CHANGING PRACTICE THROUGH BOUNDARY ORGANISING: A CASE FROM MEDICAL R&D

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Abstract

This paper seeks to contribute to our understanding of how actors work on organising multiple boundaries in the quest for developing and stabilising new medical knowing in practice. The paper introduces the notion of boundary organising to highlight that such practices are more concerned with discovering, pushing, opening and closing several boundaries simultaneously than with coordination across stable boundaries. The research material is based on a longitudinal study of a cross-disciplinary medical R&D department. Like Orlikowski (2002), we argue that boundary practices are collective 'ongoing accomplishments'. Our case also suggests that changing practices may be controversial since they often imply reconfigurations of boundaries, ideas, people, technologies and power structures.

Keywords: knowing in practice, boundaries, changing practices, boundary organising

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1. INTRODUCTION

This paper seeks to contribute to our understanding of how actors work on organising multiple boundaries in the quest for developing and stabilising new medical knowing in practice. Many breakthroughs in technological and scientific knowledge fail to be translated into medical practice even though they could drastically improve the efficiency and effectiveness of treatments and services. These failures often occur because these breakthroughs cut across disciplinary and professional boundaries or because they do not align well with established practices and established power structures (Newell et al., 2006:117; Robertson, 2007; Mørk et al., 2006; 2008a; forthcoming). The traditional linear modes of organising the production of knowledge creating divisions between research, development and product marketing pose barriers to knowledge integration. This calls for establishing collaborative working arrangements across heterogeneous groups of actors (e.g. clinicians, industrial scientists, managers, and practitioners) to facilitate "interactive innovation" (Newell et al., 2006).

Earlier studies viewed organisations as being circumscribed by fixed and unambiguous boundaries (Barret et al., 2007:3). Hence, the focus was often on the roles boundary spanning individuals or organisations play (Aldrich, 1979; Friedman and Poldony, 1992) or on the importance of boundary objects (Star and Griesemer, 1989). More recent studies have turned their attention to boundaries themselves, and argue that boundaries are dynamic (Hernes, 2003; 2004), emergent and enacted (Barrett et al., 2007). A few practice-based studies (Levina and Vaast, 2005: 336; Carlile, 2002; Orlikowski, 2002) have also examined the practices that give certain organisations the competence to span both professional and organisational boundaries.

Guston (1999) identified boundary organisations as playing an important role in spanning boundaries because they:

- Provide the opportunity for creation and use of boundary objects and standardised packages.
- Involve participation of actors from both sides of the boundary.
- Exist at the frontier of the two relatively different social worlds of politics and science.

Others (Agrawala, 2001; Keating, 2001 and Cash, 2001) have underscored how boundary organisations draw their stability by successfully internalising boundary negotations (Guston, 2001:402). We follow Miller (2001:484) who criticises Guston (1999) for overuniversalising science and politics, for depicting the boundary between science and politics as to clear and for presenting a static view of science and politics. We suggest that it could be useful to extend and apply the theory of boundary organisations to other domains by addressing more than just the boundary between science and politics, as the challenges of developing and stabilising new knowing in practice in medicine is also related to other boundaries. We therefore introduce the notion of boundary organising to emphasise that both practices and boundaries are always emergent and enacted. The following two research questions will be investigated: *What practices are involved in boundary organising? Which configurations and reconfigurations can be important when developing and stabilising new medical knowing in practice across boundaries?*

An ideal setting for studying this topic, we argue, is a medical R&D department developing novel surgical imaging technologies. The research material was constructed through interviews, document analysis and observations. Our case highlights that boundary organising has to do with discovering, testing, opening and closing several

boundaries simultaneously, such as the boundaries between science and politics, geographical boundaries and boundaries between different communities. Our case also shows that changing practices are always highly controversial since a transformation of current practice often implies a redefinition of its configuration of ideas, people, technologies and power structures.

The rest of this paper is structured as follows: It begins by presenting a practice-based approach to boundaries. It then outlines the methodology before presenting the case. The discussion relates this study to previous studies and highlights some contributions. The paper ends with some concluding remarks.

2. A PRACTICE-BASED APPROACH TO BOUNDARIES

This review examines research on boundaries and practice. The review starts with the notion of knowing in practice. It then turns to studies of boundaries and ways of spanning boundaries, including boundary spanners, boundary objects and boundary organisations. Finally, we introduce the notion of boundary organising.

2.1 Knowing in practice

Write a short introduction to practice-based studies and knowing in practice (Gherardi 2000; 2001; 2006; Nicolini et al., 2003; Orlikowski, 2002).

Bruni et al. (2007:85) "The idea of knowing as enactment conveys the idea of a network that is socially wove around a domain of knowledge... When we look at knowing in practice, we define it as the mobilization of the knowledge embedded in humans and nonhumans performing workplace practices... practicing is knowing in practice"

We understand practice as “a mode, relatively stable in time and socially recognised, of ordering heterogeneous items into a coherent set” (Gherardi, 2006:34). As underscored by Orlikowski, knowing and practice is “reciprocally constitutive, so that it does not make sense to talk about either knowledge or practice without the other”. Knowing as enactment (Bruni et al. 2007): 1) Knowledge is embedded in patients, 2) Knowledge is embedded in a medical community, 3) Knowledge is embedded in organizational rules and habbits, *4) Knowledge is embedded in a dedicated organisation,* 5) Knowledge is embedded in artifacts, 6) Knowledge is embedded in a technological infrastructure.

Knowledge is seen as performative and as “a dynamic and ongoing social accomplishment” (Orlikowski, 2006; 460), emphasising the emergent, embodied, embedded, and material dimensions of knowing. The material aspect of practice is emphasised, that knowing/practice is material, in line with Latour (1999, 1987), Law (1995), Pickering (2001), Akrich et al. (2001).

Orlikowski (2002:271) “because knowing is inseparable from its constituting practice it cannot be “transferred” or moved…“best practices” cannot simply be shared or transferred. Leaving aside the problematic notion of who decides what “best” means, practices are, by definition, situationally constituted. They are not discrete objects to be exchanged or stable processes to be packaged and transported to other domains. Practices are generated through people’s everyday action”.

2.2 Boundaries are dynamic, emergent and enacted

Boundaries have "been in the centre of influential research agendas in anthropology, history, political science, social psychology and sociology" (Lamont and Molnar, 2002:167). In organisational studies there has been a tendency to regard boundaries as stable (Hernes, 2004), given and with a focus on coordination across these boundaries (Barrett et al., 2007). Newer studies on the other hand have underscored that it is more useful to understand boundaries as dynamic, emergent and enacted (Hernes, 2004; Vallas, 2001), and following Barrett et al. (2007:5) we position our study in the latter stream of research. We therefore argue that in order to understand the complexity of boundaries it is problematic with the conceptions of stability and equilibrium. Mol and Law (2005), for instance, therefore use metaphors drawn from biology to illustrate the complexities of boundaries. As they put it: "ideas practice, people, or objects may change in shape as they move across geographical boundaries – and such shape-shifting may be subtle. Staying the same may depend on shape-shifting" (ibid: 638). Along the same lines Hernes (2004:10) suggests that: 1) boundaries are composite, meaning that organisations operate with multiple boundaries, 2) boundaries are central to organisations rather than peripheral and 3) boundaries are under constant change.

In the literature numerous types of boundaries have been discussed. Hernes (2003) distinguishes between mental, social and physical boundaries, and these boundaries can be both enabling and constraining. Orlikowski (2002:256) found that members in the organisations she studies"…enact ways of dealing with the temporal, geographic, political, cultural, technical and social boundaries through knowing how to navigate (i.e. articulatem attend to, engage with) as well as negotiate (i.e. redefine, reconstruct) them".

Technological innovation has also been reported to significantly contribute to reconfiguring the boundaries between professional groups. Barley (1986) observed how behaviour and thereby relationships changed as CT-scanner technology was incorporated into two different hospitals. These increases in 'complexity and uncertainty are functions of how the machine merged with the social system; they are not attributes of the machine itself' (Barley, 1986: 106). Accordingly, Black et al. (2004: 573) argues that technology is neither given by its inherent attributions, nor of its use, it is rather a matter of mutual shaping of technology and practice. The disruption of occupational boundaries between doctors and technologists following from introducing new technology made standard procedures obsolete, enforcing a relational imperative that 'suggests why doctors are more dependent on, and must give more discretion, to nurses and technicians to obtain the benefits from this new surgical technology' (Black et al., 2004: 602). This emphasizes the relational and emergent character of innovation, opening up established boundaries not just for renegotiation, but also foregrounding joint learning.

2.3 Approaches to spanning boundaries

The literature on boundary spanners highlights the importance of designating boundary spanners' *roles* as a means of cultivating the organizational ability to deal with the challenges of managing across boundaries. Numerous research studies have identified and classified the roles boundary spanners are expected to perform (eg,, Aldrich and Herker 1977; Friedman and Podolny 1992; Tushman and Scanlan 1981) – adopted from Levina and Vaast, 2005:338)

Fennel and Alexander (1987:458), using an institutional framework, focus on organisational boundary spanning, and state that: "We use the term boundary-spanning *activity* to refer to three different types of organizational behaviors: boundary redefinition, as when a hospital joins a multihospital system; buffering, or protecting an organization against disturhing environmental influences; and bridging, or connecting an organization to other organizations. Each of those behaviors represents a possible strategy for adapting to environmental disturbances by managing organizational boundaries".

Star (1989) and Star and Griesemer (1989) coined the concept of boundary objects to address the limitations implied by the reliance on boundary spanners who, in practice, may advance self-interest, have a limited social network, or face temporal and physical constraints (Levina and Vaast, 2005:339). In their study of Berkeley's Museum of Vertebrate Zoology they found that boundary objects played an important role in coordinating cooperation and diversity across the different groups of scientists. They underscore (Star and Griesemer, 1989: 393) that "boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become more strongly structured in individual use. These objects may be abstract or concrete". Over time these objects are developed through cooperation between the different groups.

ORLIKOWSKI (2002)

Carlile (2002, 2004) distinguishes between knowledge boundaries of varying complexity and the different challenges and means required to bridge them. The progressively complex boundaries in Carlile's model are called syntactic, semantic and pragmatic boundaries, respectively requiring transfer, translation and transformation. At syntactic boundaries, the message needs to be processed and transferred, and that requires a shared and stable syntax. Successful transfer across semantic boundaries requires mutual learning and an adaptive process. However, in some cases differences are more than semantic, and we may encounter clashes of interest. At pragmatic boundaries it is not sufficient to just add or combine knowledge, or to replace old with new knowledge. Successful transfer requires negotiations, the making of trade-offs and mutual transformations between the collaborators' knowledge claims. At such boundaries "knowledge is at stake", and people are reluctant to change their practices (Carlile, 2002:445).

Levina and Vaast (2005)
While Orlikowski 's (2002) work has demonstrated that an organizational competence in spanning boundaries is embedded in the everyday practice of its members, our interest is in investigating how a new joint field, where such practices are produced, emerges. To achiece this we draw on the concepts of boundary spanners and boundary objects… what is missing is an understanding of how boundary spanning mechanisms become or do not become enacted in practice… (Levina and Vaast, 2005:338). Contributions to KM: "whereas earlier works on this topic focused on how to build competencies within particular domains of expertise (communities of practice) (Brown and Duguid, 1991), more recent works have argued that another critical aspect of such competencies is in agents abilities to span multiple boundaries in practice (Beckhy, 2003; Carlile, 2004; Orlikowski, 2002). Our contribution to this litertatire is made through our investigation of how an organizational competence in boundary spanning

actually emerges in practice" (357). Levina and Vaast (2005:339) introduce a distinction between *nominated boundary spanners* and *boundary spanners-in-practice:* "agents who occupy dominant positions in a field, such as top leadership or KM groups in organizations, use the symbolic capital of their own positions to appoint themselves or others to various positions endowed with symbolic capital (Bourdieu 1998:51). Through this nomination process, organizational leaders try to foster the emergence of a new joint field across a particular boundary... However, formal structures may not coincide with actual practice that involves diverse interests and in which actions (e.g., nomination) have unexpected consequences (Wenger 1998:80). In contrast to nominated boundary spanners, however, boundary spanners-in-practice must actually engage in boundary spanning, relating practices".

In the continuation of Levina and Vast (2005), and Orlikowski (2002), we focus more on the boundaries and their (re-)organizing.

Introduction to boundary organisation. Draws upon boundary work, boundary objects, standardised packages. Gieryn (1983) on "boundary work" to discuss the boundary between science and non-science.

"To the extent that boundary objects and standardized packages provide stability, however, **they do so only through the consent of actors on both sides** of the boundary, for example, to the extent that researchers voluntarily engage in patenting or politicians accept patents as a measure of productivity. And even if blurred boundaries can be more productive for policy making, there is little sense of how much blurring is productive and how much might be destructive" (Guston, 2001:400)

"Boundary organisations attempt to solve these problems by meeting three criteria: first, they provide the opportunity and sometimes the incentives for the creation and use of boundary objects and standardised packages; second, they involve the participation of actors from both sides of the boundary, as well as professionals who serve a mediating role; third, they exist at the frontier of the two relatively different social worlds of politics and science, but they have distinct lines of accountability to each…The success of a boundary organization is determined by principals on either side of the boundary, both of whom rely on the boundary organization to provide them with necessary resources…The success of the organization in performing these tasks can then be taken as the stability of the boundary, while in practice the boundary continues to be negotiated at the lowest level and the greatest nuance within the confines of the organization" (Guston, 2001: 401)

"Boundary organization also differs from the boundary-spanning organization previously defined in the sociology of organizations. The concept of boundary spanning helps explain how organizations insulate themselves from external political authority (Aldrich 1979; Bozeman 1987)… The boundary organization draws its stability not from isolating itself from external political authority but precisely by being accountable and responsive to opposing, external authorities… although the boundary organisation may behave entrepreneurially, it is crucial to recognise as an important characteristic the stability it induces by successfully internalizing the boundary negotiations (ibid:402)

"Like Latour's (1987) Janusian visage of science itself, the boundary organization speaks differently to different audiences. Latour's science is able to project authority by appealing to either face in a strategic fashion—for example, by claiming that science is a messy, creative process and also by claiming that it is a neat, rational process.

Similarly, the boundary organization is able to project authority by showing its responsive face to either audience" (Guston, 2001:405)

The theory of boundary organisations has been criticised by Miller (2001:page), which argues that "the theory of boundary organizations needs to be expanded to examine what types of organizations are emerging and how they differ from and relate to one another. Likewise, the original theory of boundary organizations is too static to cope with the rapid changes associated with contemporary processes of globalization. International boundary organizations do not exist between two well-defined, deeply embedded institutions like politics and science… Rather, international science and politics, as well as institutions linking them, exhibit considerable fluctuations, are requiring a theoretical approach that addresses issues of process and dynamics rather than structure as its central focus"(Miller, 2001: 483, 484).

2.4 Boundary organising

In the previous subsection we introduced the notion of boundary organisations. We suggest that boundary organising is a better approach for understanding practices and boundares. As Weick (1979) underscored by focusing on organising rather than organisation the attention is put on process. Furthermore, "to grasp the practice of organising, it is not enough to study single events. The whole point is to know how they are related to other events, to study chains of events (Czarniawska, 2004:8)". The point we are trying to make is therefore that boundary organising is continuous process (refer back to knowing in practice).

By taking a practice-based approach to this domain we will be better able to conceptualise the emergent and enacted nature of boundaries. Boundary organising is a collective accomplishment that connects a multiplicity of boundaries together as new configurations or reconfiguration turns out to play important parts.

We suggest that practices in boundary organising often is linked with changing practices. Hence the interactive innovation process is of greater importance than the initial idea and its originator (Akrich et al., 2002a, b). Moreover, following Callon (1986) we see changing practices as complex processes of finding good spokespersons, interessement and alignment of elements and actors to make innovations materialize. Every little decision along the way might influence the direction of a project, and every controversy brings with it potential for success or failure. The emerging actors and associated elements gradually become an interdependent web, and therefore, the shape and development of the innovation are fully contingent upon the relations between the actors and elements. During boundary organising what counts as knowledge will often be contested by professionals trying to gain and maintain control (Newell et al., 2006:129), or as Swan et al. (2002:482) put it:

> Professionals involved in the development of innovations tend to be acutely aware of the implications for their control over particular knowledge domains – especially in relation to other professional groups – and may thus become an important locus of resistance and conflict.

Drazin (1990:245) underscores the same by stating that:

> Innovation then, can be seen as a political act, taking place within a network of partisan interactions, and invoked by professionals to advance, maintain or defend their claims to legitimate control over a professional domain.

We suggest that also professional boundaries are not given but rather open for negotiations. Both innovation and maintaining status quo are matters of establishing and stabilizing heterogeneous networks – of ideas, human actors, boundaries and technologies – not leaving any practice 'outside politics'. As Nicolini (2007:917) put it, 'there is no change in practice without empowerment and disempowerment'.

3. METHODOLOGY

Case studies are well suited when real-time events and processes are not easily distinguishable from their context (Yin, 1994). We have done our case study at the Interventional Centre, Rikshospitalet University Hospital, University of Oslo. The case study site is unique in a Norwegian setting with its cross-disciplinary composition and focus on organisational, medical and technological innovations[ii]. The centre was established to develop new practices by utilizing new imaging technologies and minimally-invasive techniques, and compare these practices with the established ones. These new practices require close collaboration between medical and non-medical professionals.

Our research material was constructed through observation, interviews and document analysis. The first author was afilliated with the centre from 2000-2006 (as a project coordinator from 2000-2003, and then as a PhD-student). We conducted in total 38 interviews with members of all occupational groups. The interviews focused on practice, and they mostly lasted from 45-90 minutes, but occasionally up to 270 minutes. All interviews have been fully transcribed. These transcriptions have thereafter been coded and organised into matrixes to get a better overview and to search for 'patterns, contrasts and paradoxes' (Coffey and Atkinson, 1996). We contacted the quoted informants to ensure that the translations from Norwegian are in line with what they stated. Our approach was exploratory to develop insights, and inspired by grounded theory (Glaser and Strauss, 1967), nevertheless significantly shaped through the interplay between theory and the research material. As writing the case study was an iterative process, we revisited our research material several times. Our current aim (to explore practices involved in boundary organising) was not initially clearly formulated. During the writing, discussion, review and rewriting process this focus became clearer, and accordingly the sense we made of the research material changed. We have shared our findings and interpretations with our informants, and these discussions sharpened our interpretations.

4. BOUNDARY ORGANISING IN A MEDICAL R&D CENTRE

In 2006 the Interventional Centre celebrated its 10 years anniversary. According to the centres Annual report 2006 their activities had given the following output:

- 12 PhDs (and another 28 ongoing PhD programs)
- 43 master theses
- More than 200 publications

[ii] Following Tuomi (2002) we understand innovation as change of practice.

- Coordinator of one EU project project and member of another
- Treatment of more than 5000 patients
- Development and export of over 20 new medical procedures
- Owner of minority shares in three companies established as a result of research at the centre
- 20 patents

The Interventional Centre has therefore received a lot of recognition, both nationally and internationally for their ability to develop new knowing in practice. Our informants give several reasons for this success:

- Availability of high-tech, expensive equipment and technical support.
- The personal relationships between individuals working in physical proximity.
- Motivated staff sharing a common vision.
- The (relatively) sheltered role as a R&D department and not just a production department, having the time to do procedures of long duration and the formal permission to use animals for training (Mørk et al., 2008).

In this paper we suggest that boundary organising has also played a key role. In the following we will take a closer look at how this unfolded in practice. The history has been into four periods, as this allows us to discuss different aspects of boundary organising. These aspects are, however, present in all of the other periods, but in various degrees of blend.

4.1 FROM IDEA TO MAKING A DECISION TO BUILD THE CENTRE (1990-1996)

During the latter decades new medical imaging technologies have emerged and blurred the boundaries between diagnostic and therapeutic work. Most imaging techniques (e.g. x-ray and magnetic resonance imaging) were initially developed and used for diagnostic purposes, like pre-operative examinations. In the 1990's radiologists started doing simple interventions when the patient was on the examination table rather than just investigating them. Guided by images, small balloon-tipped catheters were inserted into blood vessels to expand partly blocked lumens. Similarly, surgeons started using imaging techniques, not just for pre-examinations, but for imaging support during the operation. Ultrasound or videoscopic techniques became increasingly used requiring that surgeons ventured into the area of image interpretation in order to perform the surgery. This blurring of boundaries between the practices of radiologists and surgeons necessarily evoked conflict. Each group claimed "ownership" to the treatment and to the patients eligible for it. Despite these disputes, the indisputable benefits of the less invasive therapies were recognised several places in the world, especially in the US.

The idea behind an interventional clinic had gradually evolved while Dr Frode Lærum worked as a radiologist[iii] in Minnesota USA in 1980 and later as an assistant surgeon at the department of radiology at a Norwegian hospital. The latter radiology department started using new practices within radiology early. In 1991 Dr Lærum and a surgeon, Dr Arvid Stordahl, were students at the Institute of Health Management and Health

[iii] A radiologist is a medical doctor specialised in imaging. During traditional pre-surgery imaging, the radiologist interprets the image and reports on the findings, without necessarily seeing the patient. During a radiological intervention, such as angiography, the radiologist is present, places the catheters and evaluates the results based on the images (Mørk et al., 2008).

Economics University of Oslo. During their own work they had experienced that different hospital departments to a low extent knew the practices of other departments even though they were located next to each other. At the same time they had experienced that radical innovations often occur in the interstices between practices rather than within the traditional professional boundaries (Fosse, 2007:66). On this background they initially planned writing a thesis about why it was important to establish interventional clinics headed by radiologists. However the research community at the University of Oslo in general, and the leder Professor Ole Berg in particular, made them realise that:

> Surgeons are not important. Surgery is important! Radiologists are not important, the practices of radiology are important! We have a social responsibility for focusing on practice rather than discipline (Lærum, 2008).

Hence, "we therefore need communication and work forms that takes care of these challenges in new ways… the methods should focus on practice and the need for crossing department boundaries" (Lærum and Stordahl 1991:29).

These ideas were radical, so they early realized the need for mobilising support, and published 5000 copies of the thesis in book form that were widely distributed to the medical community all over the country.

One year later Lærum and Stordahl (1992) argue that a grey zone between the responsibilities of the different professions had appeared, in which one needs to define frameworks for cooperation and define problem tasks for the different professions. One should also establish a technological/clinical hospital department combining features from X-ray with operating department to overcome departmental and professional boundaries.

Mobilising support for their radical ideas was seen as crucial. Rikshospitalet (the national hospital) was very positive to the idea, and in 1994 they therefore established a working group headed by Dr Lærum to start planning an independent medical R&D department. Dr Lærum and another well-regarded doctor thereafter visited all university hospitals in Norway to mobilise support for their idea. Most hospitals had a positive attitude, and the Norwegian Medical Association and the Norwegian Research Council also supported the idea.

However there were also counterfources:

> When we presented a model for an interventional centre emphasizing horizontal communication rather than hierarchical structures and relational capabilities rather than individual that was like stir up in a hornet's nest (Sundar, 2003).

The managing director at a neighbouring university hospital stated the idea was "an interesting intellectual excercise", but that their hospital, as the only one in Scandinavia, was developing new methods in interventional radiology, and with a higher volume than Rikshospitalet. Another hospital emphasised that they were the leading hospital in Norway in keyhole surgey, and since they had just applied for status as a national competence centre in keyhole surgery they could not support this idea (Husom, 2007).

Around the same time GE-Healthcare invited Rikshospitalet take part in a research collaboration to develop an open interventional MRI[iv]. The motivation for sending this invitation was the plan for establishing a cross-disciplinary interventional centre. This was also a prerequisite for participating in this collaboration, and the MRI had to be purchased in 1996 (Fosse, 2001). In this period there was also a lot of focus on the fact that several hospitals were using advanced minimally-invasive therapies, where quite a few of the patients were harmed. This was brought to the attention of the Norwegian Parliament (Husom, 2007).

During his master studies at the University Lærum studied together with the person who became the health minister in the mid 90's. Lærum had also been in Moscow together with the director of the University of Oslo, making it easier to get support from these two key actors.

On the basis of a constellation of all of these facts the Norwegian Parliament therefore decided to grant 90 MNOK to build an interventional centre in 1995 (Fosse, 2007).

4.2 ESTABLISHING THE INTERVENTIONAL CENTRE AS A COMMON TOOLBOX (1996-2000)

In 1996 the Interventional Centre was established responsible for the following four tasks:

- Develop new procedures and methods
- Develop and establish new treatment strategies
- Perform comparative studies between new and established treatments
- Study social, economic and organisational consequences of new treatments

It was seen as crucial that when procedures had become routine, they would be exported to other places. Otherwise the centre would become a bottleneck (Røsjø, 1996)

In Fosse et al. (1999) and Fosse (2001) it is argued that the Interventional Centre came as a natural consequence of the industrialization of medicine. It is argued that in production companies they have clearcut boundaries between research, development and production. This had never been the case in medicine. Hence, "it is crucial to define more clearly the boundaries between production and development" (ibid: 297).

Both the specialised equipment and the staff at the Centre should constitute a 'common toolbox on neutral ground' to be used by other departments at the hospital as well as by research groups at other hospitals or institutions. In attempting to create a common ground for cross-disciplinary work across specialist boundaries, a certain degree of 'diplomatic work' had obviously been necessary in order to avoid turf battles. The centre was not located within any of the already existing hospital buildings. Instead a new building was erected on 'neutral ground' in the hospital park area, where no single group (i.e. medical speciality) had any special claims. The rooms within the building where the medical procedures were performed, were equipped like combined radiological examination rooms and operation theatres, but were formally classified as radiological laboratories. A balance between radiologists and surgeons in the staff, both

[iv] Magnetic resonance imaging (MRI) is primarily used in medical imaging to visualize the structure and function of the body. MRI provides detailed images of the body in any plane.

in general and at the top level in particular, has always been explicitly pursued (Mørk et al., 2008).

The head of the department was a thoracic surgeon, which was problematic as it opposed the traditional model of professional collegial leadership. The National Medical Association discussed the organisation of the IVC. The question was whether a surgeon could be the leader of a department with radiologists and anaesthesiologists. The centre would challenge some well defined boundaries. There were also continuous economic, organisational and political disputes around ownership of patients and procedures between the different departments involved in this period. These disputes were centred on which department should supply the IVC with the necessary personnel, who should pay for the technology and consumables used in the procedures and who should decide on the patient treatment.

In this period the centre consisted of surgeons, engineers, nurses, radiographers. The centre also had several doctors affiliated with the centre in part time positions, but with their mother department as main employer. This was done in order to open up the boundaries between the different departments to get a closer collaboration, while at the same time letting these doctors work within the boundaries of the centre. A steering committee with representatives from most departments at Rikshospitalet and from other University hospitals was responsible for making decisions about activities at the centre (Fosse et al., 1997).

It soon became evident that to develop new surgical techniques in the open MRI was more challenging than anticipated, since they needed tools that could be used in areas with strong magnetic fields. Hence, in this period the dominating activities in the MRI were development of diagnostic and technological procedures (Fosse et al., 1997; Fosse, 2001).

Insert picture 1 of MRI

Despite the fact that technology was seen as crucial for the centre, the annual seminar in 1998 revealed that there was a need for discussing not only the strategy of the centre (should it be a production department or a R&D department), but also to what extent the department "really was cross-disciplinary", or just reproducing the old boundaries between doctors and the other groups. One of the surgeons puts this challenge this way:

> This was an extension of cross-disciplinarity. If you have high-tech around you the engineers must be involved. It is a totally new setting. Now you are just a central piece of the puzzle, not necessariy the most important piece of the puzzle, around the patient. This is a totally new situation for any surgeon.

The centre therefore started to focus on how to cross the professional boundaries better. This included the way projects were planned, meetings and so forth. There were also many interesting technology projects that were undertaken within areas such as robotic surgery (an engineer partly funded by an American company) worked on his PhD in this area, and they also started working on simulator technology. Neurosurgeries (brainsurgery), keyhole surgery in the abdomen (laparoscopy) are just a few examples of the areas where the centre had several projects.

In the period 1996 until April 14 2000 the Interventional Centre conducted 1736 procedures on patients and 122 procedures on animals (Fosse, 2001). They also

focused on becoming part of large international networks in an attempt to span boundaries and to develop new knowing in practice.

In this period it was very important to mobilise support for the Interventional Centre so that they could continue their activities when the hospital moved into new facilities in 2000.

4.3 STABILISING THE INTERVENTIONAL CENTRE (2000-2004)

In August 2000 the Interventional Centre moved into their new hospital facilities. The centre had in the previous period started a number of both technical feasibility studies and clinical outcome studies. In 1999 they had for instance started a large randomised study on the use of beating heart surgery ('the off-pump project'). This project started after a pilot study involving procedures on animals as well as around 60 human patients during the years 1996 through 1999. The clinical outcome study involved 120 patients and was a large and long-term project (1999-2002) involving 7 different departments at the hospital (radiology, thoracic surgery, physiotherapy, psychosomatic, neurology), and over 60 individuals. This project resulted in numerous publications and several PhDs. The project also resulted in international recognition for high quality research. Another advantage with such a project was having many patients also leads to the production of many DRG (Diagnose Related Group) points, which is an important part of the funding of hospitals. Despite being a R&D department the centre and thereby having funding not directly related to production, they actually produced more DRG points than the amount of money the hospital should give them.

After finishing the off-pump study the centre had several other randomised studies in the area of beating heart surgery. In one of these studies they investigated the results of using a connector device for bypass grafts and compared it with the traditional suture (sewing) technique. 46 patients underwent bypass surgery (23 with the new technology), and the conclusion was that the old practice showed significantly better results than the new (Bergsland et al., 2004). Since this new practice already had been used on more than 100.000 patients in the US, this underscored the importance of having a clear boundary between production and development in medicine. Fosse (2003:1733) emphasises that "it is necessary to have a clearer boundary between development and production also within the traditional departments, out of consideration to the patients and in order to get control of costs". Later this product was witdrawn from the market.

The boundaries between the activities of the centre and other departments as well as the boundaries between the different professional groups had also constituted some challenges. The centre therefore reorganised from a classical design to a matrix design in the fall of 2001:

> This was exiting! We had to change as a consequence of what we had constructed. We needed to put more emphasis on cross-disciplinary work. We also had to make sure that all projects now included resources from different disciplines, and were development projects, not production. (Engineer)

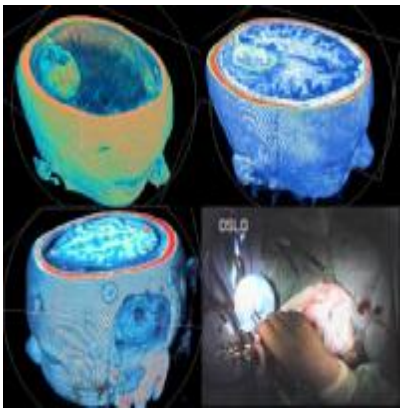
Another engineer stated:

> A modern hospital is very different from the old ones. Health personnel need to collaborate with professionals having technological, economical and organisational knowledge. This is where cross-disciplinarity comes into the

> picture. Health care professionals are still setting the premises, but the the organisation is not only therapeutical; it is also a place for developing new practices… (Engineer)

As expected, reorganizing in itself would not necessarily lead to more cross-disciplinary focus, and in the annual seminar in 2004 this was addressed. However, it was clear that the centre was "moving in the right direction, but it would take time" (nurse).

Technology projects became increasingly important in this period, and real-time imaging is one example. This allows surgeons to get pictures during the operation in the brain (for instance) rather than having to move the patient out of the centre and to a radiological department.



Picture 2. Real-time imaging during neurosurgery (brainsurgery)

The boundary between science and politics was also important in this period. In 2002 the Norwegian government launched a reform that shifted the ownership of the hospitals from the counties to the Government, and five regional health enterprises with substantial autonomy replaced the former five health regions. These different regions would also compete about the rights to treat some of the patients. The challenge was in particular difficult for Rikshospitalet, since they were receiving patients from all over the country. The Interventional Centre had as their mandate to develop new knowing in practice (???) and then to transfer this to other departments and hospitals, so it was not trivial to give away new techniques to health regions that were competing for the same patients. Actors from the centre discussed this challenge with central politicans (including the health minister) on several occasions, but without any result.

In 2003 it was evident that the open MRI from 1996 now was too old and needed to be exchanged with newer technology. The centre also had two external evaluations that pointed at the importance of having new technology as well as access to patients. The evaluation from an international committee appointed by the hospital (2003) states:

> 1. The creation of the Interventional Centre at Rikshospitalet is the embodiment of an innovative and far-reaching concept. 2. The broad strategy, the facilities provided, the central funding of the projects and its locations in a world-renowned were correct decisions which have produced positive results. Perhaps the creation of the units from the Department of Cardiac Surgery resulted in too much focus on cardiovascular work … 3. With appropriate strategic restructuring it can

maintain and increase its role in research in minimannly invasive therapy in the future" (Fosse, 2007:161)

The Norwegian Research Council also initiated an evaluation which emphasised that (in Fosse, 2007:162, 163):

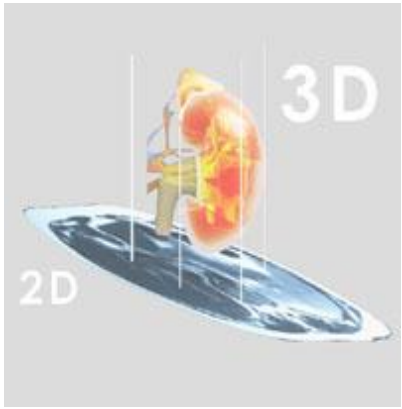
> There is worry about lack of "buffer funds", the economy being entirely based on high throughput of study patients. The current good economy may thus rapidly change if there is a reduced inflow of patients. The main threats are considered to be lack of acceptance of the concepts and, in some cases, a lack of understanding from health care authorities. There is also a risk for competition from other centres with a similar profile… but this unique unit has good chances to develop into an innovative example of the "operating room of tomorrow".

4.4 FROM THE INTERVENTIONAL CENTRE TO THE VISUALISATION CENTRE (2004-)

In 2004 the centre applied to for status as a national competence centre to overcome the boundaries between the different health regions. Several hospitals interpreted this as an attempt to get a monopoly situation, therefore the centre did not receive the necessary support, and they withdrew their application.

In 2004 the Interventional Centre received funding for the ARIS*ER (Augmented Reality in Surgery) project. The project consists of 8 Partners: 6 Academic institutions (including hospitals) and 2 Cutting edge technology companies. The consortium seeks to bridge between clinical users and technology developers, between academia and industry and between different technology disciplines.

To provide the doctor with decision support for treatment by communicating comprehensive information from multiple sources, to guide the procedure by means of visual and haptic feedback. Guidance is based on several imaging modalities, such as ultrasound, MRI and video-endoscopy. Through this research, a group of young researchers is being trained to work internationally and multidisciplinary. The team is working across the boundaries of medical interventions, information and communication technology development, and user interface design.



Pictures 3 and 4. Images from the ARISER project

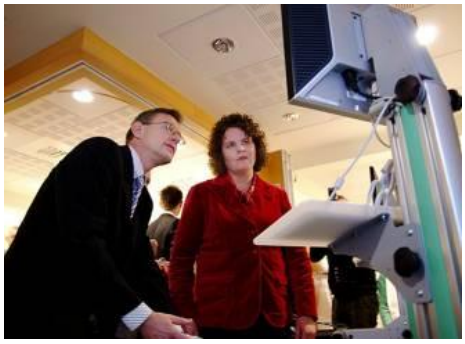
The technology developed in ARIS*ER is user-driven. The end-users of the technology will be surgeons and interventional radiologists working to give the best possible care to

patients. The clinical experts in this work package play an important role in specifying details for the targeted clinical applications.

Major changes occurred at Rikshospitalet in 2004 since it was decided in the national budget to build a national PET[v] centre with a cyclotron and a PET scanner located at Rikshospitalet. The imaging research groups at the University of Oslo and at Rikshospitalet considered this decision as a great opportunity. The building of an advanced research facility for imaging was suggested, and enthusiastically supported by the hospital administration. They therefore decided to build a new "Visualisation Centre" including the new PET centre, the department of nuclear medicine and an extension of the Interventional Centre with two new imaging laboratories/ORs. In one of these rooms a new MRI would be installed. The arguments were that it was crucial to make this decision fast since it otherwise one could run the risk of loosing key personnel, industrial actors could choose other collaborating partners, Rikshospitalet could loose its academic status if they did not invest in new technology and this was crucial both for the patients and for Norwegian health care in general (Annual report 2004; Fosse, 2007).

The building for the Visualization Centre was erected in 2006, and the PET centre has been opened. However, there still remains 150MNOK to realize the vision of starting the centre, so they have appointed a committee to continue working on this issue. They hope to start using this centre in 2009.

On November 16th 2006 the Minister of Trade and Industry Dag Terje Andersen and the Minister of Health and Care Services Sylvia Brustad launched a new initiative for healthcare related business development. The initiative was part of the National Health Plan for 2007, and the objective was to prioritize innovation by creating links between industry and research institutions.



Picture 5. Jan Sigurd Røtnes from SimSurgery had to step in when the Minister of Health and Care Services tested her abilities as a surgeon on a simulator

"It is not coincidental that we launch this program here", said the Minister of Health and Care Services Sylvia Brustad. "You have many good examples of how innovation leads to better patient treatment and better organising of medical treatments".

[v] Positron emission tomography (PET) is a nuclear medicine imaging technique which produces a three-dimensional image or map of functional processes in the body. PET is both a medical and research tool. It is used heavily in clinical oncology (medical imaging of tumors and the search for metastases), and for clinical diagnosis of certain diffuse brain diseases such as those causing various types of dementias. PET is also an important research tool to map normal human brain and heart function (source Wikipedia)

Picture 6. Managing Director for Rikshospitalet and Minister of Trade and Industry showed great interest in the simulation techniques from SimSurgery

In December 2006 a contract with institute of psychology at the University of Oslo was signed for collaboration about new MRI technology. This could again be linked to stem cell research where they cultivate new tissue and new cells. The new MRI technology makes it possible to monitor this treatment. Moreover, it makes it possible to monitor the destruction of tomours with ultrasound. These technologies therefore move our understanding of diseases from a macro anatomical til a micro anatomical level. The collaboration with the institute of psychology aims at contributing to our understanding of memory (source, 2007).

Picture 7. The open MRI is lifted out of the roof of the Interventional Centre.

In April 2007 a new MRI was installed at the Interventional Centre.

In January 2008 the Interventional Centre arranged a seminar for the all employees where they discussed how the centre was developing. The centre currently has a budget of 30MNOK per year, from which 18 are funded by the hospital. A challenge that they need to address is how to become better integrated into the hospital, and to get easier access to patients. They have therefore been in touch with another service department at the hospital called operation 3. Operation 3 has more than 5500 patients per year, whereas the Interventional Centre has around 600. The head of the department stated:

> We are a development department, but we are also a production department. We observe that the patient flow will be increasing, and we need to organize better to meet these changes. We need a predictable and clear structure. Nothing has been decided yet, but we have started looking at each other, and we find each other a bit attractive.

Summing up…

5. DISCUSSION

We have in this paper presented a cross-disciplinary medical R&D department. We shall not pretend that the story above is the only version. It was constructed to shed light on the importance of handling a multiplicity of boundaries simultaneously when trying to change practice. These processes are frail, unpredictable and open-ended. The actions of individual actors are at times important as to whether the process will start, continue or depart. The innovation process is formatted and configured by the setting and by the unfolding of the process. The case illustrates how certain individuals have worked to build alliances, mobilise resources and become part of various networks. The availability of resources, the chance encounters, the physical proximity, etc are all also having their effects (Mørk et al., 2006).

We suggest that it could be useful to extend and apply the theory of boundary organisations to other domains by addressing more than just the boundary between science and politics, as the challenges of developing and stabilising new knowing in practice in medicine is also related to other boundaries. To emphasise process rather than an entity we follow others (Weick, 1979; Orlikowski, 2002; Nicolini et al., 2003; Hernes, 2008) who talk about organising. The following two research questions have been investigated: *What practices are involved in boundary organising? Which configurations and reconfigurations can be important when developing and stabilising new medical knowing in practice across boundaries?*

Our case highlights that boundary organising has to do with discovering, testing, opening and closing several boundaries simultaneously, such as the boundaries between science and politics, geographical boundaries and boundaries between different communities. Like Orlikowski (2002), we studied how boundary practices are collective 'ongoing accomplishments' (Feldman, 2000). Our case also shows that changing practices are always highly controversial since a transformation of current practice often implies a redefinition of its configuration of ideas, people, technologies and power structures (Barley, 1986; Nicolini, 2007; Robertson, 2007).

In relation to Orlikowski's (2002) work on overcoming boundaries of various kinds, we claim that where she has studied practices of overcoming boundaries, and hence handling boundaries as rather stable, our study has put the boundaries themselves under scrutiny. This has allowed us to also see boundaries as 'enacted in sociomaterial practice, and as 'ongoing social accomplishments', to borrow from Orlikowski. Boundaries and their configurations are continuously changing, both as environmental factors change, and as involved actors engage in boundary organising activities to enhance their interests and realise their vision. Thus, boundaries have to be seen as continuously changing, as controversial, and as something that may be changed and reorganized/reconfigured. Hence, what we have explained is the organizing of boundaries, in order to change or establish new practice, via a study of actors opening, closing, and reconfiguring boundaries in their efforts to establish a new boundary organising (and functional) practice.

We have also drawn upon Levina and Vaast (2005), who studied how boundary spanning in practice emerged over time. Whereas their focus was more on how individuals become boundary spanners in practice (as opposed to nominated), we focused on the boundaries that were opened or closed when the centre tried to develop and stabilize new knowing in practice.

On several occasions the informants referred to the term ”optimal settings” as a necessary and attractive condition for changing practices, referring to how the Interventional Centre managed boundary organising. However, it is a dilemma that it is (perceived as) necessary to develop these new procedures under conditions that are utopian for most other hospital departments. The assumption of ‘optimal settings’ might well be perfectly true, but nevertheless, it might mislead both practitioners and the researchers studying them to believe that developing new knowing in practice simply has to do with developing best practices at the centre and then move it to other places. We follow Orlikowski (2002:271) who argues that “best practices cannot simply be shared or transferred... They are not discrete objects to be exchanged or stable processes to be packaged and transported to other domains. Practices are generated through people’s everyday action”. Indeed whereas the centre has been able to focus on boundary organising this will often not be the case elsewhere. Translating innovations into new settings therefore involves mobilising not only the procedure in itself, but also how it was developed, and how it is seen from different viewpoints. This means that the innovation either needs to be shaped in a way suitable for adaptation to local settings different from the IVC, or be accompanied by aligning and organising the receiving unit for handling the demands of the new practice.

Finally, we believe that boundary organising shows how “something perceived as stable, even if only temporarily, may emerge from something that is inherently unstable and where many possibilities exist for what might follow” (Hernes, 2008: xvii).

6. FINAL REMARKS

With this paper we seek to contribute to our understanding of how actors work on organising multiple boundaries in the quest for developing and stabilizing new medical knowing in practice. Whereas several other studies have focused on the role of individuals, objects or organisations to overcome boundaries, we wanted to put boundaries as such under scrutiny. We have investigated practice in a cross-disciplinary medical R&D department through a longitudinal case study. The paper introduces the notion of boundary organising as a continuous process of discovering, testing, opening and closing several boundaries simultaneously rather than coordination across some fixed boundaries. By taking a practice-based approach we will be better able to conceptualise the emergent and enacted nature of boundaries. Boundary organising is a collective accomplishment that connects a multiplicity of boundaries together as new configurations or reconfiguration turns out to play important parts. Our case illustrates how boundaries at some points are opened; other times are closed when changing practices. Finally, we wish to emphasise that we believe that it is important to acknowledge how processes of changing practice are open-ended, fragile, and often highly political.

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