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The formation of technology mental models: the case of voluntary use of technology in organizational setting

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Abstract The use of information systems in organisations presents one of the early signs of success. Hundreds of studies have generated a wealth of knowledge on systems use across a broad range of technologies and theoretical approaches. However, new types of technologies and organisations continue to pose challenges to systems use. The case of open systems that are offered to users on a voluntary basis presents one of those challenges for two reasons: 1) the systems are open in the sense that they could be configured in many ways depending on users finding use cases and possible applications; 2) the system use is voluntary and hence there is no organisational push. They bring users' choice and active finding of use cases to the centre of their success. This study questions why and how users choose to engage (or not to engage) with open technology on a voluntary basis and how and why its use options and potential unfold? It examines a longitudinal case study (1994–2012) on the voluntary use of telemedicine. The findings reveal that users' perception of open technology in a voluntary setting is formed through a continuous interplay between users' technology mental models, professional identity, institutional traditions and arrangements and work practices. If perceived to be in contradiction with professional identity, institutional traditions and arrangements or work practices, users' technology mental models are fixated on the misfit and the misfit is thereby reinforced. Hence, users do not try to find use cases or think of possible applications. However, institutional entrepreneurs could break this self-fulfilling prophecy by influencing both the technology mental models of users and the institutional arrangements.

Keywords IS-success · IS-use · Open technology · Mental models · Institutional setting · Voluntary use · Telemedicine

1 Introduction

Information systems use has received considerable attention in IS research. It has been identified as one of the factors that determine success (Petter, DeLone and McLean 2006; DeLone and McLean 1992, 2003). Lucas (1981) notes that IS use should be considered a measure of success only "where use is voluntary" (Lucas 1981, p. 14). However, most of the developed models are variables-centred and predict users' acceptance and potential use of systems (Legris et al. 2003; Venkatesh and Bala 2008; Nan 2011) on the basis of mandatory use of systems. When considering a voluntary context, a recent study showed confusing and inconsistent results. Wu and Lederer (2009) found that a voluntary context impacts the correlations between behavioural intention and the two belief variables (usefulness and ease of use) but not the correlations regarding usage (Wu and Lederer 2009). Variables-centred research masks action and actors in favour of prediction, hence it cannot explain these puzzling findings regarding voluntary use in organisations (Ramiller and Pentland 2009). An in-depth examination of this use context is therefore needed. This is particularly the case since interpretive IS research has assumed that voluntary use occurs in private individual usage and is hence almost exclusively focused on this context as a recent literature survey on the state of ICT research shows (Tscherning et al. 2008). Understanding why and how participants could be voluntarily willing to use new systems and change their work practices

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could help management better motivate them to use systems. While this is relevant for all voluntary use of systems, it is of particular value for open systems for two reasons; 1) open systems provide generic functionality and it is up to users to find use cases and applications, 2) Organisations spend millions of dollars on open systems that are usually offered to employees as a possible alternative way to conduct their work and hence their use is voluntary. Systems such as video conferencing, IM (Instant Messaging), Virtual Worlds, and enterprise voice are usually offered on a voluntary basis as they only provide an alternative to existing work practices and are not expected to replace them.

The use of open systems on a voluntary-use basis in organizations presents an interesting case of organizational investment in waiting for the possible development of applications and use cases and could be lost if users did not engage and find possible use cases and applications. Understanding employees' drivers and motivation to adopt open technology in voluntary organizational settings along with the unfolding use options and possibilities is critical to providing favourable conditions for their success.

Against this backdrop, this study questions why and how users choose (or choose not) to engage with open technology on a voluntary basis and how and why its use options and potential could unfold. It examines these questions through a longitudinal case study (1994–2012) of telemedicine adoption in a Swedish county that was offered on a voluntary basis and over the years became one of the most successful cases of telemedicine application to be found in a Swedish county. Telemedicine is an open technology as it comprises a generic video conferencing system to which different optical and diagnostic equipment could be connected. It is regarded as a service in need of use cases (Ekeland 2007) since its applications for the daily practices of medical staff and administration are not pre-defined but rather dependent on users and their local settings (Linderoth 2002). Since 'people act based on their interpretation of the world, hence their understanding must change if their actions are to change'. A theoretical approach that focuses on sensemaking processes is useful in examining how people make sense of an open technology in a voluntary setting. Porac et al. (1989) developed a framework for understanding how people make sense of their internal and environmental conditions and how both are enacted in the process of sensemaking. This study draws on this framework to develop a process framework of how participants make sense of open technology that is offered in voluntary basis.

The subsequent sections of this paper are organized as follows. The following section briefly explains the difference between mandatory and voluntary use of systems and the challenges that open systems offered on voluntary-use basis face and that could impact their success. The third section presents a review of the theoretical foundations of this research and argues that any understanding of the use of open technology in a voluntary organizational setting needs to incorporate a socio-cognitive sensemaking perspective while accounting for the institutional setting. It outlines a socio-cognitive framework that explicitly accounts for mental models and the institutional setting. The fourth section outlines the research methods employed and describes the longitudinal field study. The fifth section presents the research findings and the sixth section discusses the findings while the final section concludes the study and provides suggestions for future research.

2 Mandatory use of systems: Definition

In mandatory use of systems in organisations, the standardisation between use cases is required by the organisation (Bhattacherjee 1998; Damsgaard and Scheepers 2000) and hence institutional pressure is exercised to channel employees to use the technology. This could be done through consistently urging employees to use the system (Orlikowski 1996), encouraging them not accept work done outside the system, and/or by penalising employees for not using the system (Elbanna 2010). Therefore, employees—in a mandatory use setting—do not have the privilege of choosing whether or not to use the newly-introduced information systems and rarely have the opportunity to select the information systems applications they use (Karahanna and Straub 1999).

There is a wealth of research on open systems in mandatory settings where users are required to use the systems to conduct business processes and their adoption is monitored. Non-adopters are warned against conducting business processes outside the system and firmly channelled to use the system. Orlikowski (1996), for example, observed that the introduction of an open system—in this case a call tracking system for the customer support department at Zeta Corporation—was surrounded by "on-going urging by managers" for employees to use the system (Orlikowski 1996, p.72). She also reported that use of the system was monitored by managers who emphasised to users that "keeping process documentation up-to-date [through using the system] was … just as critical or even more important than problem solving [which was the employees' daily tasks in answering clients calls and dealing with their technical problems or enquiries]" (ibid, p.75). In contrast, in voluntary-use open systems the organisation installs the generic technology in the hope that users will find applications and use cases for it and then commit to using them. There is no particular blueprint or prescription for use and less urging and monitoring of use takes place since the degree and nature of use itself is unknown to the organization and depends on users developing use cases and applications themselves. These types of systems carry the risk of abandonment if users do not come forward with use cases. Hence understanding actors, action and artifacts and the interaction

between them could provide insight into how users' understanding and action develops and hence provides ways to help improve the chances of success (Ramiller and Pentland 2009).

3 Theoretical foundation

3.1 Sensemaking in organizations

Sensemaking is a process that combines cognition and action in interpreting events or situations (Weick 1982, 1995). Cognitive sensemaking studies maintain that there is a constant feedback loop between the cognition and action where both impact each other in a process of 'enactment' through which shared perceptions come into being (Weick 1979; Moez et al. 2007). This process is guided by the mental models, frames or schema of organisational members, organising and shaping their interpretation of organisational events (Porac and Thomas 1990; Daft and Weick 1984; Gioia 1986). People's sensemaking process is hence limited to their ability to identify and bracket cues. Different people could—in principle—bracket different cues in a different situation and hence act differently. However, bracketing of cues is informed by participants' perception of their professional and organisational identity. Cues are selected through and related to identity as "who we think we are (identity) as organizational actors shapes what we enact and how we interpret' (Weick et al. 2005, p. 416). Participants' perception of identity could, therefore, limit the perceived cues and which cues are likely to be bracketed from the environment, situation or event. However, Weick et al. (2005) explains that identity is enforced and stabilised/destabilised by how others treat us "which means our categories for sensemaking lie in their hands. If their images of us change, our identities may be destabilized and our receptiveness to new meanings increase" (Weick et al. 2005, p. 416). When cues are identified, participants would relate and connect them to previous experience, mental models, identity, knowledge of the organization, organizational routine and practices to create meaning and take action.

Following the process of cues bracketing, participants relate the extracted cues to the repertoire of frames or certain institutional logics that participants hold (Jensen et al. 2009; Jennings and Greenwood 2003). It is the connection of cues to existing frames that create the meaning upon which participants act. In this action, participants contribute to the creation of the organizational reality, environment, or event they will further respond to in a process called 'enactment' (Weick 1995). The meaning that the users create will guide their future attention and actions in the situations they face. Enactment in sensemaking carries the risk of reinforcing current beliefs where the continuous process of enactment leads to self-fulfilling prophecies, as individuals only see what they expect to see. Consequently, understanding technology is expected to be equivocal in the sense that several "possible and plausible interpretations" could emerge around the same technology (Weick 1990 p.2).

3.2 Sensemaking in IS research

Peoples' sensemaking of a technology is an important component for the understanding of systems implementation and use (Griffith 1999; Gephart 2004). Information systems research has emphasised that "to interact with technology, people have to make sense of it; and in this sensemaking process, they develop particular assumptions, expectations, and knowledge of the technology, which then serve to shape subsequent actions toward it" (Orlikowski and Gash 1994, p. 175). Orlikowski and Gash (1994) use "technology frames of reference" to refer to the organisational members' mental models relating to the implementation and use of technology. For them the formative aspects of technological frames or mental models include the contexts of design and use along with the artifact itself. Based on a case study of the open-ended technology 'Notes', they identified three domains for the participants' interpretation of the technology. These domains related to: nature of technology, technology strategy, and technology in use. Nature of technology refers to people's understanding of the technology; its capabilities and functionality. Technology strategy refers to people's understanding of the reasons behind organisational adoption; motivation, vision, and value. Technology in use refers to people's understanding of how the technology will be used on a day-to-day basis and the likely or actual conditions and consequences associated with such use.

The importance of technological frames or mental models lies in their strong influence on choices made in the design and use of technology (Pinch and Bijker 1987). However, IS studies tend to examine technological frame at a point in time as an outcome and hence focus on frame content paying little attention to the understanding of the process of framing (Davidson 2002, 2006). Their focus is generally on understanding how the congruence or incongruence of frames affects design and use and hence the studies do not question the impact of the process of framing. In her extensive review of technological frames literature, Davidson (2006) found that the focus of IS research on frames content is depriving the field of accumulating substantial theory-building knowledge in this area. She urged researchers to examine the process of framing and stressed that "Increasing research emphasis on framing as an interpretive process could move TFR [technology frame of reference] research beyond the issue of frame incongruence" (Davidson 2006, p. 25). Understanding the process of framing could add a valuable dimension to technology frames research. It could generate and find answers to puzzling questions regarding how and

from where frames develop, how and why they change, and how the change in technology frame comes about.

The concept of enactment has been used to explain how users make sense of technological change and how new organisational structure and practices emerge over time. One widely quoted study that applied this concept is Orlikowski (1996). In this study, she examined the introduction of Lotus Notes in the pseudonymous Zeta corporation to reveal the users' enactment of work practices and the resulting organisational change over time (Orlikowski 1996). She later extended the analysis of this case and compared it with another case of Notes Technology in an organisation she called Alpha to conclude that the use of technology could be viewed as a process of enactment (Orlikowski 2000). In the latter study, Orlikowski incorporated Giddens' structuration theory to show that the resulting organisational structure is enacted during technology implementation and use (Giddens 1984). She then investigates technology frames in a separate study to reveal the differences in the frames held by technologists and users that impact technology implementation and use. On the basis of this seminal work, IS researchers have studied technology frames as a separate phenomenon from technology and organisation enactment. They have either examined the impact (or mutual influence) of institutional structure on IS implementation or the impact of people's sensemaking on IS implementation, thereby missing the link between people's understanding of technology and the institutions in which they work and the ways in which these factors can influence each other. For example, Henfridsson (1999, 2000) shows how technologies are enacted in specific organizational context through actors' continuous meaning production and actions.

While the process of sensemaking consists of the sub-processes of bracketing, enactment, and framing, the above brief review shows that IS research has tended to focus on one aspect or sub-process and separate it from the bigger picture of sensemaking. Information systems research seems to slice the process of sensemaking and study each of its sub-processes separately. Studies either focus on examining technology frames or technology and organisational enactment in IS systems implementation and use (Fountain 2001), which provides valuable insights but misses the opportunity to accumulate knowledge and develop a more comprehensive theory of technology sensemaking that considers the thickly woven inter-dependant aspects and sub-processes of sensemaking of technology.

3.3 A framework for the process of technology sensemaking in organizations

In this section, we outline a framework for the technology sensemaking process in organizations. This framework is inspired by Porac et al. (1989) and considers the work of Weick, and Jennings and Greenwood as outlined above and particularly Weick's latest work in which he paid greater attention to institutional aspects.

Porac et al. (1989) developed a framework for understanding how decision makers of the Hawick community of Scottish knitwear manufacturers enact their strategic competitive position. Porac et al. (1989) provide a comprehensive framework that explicitly accounts for decision makers' mental model and the component of the competitive environment in which they operate namely; customers, suppliers, and competitors. The framework shows the reciprocal influence of cognitive and institutional factors and the fact that there is "mutual dependence" between decision makers' mental models and their competitive environment. They showed that decision-makers construct a mental model of the competitive environment through processes of induction, problem-solving, and reasoning, which consists minimally of two types of belief: beliefs about the identity of the firm, its competitors, suppliers and customers, and causal beliefs about what it takes to compete successfully within the environment which has been identified. Figure 1 exhibits this framework.

While the Porac et al. (1989) framework shows that cognition and action reinforce each other, it importantly shows that mental models are influenced by information exogenous to this transactional network. Just as mental models are determined by cues from transactions within the value chain, such transactions are also determined by the cognitive construction of organizational decision-makers. Figure 1 shows that the material and cognitive aspects of an organization are linked together in a loosely coupled 'enactment' process where each is determined partly by the other. In this sense, "what human perceivers do is to take whatever scraps they can extract from the stimulus input and if those conform to expectancy, to read the rest from the model in the head" (Bruner 1986, p.146).

The sensemaking of technology in a voluntary organizational setting depicted in Fig. 2 integrates the analytic framework of Porac et al. (1989) with the recent work on sensemaking by Weick et al. (2005) and Jennings and Greenwood (2003) where they explicitly account for the role of institutional factors in sensemaking in organizations. They find institutional factors to provide frame repertoires against which bracketed cues relate (Jennings and Greenwood 2003; Weick et al. 2005; Weick 2009). They also assert the role of professional identity in bracketing cues and also in relating to the bracketed cues. Weick also showed that "Tools and identities form a unity without seams or separable elements" hence firefighters, naval seamen, and aeronautical pilots are among those professional groups who would be reluctant to drop their tools when faced with heightened threat. For professionals, "dropping their tools creates an existential crisis" (Weick 1996, p. 308). This institutional socio-cognitive framework provides a theoretical basis and analytical lens with which to

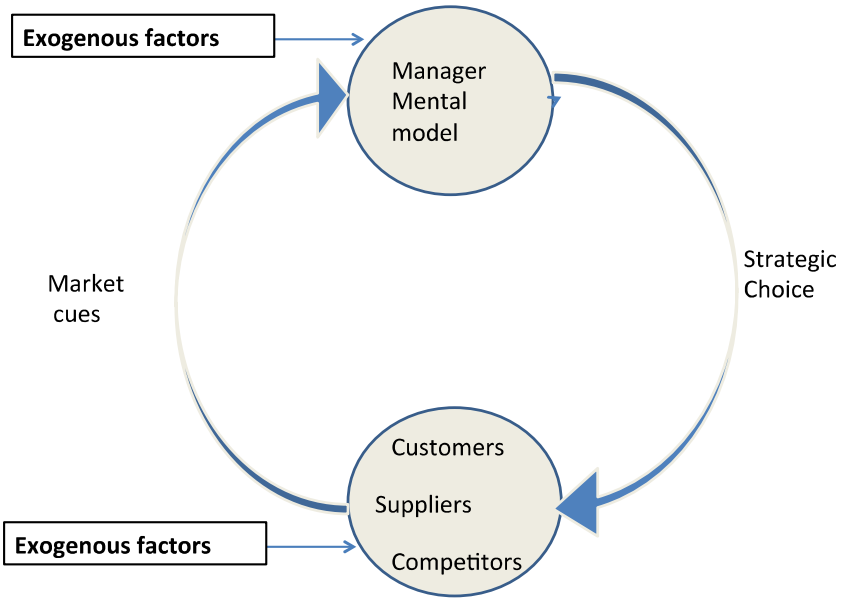

Fig. 1 Reciprocal influence of the technical and cognitive levels of analysis [adapted from Porac et al. 1989, p.399]

examine why users would change their mental models and enact a different institutional arrangement on a voluntarily basis.

4 Research methods and setting

4.1 Research methods

This study forms part of the interpretive research tradition in information systems research (Lee and Baskerville 2003; Walsham 1995a, b). It aims to explain the phenomenon of adoption and use of open technology in a voluntary organizational setting. It applies a case study approach of telemedicine adoption and use over time (Eisenhardt 1989). Longitudinal data was collected by the corresponding author over a period of 18 years in three phases between 1994 and 2012. Data was gathered from formal and informal semi- structured interviews, participant observation of project meetings and meetings between project management and equipment suppliers, examination of use records, document review, and collection of news items. The phases of data collection and used methods as illustrated in Table 1 are as follows.

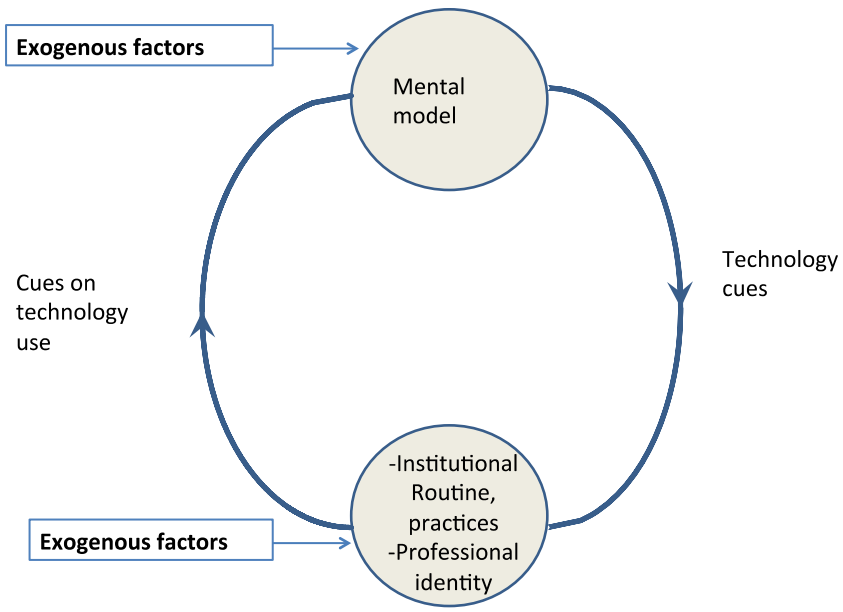

Fig. 2 Sensemaking of open technology in a voluntary organisational setting

Table 1 Summary of data collection phases and methods

Data collection phases	Formal interviews	Other methods
Phase 1: 1994–1999	62	Observation of meetings
Phase 2: 2003–2006	7	- Access to systems' use records
		- Informal interviews
Phase 3: 2007–2012		- Informal interviews
		- Sites visits
		- Collection of news items
Total	69	

The first phase took place between 1994 and 1999. In this phase, 62 interviews were carried out with 32 respondents namely; physicians, politicians and managing directors of hospitals. Interviews were carried out on four occasions: in 1996, 1997, 1998 and 1999. Observation of project meetings and meetings between project management and suppliers started in 1994 before the equipment was purchased and installed in August 1996 and continued throughout this phase. The aim of the data collection in this phase was to understand the different expectations of the actors involved regarding the future deployment of telemedicine technology and how the technology would be deployed.

The second phase took place between 2003 and 2006. In this phase, seven formal interviews were undertaken with physicians and the managers of the telemedicine support unit, two of whom had already been interviewed during the first phase. In addition, a number of informal interviews and conversations took place with various teams. In addition, access to telemedicine use records was obtained and those records were examined. The use records contained data from 1,650 occasions telemedicine had been utilised between June 2003 and January 2006. Each time the system was used, the party initiating the interaction was required to fill in some data before s/he could log off the system. Data registered encompassed: date, time, host (who initiates the interaction), connected (who has been contacted), duration of contact, comments and person initiating the contact.

The third phase of data collection took place between 2007 and 2012. It consisted of follow-up conversations and informal visits in addition to the collection of news items regarding the progress of the use of telemedicine in the County. Interviews conducted during the different phases lasted between 1 and 2 h with a mean of approximately 75 min.

4.2 Case description

The case study presents one of the most successful examples of telemedicine application to be found in a Swedish county. The project began in the early 1990 when few physicians in the county became interested in telemedicine technology. A small project was set up to identify medical areas where telemedicine might be useful. The project's team consisted of physicians and a technical director. In autumn 1994, the team identified dermatology (skin diseases), orthopaedics, otorhinolaryngology (ear, nose and throat diseases ENT), radiology, pathology, cytology, surgery and gynaecology as appropriate specialisms. However, in spring 1995 radiology was dropped because another project involving the digitalization of the radiology departments in the county started. The chosen technical platform was a standalone video conferencing system that could be connected with optical medical equipment. By connecting optical equipment to the video conferencing system, it was possible for general practitioners to examine patients and transmit pictures, e.g. the ear, or the skin of patients, live or still to the specialists. It was also possible to connect a microscope to the equipment for the examination of frozen samples. For example, the microscope located at a county hospital could be remotely operated by a pathologist at the university hospital. In 1995, it was decided that telemedicine equipment should be installed at two remote health centres, in the departments of the university hospital and at two county hospitals and the funding was approved by the county board.

Two projects were formed and each was assigned a project manager; a general telemedicine project (GTE) and a telepathology project (PAT). During this period project meetings were held monthly, or bi-monthly in the GTE-project, where experiences and forthcoming activities were discussed. The PAT-project was in practice a one-man operation, where the project managers got commitment from interested clinical specialist to test the technology. The projects had no formal steering groups. Instead a R&D manager in the county was the link between the project and the county management and the R&D manager was also a key actor in preparing the ground when the county came to deciding whether to continue investing in a telemedicine infrastructure.

The GTE-project aimed to develop and test communication between general practitioners at two health centres and specialists at the county hospital, and at the university hospital. The specialisms involved were dermatology, orthopaedics, and ENT (ear, nose and throat). The specialists were located at the university hospital, except for the orthopaedists who were located both at the university and a county hospital. The PAT-project identified two applications namely video conferencing and remote analysis of specimens and aimed to develop and test equipment between health centres, county hospital and university hospital. Though the project's participants had expected a higher number of consultations, the project was considered successful by the County and it continued to invest in telemedicine equipment. As a result, 40 units of telemedicine equipment were installed at hospital departments and health centres. As the telemedicine infrastructure was expanded, a support department, named the TeleMedLab, was

established in 1999. In January 2006 the telemedicine infrastructure installed in the county health centres and hospitals has expanded to approximately 70 units and in September 2007 this number went up to over 100 units. In 2012, the county was considered to be the Swedish county with the most developed use of telemedicine within Sweden.

5 Findings and analysis

This section follows the use of telemedicine in different hospital departments. It shows that while its use has risen in some departments, it has subsided in others. It illustrates analytically how established institutional arrangement and professional identity initially bounded the thinking of the new technology leading to initial rejection. It also shows the role of institutional entrepreneurs in overcoming institutional barriers and shifting the technology mental models leading to the consideration of different potentials for the use of such open technology. Table 2 presents a case dynamics matrix of the interplay between institutional arrangement and users' initial mental models of telemedicine use.

5.1 The need for institutional entrepreneurs

The core team of medical specialists enthusiastic to implement telemedicine technology was involved with the technical team during the implementation. However once the system went live, it was down to departments themselves to decide whether to use it and in which cases. The implementation team view was that departments should identify some potential areas of application in order to get the equipment installed in their departments. This view was expressed as:

> "…if this [telemedicine] is going to function, there needs to be a demand from the organization, we need to feel that we'll get something out of it"

The GTE group members realized that telemedicine is not a technology that comes with a prescribed use. It is down to users whether or not to use it. Even if they decide to use it, users still need to define and construct their own use cases. A general practitioner, who was one of the enthusiasts of telemedicine implementation, expressed this view as follows:

> "You must have fantasy and power of imagination in order to see how this [telemedicine] can be used. If you continue to do everything as you did before, you will not see any advantage to it."

The need to find people with imagination and spirit to experiment was, implicitly, recognized by politicians and the managing directors at the hospitals. The managing director at the university hospital stated that the development of applications and the way in which daily activities were organized, were matters for the users. In practice the introduction of telemedicine did not follow any established routines and teaching efforts varied. The idea at the outset was that members of the GTE and PAT projects should start testing the technology and these people had been introduced to the system. In addition a technician who was a member of the project should act as stand-by support at the university hospital. The medical specialists who were members of the GTE project were supposed to communicate the availability of the new system to their departments, but no formal teaching in handling the system was offered. When the TeleMedLab was introduced in 1999, the county established a formal body to inform potential users about the availability of telemedicine and support those interested with training. But the manager for the TeleMedLab stated that the success of the venture was dependent on the motivation of the parties involved and the integration of the system into pre-existing routines.

Table 2 Initial mental models in the absence of institutional entrepreneurs

Department	Contradictions	Mental model
Dermatology	- Professional identity	- No use cases
	- Financial reward system	- Medical specialists with different views kept silent
	- Career path and promotions	- Hassles in the daily routines
Ad-hoc consultations	- University hospital institutionalized superiority status	- No or late attendance to ad-hoc consultations
Pathology clinical conferences	- In line with institutionalized university hospital practices. - In line with institutionalized status between clinical- and laboratory specialists	- Develop a telemedicine clinical conferences application
Specimen remote analysis	- Operations routine - Surgeon's need for time to prepare their communication with patients - Patient's perception of the relationship between time and accuracy of diagnosis.	Scarce use

5.2 Institutional entrepreneurs and the evolution of technology mental models

In the dermatology department, it was initially no demand for the system as users could not see a reason for using it, but some dermatologists had to use it due to their involvement in the project. Hence, dermatologists did not initially have a telemedicine unit at their department. Instead, if they had to use the technology due to a planned consultation from a health centre, they had to walk through the hospital to the video conferencing studio.

Dermatologists considered their direct contact with patients to be an integral part of their professional identity (Chreim et al. 2007). This enacted view was expressed by a dermatologist as follows:

> "We should not be like a radiologist, just looking at a flat picture, you need to touch, feel and smell".

The necessity of interacting with patients was supported and enforced by the existing institutional financial arrangement that compensate specialists on the basis of the number of patients visiting the practice. Concerns over possible financial loss contributed to the enforcement of the existing mental model that supported direct interaction with patients. Also the career path including performance evaluation and the promotion of physicians was dependant on their research output. Dermatologists viewed research to be dependent on the continuous flow of patients visiting the department. Hence they feared that if the numbers of visiting patients dropped as a result of using telemedicine, that would negatively impact their research and hence their performance evaluation and career.

The existing institutional arrangement supported the view that patients had to be seen face-to-face. Hence the initial mental model of most dermatologists towards telemedicine was that there is no use for such technology. Another medical specialist claimed that the importance of the presence of patients in consultations is overestimated, but preferred not to express this opinion in public. He was not willing to risk contradicting the institutional arrangement and professional identity.

The understanding of how the technology could be used in the department of dermatology changed slowly as a new dermatologist joined the team. She saw the available telemedicine equipment and became interested in exploring how it could benefit the department. So she started an initiative to find possible use cases for the telemedicine equipment. The initiative identified classes of patients and types of consultation that could be handled through the system.

At that time, there was a shortage of staff at the dermatology department at a district hospital 140 km away from the university hospital. This shortage of staff required that university hospital staff had to rotate between them a weekly visit to the district hospital. This weekly visit was considered a tiring and undesired task. It required a member of staff from the university hospital dermatology department to take a 2 h bus journey very early in the morning to the district hospital to meet and examine patients throughout the day. In the late afternoon that member of staff spent another 2 h by bus on the return journey. Even though this duty was rotated among the dermatologists and was compensated for with an extra day off, it was not a popular task. The dermatologist who soon became the head of the department presented the findings of the experiment to the other dermatologists as a possible solution to the long bus journey to the district hospital. This solution was then welcomed by the other dermatologists in the department as it would ease the burden of waking up at 4.30 in the morning to take the bus. The dermatologists became involved in the discussion regarding what kind of patients were appropriate for telemedicine examination and what procedures should be followed when using the equipment. It was agreed that the nurse at the district hospital could take photos of the patients' skin, send them to the university hospital where the dermatologist would examine the photos while the nurse was with the patient.

The remote examination of dermatology patients was successful and dermatologists at the university hospital announced that they would cease commuting to the district hospital. As the nurse at the district hospital who was involved at the experiment retired a few years later, the new nurse considered telemedicine consultations to be part of the definition of her role and the method by which patients obtained treatment. Thus, the mental model regarding telemedicine use changed at the dermatology department from being one of high scepticism of telemedicine consultation in the first few years to one of enthusiasm for using the technology. Within 10 years the specialism of dermatology had become one of the heaviest users of telemedicine.

5.3 The contradiction between the technology mental model and the institutional arrangements and relationships

In the GTE group, there was low number of ad hoc consultations from health centres to university hospital. Initially the health centre saw telemedicine as an opportunity to get hold of university specialists on an ad hoc basis. However soon, GPs at the health centres found out that despite the technical potential of telemedicine to connect with university hospitals, the institutional arrangements at the university hospitals made it difficult to find specialists on an ad hoc basis. They also found out that ad hoc consultation does not mean instant consultation as university hospitals' specialists still need time to operate the equipment. This view was expressed by a general practitioner at the health centre as follows:

> "It is the accessibility [of clinical specialists] that makes it complicated, the system is not complicated….If I try to get hold of someone and they are not immediately available, someone has to go and look for them, and then they don't know how to handle the equipment and what to do—suddenly an hour is gone"

The health centres' mental model regarding using telemedicine as a means of immediate access to medical specialists contradicted the institutional barriers between university hospitals and health centres and the professional status of university hospital specialists and hence was met with cynicism from university hospital specialists. This view was expressed by a general practitioner as follows:

> "Suddenly primary care is coming and making demands on hospital care, for example to develop routines for managing incoming consultations from primary care….or to develop services for primary care"

5.4 Enacting existing organizational routines

In contrast to the GTE-project, laboratory specialists involved in the PAT project from the beginning had in mind a particular application which was to organize clinical conferences via telemedicine between the gynaecology department at the district hospitals and pathologists and oncologists at the university hospital. Over the years, the hosting of clinical conferences became the major application of telemedicine in the county.

The practice of holding a weekly professional meeting for specialists at university hospitals is a well-established professional and institutionalized practice. It aims to provide weekly encounters for all levels of specialist doctors and students to discuss and learn from different cases. The organizational routines of university hospitals provided mechanisms for these meetings to take place on a regular basis as they are considered important weekly events for mentoring and competency development and are part of what defines a university hospital. So when introduced to telemedicine, pathologists at the university hospital immediately found a use case in line with existing practice, professional convention and organizational routine—namely the clinical conference. They approached the use of telemedicine in clinical conferences as an extension of the current practice and routine that ensured the provision of a quality learning environment. This provided participating gynaecologists at the district hospitals with perceived value of participating in such conferences.

While pathologists at the university hospital used the conferences as a competency development opportunity for gynaecologists, the gynaecologists' mental model of pathology conferences evolved from it being a means of competency development to being an integrated part of their operations and decision making. Gynaecologists' mental model evolved to consider it an opportunity to discuss patients' cases with pathologists and take decisions accordingly. It became common to hear gynaecologists discussing a patient case saying: "Let's wait till the conference to decide on further treatment", the head of the gynaecology department said. Specialist found these conferences a way to diagnose difficult cases. A patient's diagnosis could be changed during a conference as a result of additional information supplied.

Telemedicine clinical conferences soon became part of routine activity, and the application was adopted at another county hospital. The organizational routine and arrangement for preparing and conducting clinical conferences was adopted and extended by telemedicine application. For example, conferences were held at the same time and same day every week, and detailed routines were set up for how to report a case to be discussed at the conference.

5.5 Contesting the existing mental model of time

The PAT project management suggested from the beginning another application for telemedicine which was tele-pathology meaning the immediate analysis and reporting on frozen specimens. In this application, a microscope for the examination of the frozen sections was located at the county hospital but was maneuvered by the pathologists and cytologists at the university hospital. The aim of the application was to speed up the analysis and give surgeons a response within a few minutes regarding the nature of the sample. This potential application was not put to any significant use and soon faded away.

Surgeons at the county hospital who suspected tumours were invited to use the technology for urgent evaluation of frozen sections. They were sceptical as to whether they could trust the results, however, because the method was not scientifically validated. The method was later scientifically validated by the management of the PAT-project and the findings showed that there were no significant differences between the traditional methods for diagnosing on the basis of frozen sections and diagnosis via tele-pathology. However, surgeons continued to show a lack of interest in this application. The speed of diagnostic response was in sharp contrast with the previous routine of sending a sample of a suspicious tumour to the lab and receiving the results a few days later. The surgeons found it difficult in such a short period of time to mentally prepare themselves to convey the serious news to a patient that they had cancer. Concerns were also raised as to how the patients would react if they were given the diagnosis "cancer" half an hour after a section had been taken. The surgeons felt ambivalent towards the speed of the results that this application provided, which contrasted sharply with existing professional practices and the procedures for giving patients feedback.

5.6 Following existing institutionalized communication patterns

By analysing use records of 1,650 consultations between June 2003 and January 2006 with regard to communication patterns between different hierarchal levels, it became evident that use of telemedicine had developed in accordance with existing and institutionalized communication patterns (Table 3). The vast majority of consultations (59 %) are related to clinical issues and conducted between hospital departments. Apart from the dermatology consultations, the use case dominating consultation between hospital departments was the holding of clinical conferences between clinical specialists and laboratory specialists. This practice reinforces the existing institutionalized roles and relationships in the health care sector. Moreover, during the time period in which the data was collected, hardly any ad hoc consultations were conducted. Initially ad hoc consultations were expected to be the primary use case. But as described, this particular use case came to contest the established mental models for how communication and information are managed in health care organizations.

6 Discussion

This paper questioned why users would choose to adopt a new open technology and why and how its use options and potential might unfold. To answer these questions a longitudinal case study (1994–2012) of one of the most successful introductions of telemedicine use to a county in Sweden was examined.

The findings show that in the voluntary use of open technology, users' initial mental model develops along the lines of existing institutional arrangements, routines, and definition of professional identity. If the technology is found to be in line with the latter elements, users will be likely to develop a positive mental model regarding the technology. They are likely to incorporate it into the current organizational fabric and include it in the existing organizational routine. This was the case with clinical conferences. The practice of clinical conferences and providing regular opportunities for professional development constituted part of the existing professional identity of specialists at university hospitals. Conferences were also aligned to the existing routine of scheduling and preparing for these events. So university staff readily developed a positive technology mental model and used the telemedicine systems to conduct clinical conferences with the district hospital following the existing institutional arrangement and routine. For district hospital staff, the conferences were considered a good learning opportunity, introducing them to the university hospital practices and hence they developed a positive mental model and were eager to adopt similar organizational routines and arrangements. This finding supports the findings of other studies on technology frames and mental models (Davidson 2002; Davidson and Pai 2004; Orlikowski and Gash 1994) and clearly shows the impact of institutional elements on the technology sensemaking process (Fig. 3).

Table 3 Consultations between hierarchical levels (June 2003–January 2006)

Hierarchical level	Number of consultations	% of total
Hospital-Hospital, clinical	977	59 %
Hospital-Hospital, other	18	1 %
Hospital-Health Centre, clinical	357	22 %
Hospital-Health Centre, other	105	6 %
Health Centre-Health Centre	193	12 %
Total	1,650	100 %

Similarly, following the self-fulfilling prophecy of bracketing cues and relating to what is known, users are likely to reject the technology if it contradicts their institutional arrangements, routines, or existing definitions of professional identity. In cases of voluntary use of open technology, users are likely to dismiss the technology from the outset as a possible alternative for conducting their work. This was initially the case with the dermatologists. However, the study shows that this reinforcement of existing mental models can be interrupted and shifts of technology mental models can occur within the same professional group without institutional pressure or coercion. These findings show that mental models can evolve and that they are not as static or reinforcing of existing beliefs as studies of technology frames contents have previously depicted (Orlikowski and Gash 1994; Lin and Conford 2000).

Studies of mandatory implementation and use in organizations have found that "understandings, interpretations, and expectations of information systems are framed and reframed through the exercise of power" (Lin and Silva 2005). In contrast, we found institutional entrepreneurs to play an important role in the evolution of the users' technology mental models and institutional arrangements. Institutional entrepreneurs were able to help users to break away from existing mental models, to imagine new possibilities and other ways of working. Research in organization studies suggests that institutional entrepreneurs have the capacity to imagine alternative possibilities and the ability to contextualize past habits with the contingencies of the moment (Emirbayer and Mische 1998; Garud et al. 2007). As depicted in Fig. 4, our study contributes to this line of research by showing that technological-institutional entrepreneurs could play a significant role in problematizing the use of technology and encouraging users to rethink their practices in the light of new problems. They could cultivate a spirit of experimentation

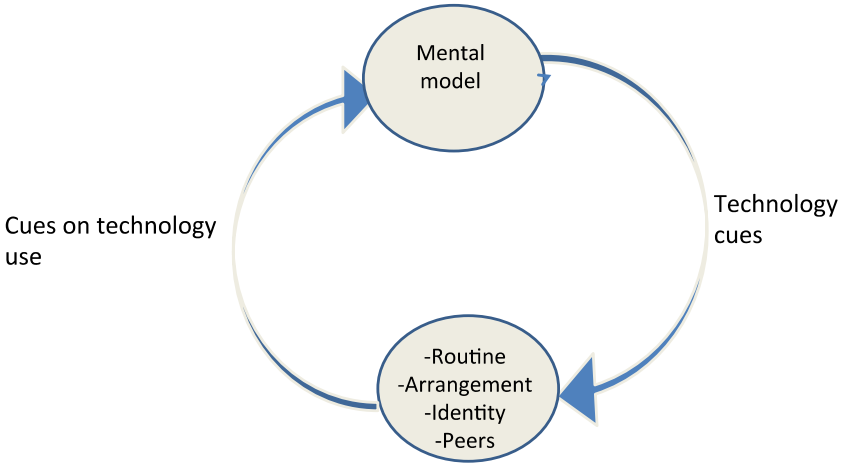

Fig. 3 Clinical conferences: reinforcing mental models and institutional arrangements and identity

around the technology use and influence organisational change to accommodate the newly-imagined use of the technology. Since technology mental models, institutional factors and professional identity are interlinked, a change in one might trigger changes in the others. Once institutional entrepreneurs influence technology mental models through problematization and infusing the context with a spirit of experimentation and discovery, users will find it possible to bracket different technology cues. When influencing the organisation to change its practices, the newly-bracketed cues are then related to institutional practices that seem to be accepted and in-line with professional identity. As users find the new technology to solve a problem or improve practice and to be in-line with existing institutional practices, users will shift to a new mental model where the technology becomes an integral part of what they do and part of their institutional practices and professional identity.

This finding provides an explanation as to how change comes about in the technology sensemaking process. In establishing this, the study contributes to research on technology frames and responds to Davidson (2006) call for researchers to adopt a more dynamic perspective on frame changes as an ongoing interpretive process triggered by a variety of organizational circumstances. Previous research has considered technology frames as a static phenomenon and paid little attention to the process of framing (Davidson 2002). Our adoption of a process view of technology sensemaking and mental model formation helps to move technology frame research forward beyond the well-established tenets of contents of technology frames. In understanding how change comes about in the voluntary use of open systems, organisations could learn how to influence this process in order to help users to think of possible use cases and application of the technology. Porac et al. (1989) framework has been applied in IS research (Elbanna 2012). However, the explicit consideration of the role of institutional elements in the development and enactment of users' technology mental models that presents another contribution of this study.

The concept and role of the institutional entrepreneur is relevant but different than the role of 'change agent' identified

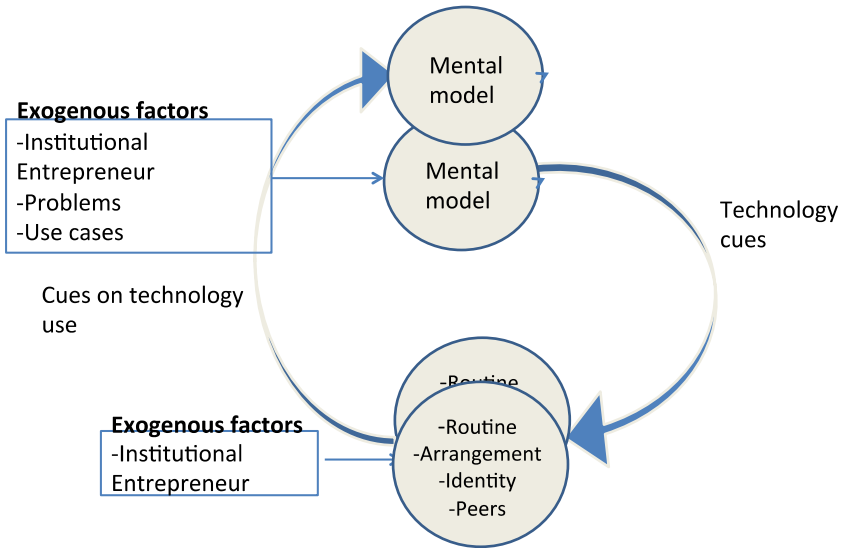

Fig. 4 The role of institutional entrepreneurs in shifting technology mental models and institutional environment

by Rogers (2010) and Connor et al. (1988). For Rogers (2010), change is presented as a known territory and the change agent role is to steer the organization to follow this intended direction. Hence, he defines a change agent as "an individual who influences clients' innovation decisions in a direction deemed desirable by a change agency." and prevents clients from adopting "certain innovations with undesirable effects." (Rogers 2010). This intentionality and clarity of the change contents is shared by Connor et al. (1988). For them, the change agents' role is "to alter the status quo in an organization. It is their [changes agents] intention to cause parts of an organization to operate differently from the way they have operated in the past (Connor et al. 1988). In contrast to change agents, technological institutional entrepreneurs do not have a clear vision of change or a particular project to steer the organisation towards. Instead, they are entrepreneurs in the sense that they encourage exploration and experimentation and they are flexible in trying to accommodate discovery. The role of institutional entrepreneur in this case is almost the opposite of the role of the 'gatekeeper' who decides "how the technology should be deployed, what the system should do, and how it should do it" (Rau and Haerem 2010, p.288) .

7 Future research and implications for practice

Existing studies that have examined voluntary use have done so through studying university students or making the participation of the study itself voluntary (Moez et al. 2007; Weill and Olson 1989). There has been little understanding of the nature of systems use in an organizational setting when offered on a voluntary basis despite its importance and the current open technology that are offered to organisational users on voluntarily basis (Petter et al. 2008). Our study contributes to the closing of this gap by providing a case study of voluntary use in its organizational setting, resulting in an understanding of conditions relating to the finding of use cases and applications.

In contrast to mandatory use in an organizational setting where users could be under significant pressure to adopt the technology (Wastell and Newman 1993), in voluntary use organizational settings, users are invited to explore and experiment without pre-conceived ideas or being given a blueprint for use. While previous research has shown the existence of a window of opportunity for users to change the implemented systems after which the system will be stabilized (Tyre and Orlikowski 1991), our study shows that in voluntary use organizational setting, exploring use cases and applications is an on-going process of innovation. It requires imagination and exploration of possibilities and is triggered by the availability of equipment. The imagining of new ways of using the technology to accomplish work is particularly important in cases of voluntary open technology. Urquhart (1997) in her study regarding user-developer interactions during requirements determination had also identified imagination as a pattern of interaction tactics. The role of imagination and how it could be used in systems development and use is in need of further investigation. Researchers are invited to follow up from this study to examine it in-depth.

Therefore, managers and practitioners need to influence users' mental models and provide favourable institutional arrangements to make it possible for users to use the new technology. They need to influence the changes in perception through changes in organizational routine and procedures. The medical profession is highly regulated by strict codes of practice and protocols, hence new institutional procedures might need to be tested, approved by professional bodies, and documented once change of technology mental models occur and new institutional arrangement is considered (Linderoth 2002).

In conclusion, it is not sufficient to make an open-ended voluntary technology available for its users, or to passively demand that they use the technology. Successful use is likely to occur through a continuous interplay between mental models, actions and organizational elements. Hence ideas for use could be suggested to identify initial obstacles that management need to overcome, institutional entrepreneurs need to actively find use cases, compare experiences, and initiate debate while experimentation and exploration are invited and encouraged.

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