure that 'the documentation would live up to the requirements (unified documentation)'. They also mentioned that 'being able to document the work in the right place in the system' meant that they were able to 'keep their notes up to date and not pass on their workload to peers' (another aspect added to the map). We also asked the doctors whether important

information was not included in the map or whether they disagreed with some of the constructs. A few of the participants had something to add to the map but none of the constructs were removed.

As such, the group discussion of the maps was an occasion for the doctors to collectively negotiate the meaning and usefulness of the EPR system and to reflect upon the perceptions of others. One doctor stated: "I recognize many of my statements in the map and I also recognize what some of my colleagues might have said. We do seem to agree on many of these things". Often the doctors used 'we' instead of 'I' when they commented on the aspects in the map and in their discussion of the content of the map, reflecting a high degree of agreement. In this way, the cognitive maps worked as artifacts to increase the doctors' awareness of each other's interpretations and reactions to the EPR system which facilitated a collective negotiation of the system's meaning. They also facilitated that the chief physician got an impression of the participants' perceptions and was able to address some of the issues from a managerial point-of-view during the meeting, and later present some of the issues to top management. For example, issues on the need for more user training and hands-on support in the clinical ward were relatively easy to implement but required resource allocation from top management. The maps also helped to put a discussion of how to improve integration between the EPR system and other systems in the hospital on the managerial agenda. In this case study the chief physician argued that a similar process could also be useful as a learning process for vendors and other stakeholders. We will discuss this in further detail below.

Discussion and Implications

The case example illustrates how CM can be used to inquire into users' interpretations of technology adaptation. It also illustrates how the resulting maps serve as representations to share the interpretations among users, thereby enabling individual reflection as well as collective discussion.

Based on the findings from this study, we next discuss the relevance of CM for IS research in terms of technology adaptation. This leads to a discussion of the epistemological and methodological issues that emerged during the use of CM and which are important to consider when engaging in CM activities; i.e. the nature of cognitive maps and the choice of mapping technique. We conclude the discussion by suggesting practical implications along with avenues for future use of the method.

The Value of Cognitive Mapping in IS Research

As a method of inquiry, CM has the potential of engaging users in constructing a map of their interpretations of the technology-in-use. The mapping process provides a "window of opportunity" for the user to articulate his or her perceptions and experiences with the use of the technology [Tyre and Orlikowski, 1994], which are often implicit and part of what is taken for granted in everyday

life. In this way, our study supports the existing stream of research that emphasizes the importance of users' interpretations of technology, individual reflection and group conversations on the adaptation of technology to work practices.

Our study extends the current knowledge base by providing an example of "how to go about" studying user interpretations relative to technology implementation and technology-in-use. As a tool for representing interpretations, CM provides the maps as artifacts that can be used to present problems or inconsistencies in users' expectations and experiences of technology and to document reactions or perceptions of technology. This is important in the sense that users' interpretations of technology are critical if we want to understand their interactions which is also pointed out by e.g. Orlikowski and Gash [1994]. The process of inquiring into and also of representing users' interpretations help create a dialogue among users and managers about congruent and incongruent interpretations that may have an impact on technology acceptance and use in practice. These interpretations may change over time, which has been supported by a number of more recent studies [see e.g. Agarwal et al., 2010, Davidson, 2006] and accordingly we suggest using CM as a technique to capture changes in interpretations over time.

The cognitive map can serve as a representation of individual reflection providing each user with a sense of his or her interpretations. In this way, the map helps each user to highlight his or her perceptions of the technology. The value of expressing interpretations of technology is apparent in studies of post-adoption processes where changes to systems need to be implemented in order to make a better fit between the technology and the work processes in which it is used and where people struggle to create meaning [Vaast and Walsham, 2005]. As we illustrated in the case study, the map can also be used to share interpretations among a group of users or among various groups as for example different specialist groups as is the case in studies of EPR systems [Ellingsen and Monteiro, 2003, Oborn et al., Forthcoming], among developers, vendors and users [Gal et al., 2008, Levina and Vaast, 2008, Svejvig and Jensen, 2010] or management and users [Davis and Hufnagel, 2007, Lin and Silva, 2005]. As input for discussion, maps can form a valuable contribution for groups of users to get inspiration from each other and to address resistance to using the technology in a particular practice [Jian, 2007, Lapointe and Rivard, 2005].

In the case example, the group map was used as a starting point for a collective process of discussing and negotiating the articulated beliefs and practices. The doctors used the group map to reflect upon and negotiate statements from others and to give new meaning to the use of the EPR system in their everyday work practice. Although we encountered only little disagreement between doctors, the method could also be used to show conflicting interpretations which might not be easily

resolved in the process itself but would need to be discussed further and could lead to technological or strategic changes. We next discuss the construction and the nature of the maps.

Constructing Cognitive Maps

An important point for discussion relates to considerations about the construction of the maps which took place in the interaction between the interviewing researcher and the participants. In the case example, the maps represented a socially constructed view of how the doctors experienced the EPR implementation, showing concepts and relations that were subjectively meaningful for the participants. The participants created a representation of their subjective beliefs, explained to the interviewing researcher, while triggered and framed by the questions posed by the researcher. The resulting maps were bound by the method used for data collection, as also suggested by Goldberg [1994]. Consequently, the mapping process is a subjective representation of the meaning creation process taking place in the interaction between the participants and the researcher and one may ask how the maps can actually be trusted to capture the issues that are salient to the participants? And can we be sure that (more) important issues are not left out [Jenkins, 1998]? The short answer to this is that we cannot capture a complete and true representation of the participants' beliefs. Rather, we claim credibility of the use of CM [Lincoln and Guba, 1985] based on the process of systematically pursuing issues suggested by the participants in order for them to exhaust the topic, as it is done using the laddering technique and through collective discussions in groups.

The role of the researcher in the construction of data is a common topic for discussion in qualitative research. We argue that trustworthiness can be achieved in CM by being as open as possible about what methods have been used and how they have been applied. In the case example, we predominantly draw from an interpretive epistemological stance by aiming at providing transparency of how the cognitive maps were created and analyzed. However we also pursue a localist or constructivist perspective by emphasizing that meaning is constructed in a very local and situated context and that the maps are embedded and cannot be separated from local practice

We thereby suggest that learning can be achieved from CM by focusing on the process of constructing the maps and by observing the reactions of people to the contents of the maps. If we accept that the maps represent subjective beliefs of the participants and are created in the interaction between the researcher and the participants, we place emphasis on the process of articulating the participants' beliefs, i.e. on the mapping process. As mentioned by Swan [1997], the map is shaped in the creation process because the interaction between the researcher and the participants involves articulation which changes the understandings. In the case example, meaning construction took

place in the interaction between the doctors and the researcher and among doctors, i.e. the concepts and the relations between concepts in the map were created in interaction between the participants in the local setting. This links to a discussion about the choice of mapping technique.

Collective Approach to Creating Maps

When using CM, we became aware of the difference between using an aggregated and a collective technique for constructing group maps. One way of creating group maps is to use one-to-one interviews and subsequently aggregate the results into a group map [Eden and Ackermann, 1998], as was the case in this study. Another way is to create the map directly during a group discussion meeting where participants work towards a common understanding, using a group decision support system, resulting in a shared cognitive map [Ackermann and Eden, 2007]. Although the results of both methods are group maps, the maps will be quite different. Whereas the aggregated map has a large degree of researcher influence, since the researcher puts together the individual statements into one map, the collective method is less influenced by the researcher. In addition, the reciprocal influence of the participants will be more pronounced when using the collective model compared to the aggregated model where participants are interviewed individually.

In the case example, the aggregated approach based on individual interviews with doctors was used in order to show a variety of meanings and to compare and contrast these. This would not have been possible had the collective method been applied. Although our approach of first constructing ladders and then combining them into one map does not result in findings about the construction of maps in collaboration, as other researchers have reported [Ackermann and Eden, 2007, Sheetz et al., 1994], it showed to be valuable for enabling the doctors to negotiate the meaning of the EPR system.

The choice of mapping technique is closely related to the intended use of CM. Whereas an aggregated approach provides a comprehensive representation of individuals' meaning constructions and serves the purpose of giving an overview of diversity in meanings, the collective approach provides a negotiated understanding which can be useful as part of a process with the goal of reaching a shared understanding. Related to the choice is also the question of whether cognition belongs to the individual or whether it can be attributed to groups or organizations [Eden and Ackermann, 1998]. Regardless of whether one believes that the collective is a subset of individual knowledge or vice versa, it is generally acknowledged that groups and organizations cannot be attributed the ability to think or believe but that the elicitation of thoughts and beliefs can happen in a collective process in which individuals' contributions influence each other reciprocally, leading to a different result than if elicited individually.

Conclusion and Suggestions for Future Research

In conclusion we find CM specifically relevant to use in processes where collective negotiation of new technology is in focus and where the goal is to construct a shared understanding of its use among a group of people. However, realizing that technology is not a stable but a dynamic construct which continuously changes with use, we suggest that future research based on CM is conducted as process studies. As our case example illustrates, the map as the immediate result of the CM process will always be a static snapshot representing the participants' meaning constructions at a given point in time. A static snapshot at a single and fixed time point may allow analysis of a topic matter in detail; however, as technology adaptation is an ongoing process, it should be studied as such. We therefore acknowledge that a limitation of the case example presented in this paper is that we only worked with the construction of one group map and therefore did not have the opportunity to see changes in time as would have been the case if we had constructed maps at a later point in time. The use of CM may be even stronger when used to study changes in-between two maps and we suggest that future research take into consideration that the mapping technique can be used to emphasize changes in meaning constructions over time where new processes of negotiations regarding the technology may appear.

The study also has significance for practice, offering implications for IS managers engaged in processes of IS implementation and use. Research on IS implementation has encouraged practitioners and researchers alike to consider the interaction between users' interpretations of technology and behavior. IS managers can use CM to assist user groups in eliciting these interpretations in a collective process of constructing meaning and making it explicit. In this process, the maps help elicit feedback from others and create common grounds for discussion of the technology and its use in practice [Carlile, 2004]. The maps are strong tools for making differences in various professional groups' perceptions of IS explicit. This may help facilitate discussion among the groups involved. For example in studies of intergroup relations and use of technology in healthcare, it would be relevant for different healthcare groups to study each other's cognitive maps in order to discuss discrepancies and potentially spur a new process of constructing a shared map. The cognitive maps may help the different professional groups to develop joint understandings as the maps enable them to focus their attention and provoke them to reflect [Vlaar et al., 2008, p. 247].

Cognitive maps are evocative as they provide the possibility to represent users' thoughts, ideas, and critical comments about a technology and other related aspects. By engaging in the CM process and by studying the maps, managers can make more sophisticated decisions on organizational

adaptations and changes. They can use the maps to discuss future opportunities of IS or how IS can support work practices. Our study supports the insight from Weick and Bougon [2001] that cognitive maps can make an equivocal situation around IS implementation more sensible. In this sense, a cognitive map "… contains the structure, the process, and the raw materials from which agreements and conflicts are built when people coordinate action" [Weick and Bougon, 2001, p. 328]. In this study we did not use the maps to discuss ordered relationships among the doctors or between doctors and other healthcare professionals but this could be integrated in further empirical investigations.

Although the use of CM can be perceived as rather time-consuming and demanding, our experience was that it took some practice to learn to construct the maps but this time was well invested. The mapping technique proved to provide much more detail in a more structured process than other dominant qualitative methods like observations and interviews which are also time consuming and do not always lead to results so effectively as what we experienced in using CM. While we argue that CM is a valuable method for eliciting users' interpretations of technology, we also stress that continuous refinement and fine-tuning of the use of the approach is necessary to explore its most relevant use in future research.

References

Ackermann, F. and C. Eden. (2007) Negotiation in Strategy Making Teams: Group Support Systems and the Process of Cognitive Change. *Academy of Management, Philidelphia, PA, USA, 2007*.

Ackermann, F., C. Eden, and S. Cropper (1992) Getting Started with Cognitive Mapping, in *7th Young OR Conference*, pp. 65-82. University of Warwick.

Agarwal, R., C. M. Angst, C. M. DesRoches, and M. A. Fischer (2010) "Technological Viewpoints (Frames) about Electronic Prescribing in Physician Practices," *JAIMA* (17pp. 425-431.

Alvesson, M. (2003) "Beyond Neopositivists, Romantics, and Localists: A Reflexive Approach to Interviews in Organizational Research," *Academy of Management Review* (28) 1, pp. 13-33.

Bansler, J. P. and E. Havn (2006) "Sensemaking in Technology-Use Mediation: Adapting Groupware Technology in Organizations," *Computer Supported Cooperative Work* (15pp. 55-91.

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

Bartis, E. and N. Mitev (2008) "A Multiple Narrative Approach to Information Systems Failure: a Successful System that Failed," *European Journal of Information Systems* (17pp. 112–12.

Bourne, H. and M. Jenkins (2005) "Eliciting Managers' Personal Values: An Adaptation of the Laddering Interview Method," *Organizational Research Methods* (8) 4, pp. 410-429.

Carlile, P. R. (2004) "Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries," *Organization Science* (15) 5, pp. 555–568.

Chu, T.-H. and D. Robey (2008) "Explaining Changes in Learning and Work Practice Following the Adoption of Online Learning: A Human Agency Perspective," *European Journal of Information Systems* (17pp. 79-98.

Davidson, E. (2002) "Technology Frames and Framing: A Socio-Cognitive Investigation of Requirements Determination," *MIS Quarterly* (26) 4, pp. 329-358.

Davidson, E. (2006) "A Technological Frames Perspective on Information Technology and Organizational Change," *Journal of Applied Behavioral Science* (42) 1, pp. 23-39.

Davis, C. J. and E. M. Hufnagel (2007) "Through the Eyes of Experts: A Sociocognitive Perspective on the Automation of Fingerprint Work," *Management of Information Systems Quarterly* (31) 4, pp. 681-703.

DeSanctis, G. and M. S. Poole (1994) "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," *Organization Science* (5) 2, pp. 121-147.

Eden, C. (1988) "Cognitive Mapping," *European Journal of Operational Research* (36) 1, pp. 1-13.
Eden, C. (1992) "On the Nature of Cognitive Maps," *Journal of Management Studies* (29) 3, pp. 261-265.
Eden, C. (2004) "Analyzing Cognitive Maps to Help Structure Issues or Problems," *European Journal of Operational Research* (159) 3, pp. 673-686.
Eden, C. and F. Ackermann (1998) Analysing and Comparing Idiographic Causal Maps, in C. Eden and J.-C. Spender (Eds.) *Managerial and Organizational Cognition: Theory, Methods and Research*, London: Sage, pp. 192-209.
Eden, C. and J.-C. Spender (eds.) (1998) *Managerial and Organizational Cognition: Theory, Methods and Research*, London: Sage.
Ellingsen, G. and E. Monteiro (2003) "Big is Beautiful: Electronic Patient Records in Norway 1980-2000," *Methods of Information in Medicine* (42) 4, pp. 366-370.
Gal, U., K. Lyytinen, and Y. Yoo (2008) "The Dynamics of IT Boundary Objects, Information Infrastructures, and Organisational Identities: the Introduction of 3D Modelling Technologies into the Architecture, Eengineering, and Construction Industry," *European Journal of Information Systems* (17pp. 290-304.
Goldberg, J. (1994) Cause Mapping: An Outsider's View, in *EIASM 2nd Workshop on Managerial and Organisational Cognition* Brussels.
Griffith, T. L. (1999) "Technology Features as Triggers for Sensemaking," *Academy of Management Review* (24) 3, pp. 472-488.
Hatch, M. J. and A. L. Cunliffe (2006) *Organization Theory: Modern, Symbolic, and Postmodern Perspectives*, 2. ed. edition. Oxford: Oxford University Press.
Henfridsson, O. (1999) IT-Adaptation as Sensemaking: Inventing New Meaning for Technology in Organizations. PhD Thesis, Umeå University.
Hodgkinson, G. P. (2004) "Causal Cognitive Mapping in the Organizational Strategy Field: A Comparison of Alternative Elicitation Procedures," *Organizational Research Methods* (7) 1, pp. 3-26.
Jasperson, J., P. E. Carter, and R. W. Zmud (2005) "A Comprehensive Conceptualization of Post-Adoptive Behaviors Associated with Information Technology Enabled Work Systems," *Management of Information Systems Quarterly* (29) 3, pp. 525-557.
Jenkins, M. (1998) The Theory and Practice of Comparing Causal Maps, in C. Eden and J.-C. Spender (Eds.) *Managerial and Organizational Cognition: Theory, Methods and Research*, London, UK: Sage, pp. 231-249.
Jian, G. (2007) ""Omage is a Four-letter Word": Toward a Tension-Centered Model of Resistance to Information and Communication Technologies," *Communication Monographs* (74) 4, pp. 517-540.
Kim, H.-W. and A. Kankanhalli (2009) "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *Management of Information Systems Quarterly* (33) 3, pp. 567-582.
Langfield-Smith, K. (1992) "Exploring the Need for a Shared Cognitive Map," *Journal of Management Studies* (29) 3.
Lapointe, L. and S. Rivard (2005) "A Multilevel Model of Resistance to Information Technology Implementation," *Management of Information Systems Quarterly* (29) 3, pp. 461-491.
Laukkanen, M. (1998) Conducting Causal Mapping Research: Opportunities and Challenges, in C. Eden and J.-C. Spender (Eds.) *Managerial and Organizational Cognition: Theory, Methods and Research*, London: Sage, pp. 168-191.
Leonardi, P. M. (2009) "Why Do People Reject New Technologies and Stymie Organizational Changes of Which They Are in Favor? Exploring Misalignments Between Social Interactions and Materiality," *Human Communication Research* (35pp. 407-441.
Levina, N. and E. Vaast (2008) "Innovating or Doing as Told? Status Differences and Overlapping Boundaries in Offshore Collaboration," *Management of Information Systems Quarterly* (32) 2, pp. 307-332.
Lin, A. and L. Silva (2005) "The Social and Political Construction of Technological Frames," *European Journal of Information Systems* (14pp. 49-59.
Lincoln, Y. S. and E. G. Guba (1985) Establishing Trustworthiness, in Y. S. Lincoln and E. G. Guba (Eds.) *Naturalistic Inquiry*, Beverly Hills, CA: Sage.
Maitlis, S. (2005) "The Social Processes of Organizational Sensemaking," *Academy of Management Journal* (48) 1, pp. 21-49.
McKay, J. and P. Marshall (2005) Reflecting on the Efficacy of SODA and Cognitive Mapping for Problem Analysis in Information Requirements Determination, in *IS-Core Workshop at the International Conference on Information Systems 2005*. Las Vegas, USA.
Miles, M. B. and A. M. Huberman (1994) *Qualitative Data Analysis*. Newbury Park, CA: Sage.
Montazemi, A. R. and D. W. Conrath (1986) "The Use of Cognitive Mapping for Information Requirements Analysis," *MIS Quarterly* (10) 1, pp. 45-56.
Narayanan, V. K. (2005) Causal Mapping: An Historical Overview, in V. K. Narayanan (Ed.) *Causal Mapping for Research in Information Technology*, Hershey: PA, USA: Idea Group Publishing, pp. 1-15.
Oborn, E., M. Barrett, and E. Davidson (Forthcoming) "Unity in Diversity: Electronic Patient Record Use in Multidisciplinary Practice," *Information Systems Research*.

Orlikowski, W. J. (1992) "The Duality of Technology - Rethinking the Concept of Technology in Organizations," *Organization Science* (3) 3, pp. 398-427.
Orlikowski, W. J. (2000) "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations," *Organization Science* (11) 4, pp. 404-428.
Orlikowski, W. J. (2010) "The Sociomateriality of Organisational Life: Considering Technology in Management Research," *Cambridge Journal of Economics* (34pp. 125-141.
Orlikowski, W. J. and D. C. Gash (eds.) (1992) *Changing Frames: Understanding Technological Change in Organizations*. Vol. CISR WP No. 236, Sloan WP No. 3368-92. *Sloan WP, Massachusetts Institute of Technology*: Center for Information Systems Research, Sloan School of Management.
Orlikowski, W. J. and D. C. Gash (1994) "Technological Frames: Making Sense of Information Technology in Organizations," *ACM Transactions on Information Systems* (12) 2, pp. 174-201.
Pinch, T. and W. E. Bijker (1984) "The Social Construction of Facts and Artefacts: Or How the Sociology of Sciece of the Sociology of Technology Might Benefit Each Other," *Social Studies of Science* (14) 3, pp. 399-441.
Schultze, U. and M. Avital (2011) "Designing Interviews to Generate Rich Data for Information Systems Research," *Information and Organization* (21pp. 1-16.
Sheetz, S., D. Tegarden, K. A. Kozar, and I. Zigurs (1994) "A Group Support Systems Approach to Cognitive Mapping," *Journal of Management Information Systems* (11) 1, pp. 31–57.
Siau, K. and X. Tan (2005) "Improving the Quality of Conceptual Modelling Using Cognitive Mapping Techniques," *Data & Knowledge Engineering* (55) 3, pp. 343-365.
Sidorova, A., N. Evangelopoulos, J. S. Valacich, and T. Ramakrishnan (2008) "Uncovering the Intellectual Core of the Information Systems Discipline," *Management of Information Systems Quarterly* (32) 3, pp. 467-482.
Silva, L. and J. Backhouse (2003) "The Circuits-of-Power Framework for Studying Power in Institutionalization of Information Systems," *Journal of the Association for Information Systems* (4) 6, pp. 294-336.
Strauss, A. and J. Corbin (1998) *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks, CA: Sage.
Svejvig, P. and T. B. Jensen (2010) What Can We Learn from a Well-Adapted Enterprise System? A Case Study Approach, in *Academy of Management 2010*. Montreal, Canada.
Swan, J. (1997) "Using Cognitive Mapping in Management Research: Decisions about Technical Innovation," *British Journal of Management* (8) 2, pp. 183-198.
Swan, J. and S. Newell (1994) "Managers' Beliefs about Factors Affecting the Adoption of Technological Innovation," *Journal of Managerial Psychology* (9) 2, pp. 3-11.
Tolman, E. (1948) "Cognitive Maps in Rats and Men," *Psychological Review* (55pp. 189-208.
Tyre, M. J. and W. J. Orlikowski (1994) "Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations," *Organization Science* (5) 1, pp. 98-118.
Vlaar, P., P. Fenema, and V. Tiwari (2008) "Cocreating Understanding and Value in Distributed Work: How Members of Onsite and Offshore Vendor Teams Give, Make, Demand and Break Sense," *MIS Quarterly* (32) 2, pp. 227-255.
Vaast, E. and G. Walsham (2005) "Representations and Actions: The Transformation of Work Practices with IT Use," *Information and Organization* (15pp. 65-89.
Wagner, E. L., S. Newell, and G. Piccoli (2010) "Understanding Project Survival in an ES Environment: A Sociomaterial Practice Perspective," *Journal of the Association for Information Systems* (11) 5, pp. 276-297.
Walsh, J. P. (1995) "Managerial and Organizational Cognition: Notes from a Trip Down Memory Lane," *Organization Science* (6) 3, pp. 280-321.
Walsham, G. (1993) *Interpreting Information Systems in Organizations*. Chichester: Wiley.
Walsham, G. (1995) "Interpretive Case Studies in IS Research: Nature and Method," *European Journal of Information Systems* (4pp. 74–81.
Weick, K. E. (1990) Technology as Equivoque: Sensemaking in New Technologies, in P. S. Goodman and L. S. Sproull (Eds.) *Technology in Organizations*, San Francisco, CA: Jossey-Bass, pp. 1-44.
Weick, K. E. (1995) *Sensemaking in Organizations*. Thousand Oaks, CA: Sage.
Weick, K. E. and M. Bougon (2001) Organizations as Cognitive Maps: Charting Ways to Success and Failure, in K. E. Weick (Ed.) *Making Sense of the Organization*: Blackwell Business.
Weick, K. E. and R. E. Quinn (1999) "Organizational Change and Development," *Annual Review of Psychology* (50pp. 361-386.
Woodruff, R. B. and S. F. Gardial (1996) *Know Your Customer. New Approaches to Understanding Customer Value and Satisfaction*: Blackwell Publishers Ltd.
Zmud, R. W., W. P. Anthony, and R. M. Stair (1993) "The Use of Mental Imagery to Facilitate Information Identification in Requirements Analysis," *Journal of Management Information Systems* (9) 4, pp. 175-192.