Institutionalizing innovation

Instances of change in the Danish system of innovation

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INSTITUTIONALIZING INNOVATION: INSTANCES OF CHANGE IN THE DANISH SYSTEM OF INNOVATION

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Abstract:

Policy changes, globalization, and an intensified focus on knowledge in society relays a new role for universities and national laboratories where research is pursued to a larger extent in co-operation with industry. Research institutes must innovate or evaporate yet how to navigate and support innovation, including which aspects to formalize, remains vexing to most.

This article explains how innovation became integrated in the general conceptualization and practice of technology transfer at Risø National Laboratory in Denmark and how these innovation activities were – and were not- institutionalized. Through an empirical investigation of the pragmatic routines, communicative practices, and strategic concepts developed and deployed, it becomes clear that the greatest advantages derive from

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balancing tensions between preparedness of mind and openness to new interpretations of technical problems and their contexts.

Key words:
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1. INTRODUCTION: THE LAB IN A KNOWLEDGE SOCIETY

Policy changes, globalization, and an intensified focus on knowledge in society relays a new role for national laboratories and universities in the post-industrial society. This focus on applied technology (Hargadon, 2006; Rosenberg & Nelson, 1994 p. 355-7) has been brought to the fore with concepts like National Systems of Innovation (Lundvall et al., 2002; Lundvall, 1992; Lundvall, 2005), Triple Helix (Etzkowitz & Leydesdorff, 2000), and Mode 2 (Nowotny et al., 2003) which emphasize the importance of knowledge creation in society at large and point towards a trend where research becomes more applied and is pursued to a larger extent in co-operation with industry. However, how such role transformations actually occur within institutions – on the level of policy, practice, identity and knowledge – remains a dark area of scholarly attention.[3]

This article tells the story of how 'innovation' became the strategy of technology transfer at Risø National Laboratory in Denmark and how these innovation activities were then institutionalized. The general strategy of Risø has historically been to create, develop and apply technology for the benefit of society. Traditionally this strategic research has been pursued in long term strategic programs within a larger political framework.

As all national laboratories, Risø is a special policy case tasked to diffuse knowledge in society. That is, they are specifically accountable to the social good. Historically, their main strategic area has been energy and though they have expanded their research areas over the years, they faced an

[3] With the notable exceptions of (Bozeman, 2000; Colyvas et al., 2002; Howells, 2006; Jacob et al., 2003; Miller & Garnsey, 2000; Rogers, 2002).

identity crisis as the last nuclear reactor was closed in 2000. By then the political climate was changing and the university system at large was given a new assignment – innovation. In 2000 the only formal Technology Transfer Office of Risø employed was a patent jurist and the few efforts to improve the relation to industry were handled by the human resources department. Risø was then tasked with justifying a new existence in a new political climate – a move that would demand increased interactions out of the asylum of basic research.

At the turn of the millennium the political winds shifted towards more market accountability and a focus on boosting knowledge creation in society. This post-nuclear laboratory born of Cold War politics and an insular mentality faced an ultimatum: innovate, that is, demonstrate a greater focus on technology transfer to industry (hence society), or close down operations. Part of Risø's reaction is to invoke *innovation* as a strategic resource, which thus gives answer to both challenges from the political milieu- to increase knowledge creation *and* market relevance.

Once "innovation" is on the strategic headline, what happens? Can innovation be institutionalized? This article reaches into the practices, identities and models (re)formed by researchers and administrators at Risø to build in innovation. By digging into the different methods and conceptualizations of innovation employed, this article provides a detailed look into what happens when a historically entrenched institution is faced with the choice to innovate or evaporate.

This article is an investigation into instances in the transformation of the Danish innovation system involving how a national laboratory develops

new meanings of technology transfer and knowledge brokering. The story reveals what Bozeman in his analysis of national laboratories terms a move from a “mission” technology policy paradigm to a more “cooperative” one (Bozeman, 2000). In this telling, the government goes from dictating areas of strategic research to supporting direct cooperation between research and industry.

The transformation of Risø started to take shape in 2002 when a new Vice President – Jon Wulf Pedersen – was hired. His expertise hit squarely on helping institutions become more innovative. Although Risø has demonstrated a good understanding of the importance of industrial relations, innovation was still seen in the old Schumpeterian sense with a process from discovery to market (Schumpeter, 1975 [1942]; Schumpeter, 2002 [1934, 1912]).

However, during Pedersen’s work to set up a more permanent innovation task force, the very notion of innovation was transformed multiple times. We see a movement at Risø from thinking of innovation in terms of industrial relations, to technology transfer, to a need driven practice. (Clark, 1985; Rothwell & Zegveld, 1985; von Hippel, 1976; von Hippel, 1994; von Hippel & Tyre, 1995) This follows the trend in innovation and in technology transfer literature away from the linear understating of how technology diffuses in society. Schumpeter’s view that an innovation starts out as an invention and then moves towards the market has evolved to a more iterative and interactive understanding of innovation in general (Rothwell, 1986; Rothwell & Zegveld, 1985; von Hippel, 1986)

and technology transfer in particular (Capart & Sandelin, 2007; Williams & Gibson, 1990).

The Risø case is both illustrative for the policy discussion that can be seen in theories like mode 2 (Nowotny, Scott, & Gibbons, 2003) and triple helix (Etzkowitz & Leydesdorff, 2000) yet the case also contributes to theory building (Eisenhardt, 1989) on the role that technology transfer can play in such an environment. In this sense it is an illustration of how a national laboratory acts, proactively, in the transformation of the Danish innovation system (Lundvall, Johnson, Andersen, & Dalum, 2002; Lundvall, 1992). With the help of the notion knowledge brokering (Hargadon, 2006; Hargadon & Sutton, 1997) we build a theoretical vocabulary for how innovation is institutionalized and how the people working with these institutions reinterpret "technology transfer".

This reinterpretation can be seen both in work practice and in the use of the notion innovation. This reinterpretation is both a reaction to an external policy change, but also an internal process where the people working with innovation learn from experience. Through their experience researchers and managers at Risø build up an undogmatic relation to innovation that sees technology transfer as working with different experiences coming together in dialogue. The researchers that participate in this dialogue are not just experienced in the sense that they are well versed in their expertise, but also in the sense that they are open to new experience. We use Gadamer's hermeneutics show the importance of this latter kind of experience to invoke a dialogue that facilitate the emergence of new

constellations between technology and market. (Gadamer, 1989 [1975, 1960])

In section 2 we outline the changing political environment that induces the focus on innovation at Risø. In section 3 we sketch some of the early experiences of working with innovation at Risø and present a case that had great influence on the understanding of innovation at Risø. In section 4, we describe the institutionalization of innovation at Risø and the concepts that constitute the institutionalization. In section 6 we discuss the competences that the people working with innovation at Risø have built up. And finally in section 6 we draw some conclusions.

2. THE POLITICAL TRENDS: INNOVATE OR EVAPORATE

The instances of change towards innovation at Risø started with the hiring of a new vice president and the eventual formulation of Risø Innovation Activities (RIA) – the main character in this drama. But before we discuss the development and implementation of the practice of need driven innovation[4] some contextual background is helpful.

2000-2006 was a turbulent period in the Danish educational and research system as the government was considering fusing universities and closing research labs. Many reports and political action plans were published, sometimes with different conclusions and emphasis, and there

[4] When talking to and reading the documents of RIA we have encountered different notions to name this practice. Need driven, problem driven, consumer driven and market driven are often used to capture the strategic intent of tearing down the walls between Risø and the rest of the world. We see need driven as the most general of these terms, and thus, we use it in this text. It involves public institutions (not only market) and takes into account that an innovative idea can too vague to be captured as a "problem".

was a lot of momentum and political will to restructure the whole university system.

One report advised that Risø, and other national laboratories, should merge with different universities, thus building on the idea that education is the best way to diffuse knowledge into the society (Danmarks Forskningsråd, 2002). However, only a year later a new report- or in this case an 'action plan'- came recommending a deeper cooperation with industry, thus emphasizing the idea of innovation as knowledge diffusion. The governmental action plan from 2003 entitled "New ways of interaction between research and industry – turning science into business" states:

> The Danish Government intends with this action plan to make it more attractive for both knowledge institutions and the business and industry sector to meet and collaborate. A higher number of business enterprises should be given speedier and easier access to knowledge to allow it to blend in with their products, services and production. (Danish Government, 2003 p. 7)

This call to tighten the cooperation between research institutes and industry is also reaffirmed the Danish Globalization report from 2006 (Danish Government, 2006), the governments strategy to deal with globalization[5].

[5] These kinds of discussions follow a 2000 act that gave universities the right to retain patents on inventions (Videnskabsministeriet, 2004). This was inspired by the American Bayh-Dole act that has a similar formulation and mission to promote innovation and growth in society at large. However, before 2000 Risø was under the general act that gave private companies the right retain patent on inventions made by the employees. Hence, this was not new to Risø, but it gave a new dimension to the political discussion concerning the future of the research institutions. From now on, also the universities had the assignment to support growth with commercial means and for Risø this meant that it was compared with the universities on several dimensions.

The overall political trends in Danish society – an illustration of the theoretical discussions on higher integration between research and industry (Etzkowitz et al., 2000; Lundvall, Johnson, Andersen, & Dalum, 2002; Lundvall, 1992; Nowotny, Scott, & Gibbons, 2003) – as the Danish innovation system is moving towards a "cooperative" model (Bozeman, 2000) is an emphasis on commercializing the relation between university and industry. This political shift then implies new roles for both Risø and other research institutes, including the university.

There are at least three ways that Risø attempts to position themselves as a unique asset in the research and university system in Denmark. The first is their ability to handle large project and large facilities, like the nuclear power station of yesterday and today's clean room, cyclotron and biosphere house. Secondly, Risø injected a new vigour into all teaching activities in direct response to the governmental reports that linked the role of education to knowledge diffusion. The last, and the focus on this article, has to do with innovation.

Innovation is not new at Risø, yet the political changes mark new understandings of what constitutes innovation. During the 90s there was a focus on industrial relations and in 1999 a SPIN (Situation, Problem, Implication, and Need-payoff) course was offered to help researchers communicate with industry. The philosophy of SPIN is to learn to listen to the problems of the customers, which later became one of the basic principles of innovation at Risø.

Further, we can also see that the notion of innovation gets a more prominent place in the formal strategies of Risø. In 1996 innovation is

mentioned as an activity, in 2000 it has become part of the mission, and in 2004 it is a strategic area (along side with heath and energy). The strategic area of innovation was formulated as:

> We build up **competence platforms and ensure knowledge-sharing** through establishing and managing networks where our know-how can come out into a larger sphere. We provide students and the business sector with access to frontline research and major research facilities. Through special **innovation activities** we systematize the transfer of knowledge to concrete business concepts. We enter into cooperation with existing enterprises and initiate start-up companies. We are out-reaching and together with business enterprises we solve the technical problems that stand in the way of creating new products. We undertake **customer-driven activities**, solving specific assignments and problems for e.g. private companies on commercial terms. (From web page)

While the emergence of innovation as a strategic intent took advantage of fertile ground laid from past commercial successes and rhetoric at Risø, innovation and knowledge creation as voiced in the political milieu had a significant impact on the new innovation activities at Risø that led to the development of RIA.

A noteworthy institutional force to bring innovation on the table occurred around 2002 with the hiring of Jon Wulff Petersen as Risø's Vice President. The board of directors decided upon Petersen because of his work as the head of Micro Electronics Department at the Danish Technological

University (DTU) where he had introduced a more interactive relationship with industry. Petersen's opinion on technology transfer was quite strongly bent towards a focus on innovation and start-up. For him the justification of strategic research was the effect on GDP, that is, innovation, otherwise government ought to use the money on education.

> when the social status of these people [the researchers at Risø] start to coming down to the point where you can ask questions about what they are actually doing for the tax payers money then these guy's won't have an answer because there is not a business model for the tax payer, its just, so I thought why do we not invent a business model for a lab like this. DP (Petersen, 2006)

Petersen saw the laboratory from the point of view of national economy rather than strategic research. It has to be profitable and as in venture capital, he asked for a return on investment for the citizens (the investors). It is these ideas that lay ground fro the 2004 strategy.

Risø was already a highly productive institute before Petersen was hired. The researchers had many external contacts and were good at delivering what was asked for. Risø did test and consult assignments, participated in alliances and consortia, and had a good track record of licensing and start-ups. However, what Petersen saw when he came to Risø was an underexploited research facility. Risø was and always has been very good at basic and applied research and yet, seen from an innovation perspective, Petersen meant that much more could be done. The question is what needed to change to turn a strategic research institute into business

model of innovation? Shortly after Petersen began at Risø he had a discussion with entrepreneur Jeppe Jessen and together they characterized Risø as a place that must have a huge number of slumbering ideas and unemployed knowledge that can be harvested.

3. EARLY INNOVAITON ACTIVITIES

As a start, Petersen and Jessen felt Risø needed to identify and evaluate every activity through a model of innovation with the goal of changing the nature of the relationships the scientists had with industry. In order for this to occur, Risø employees needed to become more aware of their own innovative potentials and Risø as an organization needed to be structured so that innovative ideas are given primacy. The result was that Jessen was hired on consultancy basis to deal with the issue.

> Yeah, I don't know how systematic it [innovation] actually needs to become… The idea was that Jeppe [Jessen] would hunt down these ideas specifically, but also on top of that was the idea that by taking contact to companies and having a dialogue with them you would also open up a lot of the other stuff you could do with them…bringing them up to speed on things that Risø knew about, create collaborative project of different kinds, so to say it was an acquisition effort [of ideas] of a different type. (Petersen, 2006: 50' 00")

Jessen was endowed with a team to map out inventive ideas that had an innovation potential under the name "Diamond Hunt". At this early stage of innovation at Risø the practice of innovation was highly Schumpeterian; they were looking for inventions that required a bit more energy in order to

become innovations (Schumpeter, 2002 [1934, 1912]). The Diamond Hunt tried to identify and/or construct new combinations that could start-up as companies or be bought by established companies.

The template used to evaluate the slumbering ideas illustrates the understanding of innovation at that time. It has four dimensions and follows a very classic understanding of innovation: market, competition, capital and team (Ryde, 2003). The model was initially discussed very closely with the scientists and in this way the model both worked as an evaluation of idea potential, but also served as a means for the researchers to assess the strength and weakness of their research from a commercial point of view. In this sense the new focus on innovation was not only to see what potential inventions that where lying around in the drawers of the researcher, but also to acclimate the researcher at Risø to think more in terms of innovation.

Also at this early stage of innovation, a Business Executive Network (BEN) was created to get experienced businessmen to look at the potential inventions found at Risø. “The BEN’s” are presented with ideas and concepts that have the most market potential and then expected to assess and critically examine the analysis done by the interns of the Diamond Hunt. Thus the market opportunity analysis further structures the conception of an innovation. Jessen, having an entrepreneurial sense, knew the importance of taking in market knowledge at an early stage to make the innovation process faster and more focused. With this entrepreneurial insight we can see a market pull logic becoming integrated in Schumpeterian technology push strategy, creating more of a structural view of innovation (Rothwell & Zegveld, 1985).

Usually people from a science and technology field tend to underestimate the knowledge of business people. However, BEN is the first indication that business and market knowledge play a more prominent role in Risø's understanding of innovation. Instead of making an entrepreneur of the inventor, they brought experienced businessmen in as entrepreneurs. In effect, this strategy employed the market as a source of experience and knowledge.

The experience of the Diamond Hunt also had implications for the philosophy of innovation at Risø. Most of the prosperous ideas that came out of the Diamond Hunt where induced by outside actors – that is they were need driven rather than technology push. From three hundred ideas that where found in the Hunt only between ten and twenty were innovation ripe. From those few ideas with innovation potential, most were induced from outside actors.

3.1. DENTOFIT A CASE OF NEED DRIVEN INNOVATION

A further incident that coloured the practice of innovation at Risø took place simultaneously with the Diamond Hunt. A stated need within dental technology shows the complexity of invention – the importance of understanding the interrelation between learning and cooperation – and how institutionalised roles and networks can help to support innovation. This case has been used by the practitioners of innovation in the formation of a more co-operative understanding of innovation at Risø and it is easy to see many of the influences in the case. In this case the hermeneutics of Gadamer helps us to illustrate both the historicity of the change process, but most of

all the intricate relation between personal experience and the social formation of an innovation.

Late summer of 2003 the head of the polymer department, Kristoffer Almdal received a call from the Dental Materials Department at Copenhagen University. They hoped that Almdal could solve the major problem of using plastic as a dental filling material. Shrinking is a general characteristic of polymers and has been a persistent problem in dental filings. Even though that the problem of shrinkage is less today, it still creates small cracks between the filling and the tooth which makes it easy for bacteria to gather and create cavities.

Almdal, who had done research in this area before, knew that there was no point in following the existing technological trajectory. Major companies like 3M had put vast amounts of money in that kind of research the last 20 years. So he though they should think of it as a mechanical problem and sent the problem with a Project Pilot to the materials department. Project pilot is an institutionalized “gatekeeper” (Tushman & Katz, 1980) that was introduced at the polymer department at the end of the last millennium to handle requests like this. Instead of giving extra workload to senior researchers at the department that may get lost amongst other responsibilities, the project pilots were specifically tasked to identify the right collaborators and drive the project.

So Alexander van Lelieveld, the project pilot of the polymer department, went down to Bent Sørensen at the Materials Department to see what he had to say about the problem. After some discussion on putting fibres in the polymer, Sørensen came to the idea of using Zirconia. The idea

is based on the thought that Zirconia is expanding in some phase transformations, which then could be utilized to counter the shrinkage of the polymer. Out of five basic ideas brainstormed, this became their main focus. However, Sørensen's knowledge of Zirconia is limited so they wandered over to the Fuel Cell Department where Søren Linderoth had more experience of working with Zirconia. The basic problem, which became the work for van Lelieveld in the coming years, is that Zirconia normally only phase transforms at very high temperature and pressure. He had to make the Zirconia phase transform at room temperature so that it can be used for dental fillings. This is an emblematic story of the research 'park' where one can wander around and harvest the toil of others.

As they came to the point of filing a patent for the phase transformation of the mix of Zirconia and polymer they learned about the Diamond Hunt and Jessen's work to identify potential innovations at Risø. In this way the invention of van Lelieveld, Almdal, Sørensen and Linderoth was integrated into the newly developed innovation activities at Risø. One of the BEN's, Per Bækgård, responded to the dental filings case in the way that Jessen has hoped: he took on the project of making the invention into an innovation. Half a year after the problem was stated, a patent was filed, Bækgård was working on a business plan, and contact to venture capital was established. During the spring of 2004 DentoFit A/S was founded and the start-up was a reality.

Though the success of DentoFit had to do with timely circumstances and other factors, it was clearly picked up as a success story for innovation at Risø. The DentoFit case is a good illustration of and came to be a prime

example for need driven innovation at Risø. It had several components that served to shape future conceptions of innovation at Risø. First, the problem came from the outside, thus supporting need driven innovation. Second, the project pilot function worked beautifully to drive the problem through different experts ending up with set of potential solutions. Lastly, the presentation of the invention to the BEN's enabled the formulation of a start up. Much of the institutionalization of innovation at Risø would come to be coloured by DentoFit.

What we also can see in this case is how invention often needs more than long experience and well founded knowledge. Louis Pasteur should have said: "In the field of observation, chance favours the prepared mind." However, to be prepared is not enough. Chance in the invention of the DentoFit case is reduced by two important dimensions of knowledge that can be seen in the hermeneutics of Gadamer (Gadamer, 1989 [1975, 1960]). The experience of finitude and the ability to place the problem in a new question (re-contextualization) are two dimensions of knowledge that help to shed light on the constitution of innovation in the case. To understand the implications of these two dimensions of knowledge, we have to understand experience as negative and disruptive, rather than cumulative and conforming. With this understanding of experience the ontology of the situation shifts from facts to interpretations suggesting that perception matters when encountering a new situation.

> If we thus regard experience in terms of its result, we have ignored the fact that experience is a process. In fact, this process is essentially

> negative. /…/ The truth of experience always implies an orientation toward new experience. That is why a person who is called experienced has becomes so not only *through* experiences but also is open to new experience. /…/ Thus experience is experience of human finitude. (Gadamer, 1989 [1975, 1960])

To realize the limitation of ones own knowledge and the technological trajectory that one has been working with is of great importance to innovation. In the Dentofit case, the researchers needed to approach their problems with fresh minds; they needed to ask new questions. This is what Almdal did when he saw the limitations of his technical experience. However, that does not mean that he believes that there are no answers to the problem but rather that they would require a fresh approach and new questions.

What Almdal had to face was that the way the problem was framed and the consequential questions asked carried a particular historical context. The questions restated (re-enacted) a technological trajectory with little prosperity of solving the problem. What was required was to move out of the framing context in order to ask different sorts of questions, thus transforming the problem. To get new answers, to see the problem anew, he needed new questions; questions that required reaching into a broader problematic. Gadamer explains:

> Thus the relation of question and answer is, in fact, reversed. The voice that speaks to us from the past – whether text, work, trace – itself poses a question and places our meaning in openness. In order to

> answer the question put to us, we the interrogated must ourselves begin to ask. We must attempt to reconstruct the question to which the traditionary text is the answer. (Gadamer, 1989 [1975, 1960] p. 374)

In the DentoFit case what happened when the problem was handed over to Sørensen is that new questions can be asked within a broader problematics. Sørensen is not stuck in a "world of plastics." He sees the tooth and how to fix it from a mechanical perspective, exactly what Almdal wanted. It is interesting how the shrinkage of the plastic has in this new context turned into an advantage, thus the new answer to the new question is a whole new problem.

In this sense we can minimize the amount of explanatory power that we give to "chance" in the DentoFit case. We can see both the insight of finitude and the reconstruction of questions in the greater problematics play an important role in the invention of the DentoFit case. The modest experience of zirconia that Sørensen had must be attributed to Pasteur's dictum. The more and broader experience that you have, the greater is the chance of finding a solution in a given situation. However, we are not to stand on the shoulders of giants; we are to accumulate their headaches, to understand their and our finitude which forces us to ask new questions.[6] The

[6] Others have also given a more ambiguous and dynamic view of how we break with history. Thomas Kuhn when he speaks on the relation between history and the formation of new paradigms calls it "the essential tension" (Kuhn, 1977) and Spinosa, Flores and Dreyfus emaphazise the importance of holding on to an anomaly when they define entrepreneurship (Spinosa et al., 1997). Breakthrough in science and technology is neither simplistic nor brilliant, most of all it is ambiguous and for the people working with innovation it is important to bring out the ambiguity of the situations and problems that they are working with.

import of preparation *and* openness cannot be undervalued as a central competence for innovation.

3.2. LEARNING ABOUT INNOVATION

This is a learning period for those working with innovation at Risø. The strategic initiative to encourage and locate innovation at Risø was formed into a quasi organization, a sort of boundary spanning activity (Chesbrough, 2006; Cohen & Levinthal, 1990; Tushman, 1977; Tushman & Katz, 1980; Utterback, 1971) to enact an external organization (Marshall, 1997). That is, the activities crossed departmental boundaries (Dougherty, 2001; Lindkvist, 2005) as well as the bounds of the lab itself to reach into industry (Bozeman, 2000; Colyvas, Crow, Gelijns, Mazzoleni, Nelson, Rosenberg, & Sampat, 2002; Jacob, Lundqvist, & Hellsmark, 2003; Rogers, 2002).

The Diamond Hunt lessons and the DentoFit case continue to be edifying stories retold again and again. These early experiences were as much about implementing a new way of thinking as about testing and developing tools to deal with need driven innovation at Risø. Helle Bunkenborg, who worked with Jessen (and eventually takes over what later comes to be Risø Innovation Activities – RIA), speaks of this period as one of constant learning, trying to find out which role she is to have and what concepts that she is to use:

> [I had to learn] What is it actually that we are trying to do, because otherwise I couldn't tell other people what we where trying to do, and that was the sort of, trying to get that more oh, get more understanding in the organization of why are we doing this and what are we doing,

> but also try to sort of get people involved in not only doing it, but also understanding what they where doing. (Bunkenborg, 2006 28 min 00 sec)

There are three operational dimensions to this learning phase: (1) understanding what innovation was about in a national laboratory, (2) enacting innovation in the organization, and (3) getting people outside of Risø to understand what potentials for innovation exist when cooperating with Risø.

The Diamond Hunt together with the case of DentoFit taught the people working with innovation at Risø that they needed to place Risø in a larger context and that this demanded rethinking innovation. Hence in the same sense as Almdal needed to re-contextualize dental fillings, the people working with innovation at Risø needed work with both the context and the content of their ideas of innovation. (Later Bunkenborg has stated that also RIA became "need driven" in the development of their tools and how they worked interactively in the development of their concepts.) By placing Risø in an interactive context where industry played the role of inducing ideas they saw that they needed to take on the role of knowledge brokers (Hargadon & Sutton, 1997) to emphasize interactive learning between research and industry. The new structure of the innovation philosophy at Risø revolved around a need driven practice with centralized and decentralised gatekeepers. The Project Pilot of the DentoFit case also became a model not only for the innovation activities at Risø but also initiated a new role at Risø called Innovation Pilots.

Learning about innovation at Risø came with some surprises. The Diamond Hunt was supposed to unearth rough ideas that could be polished to commercial successes. However, most of the ideas generated in the Diamond Hunt weren't that useful. Instead, the best ideas were those that emerged from outside the laboratory as a specific and local problem for some group. The need for fillings came from the dental community, vis-a-vi the dental school and was indeed a problem for a larger industry. It was drawn through existing contacts of a senior researcher and championed by a Project Pilot who spanned multiple departments in his pursuit of a solution. In this way, the DentoFit case worked as the paradigm for the practices and concepts that grew to have currency within the organization by supporting shifting the hunt from inside to outside the lab.

RIA's work promoting Risø as full of innovative potential draws attention to the cultural dimensions that function in concert with the operational dimensions. It is easy to find people at Risø who were open to work with industry, however most people were stuck in collective introversion. The notion "outside the fence" is regularly used to express an uninterested mass outside the lab that does not recognize the brilliance that lay within Risø. Such a perspective is illustrated in a parallel story from the head of Optics Department Jens Peter Lynov.

Lynow overcame his ivory tower and participated in a regional development initiative called Musicon Valley. Here he met a local business man who was exploring the possibilities of replacing incandescent bulbs with a bulb based on LED (Light Emitting Diodes). This business man passed the "fences" of Risø everyday on his way to work, but saw it as far

too advance a research center to visit. Lynov and the businessman reconciled their interests and today Risø has a LED group that continues to cooperate with the men who broke the cultural barrier. Also here we have people who are open for new experience and break with their ordinary context as they explore new cultural environments to get a new perspective on what they are doing.

Musicon Valley also led to some other minor project but most relevant to innovation was when Risø arranged a popular “Materials Day” where researchers presented new materials to the design community. This culminated in a “12+12” meetings where twelve designers met with twelve scientists at four successive meetings. The most prosperous result of this meeting was a designer chair made of 100% decomposable material. The idea to work with designers has also been pursued by the LED group to create lamps especially designed for LED technology. The effects of the co-operation with the design community are today present in the practices and identities of both at the materials and optics department. The trend that Lynov started helped to tear down the “fences”; and showed the importance gatekeepers in enacting the external organization and planted the seeds for RIA becoming a boundary spanning organization (Guston, 2000).

These early innovation and networking activities enacted the idea of need driven innovation. Whether it was the needs of the design community, a company or an industry, a new paradigm at Risø was instituted and new ways of engaging industry were initiated. The open and interactive relationships individuals had to the market yielded results. Further,

matching up people possessing different areas of expertise gave Risø real problems to solve that automatically found a place in the market.

Von Hippel's notion of "sticky information" (von Hippel, 1994) is a good illustration of the logics that Risø began to practice. The problems that different industries encountered in their everyday practice where "sticky" from the perspective of Risø, so they needed to develop a practice that gave them access to the problems that industry had. Risø had scant expertise in what the market needed, but when someone stated a problem, Risø could find a process to identify or develop technological solutions. The aim was to institutionalize forums and activities where market and technology could merge to generate innovation (Clark, 1985; Rothwell, 1986).

The practice that starts to evolve here is not to diffuse and transfer knowledge, but to share experience and to integrate knowledge. Although we can see a theoretical literature in technology transfer that focuses on both push and pull, the early innovation activities at Risoe illustrates a focus on the dynamics of knowledge and learning that takes place both on the pull and the push side. To generate high quality technology transfer, interactive learning has to emerge where market/business knowledge and technology is considered equally important.

Market knowledge is upgraded as Risø realizes its core competencies in relation to industry. The emerging notions of innovation help to clarify what Risø is good at and what it lacks. A relational/interactive understanding of innovation develops where science and market are seen as equally important. Good science/technology does not sell it self, it needs a context and a purpose. In the language of the DentoFit case, Risø has vast

experiences, that is, a storage house of answers. However, they need questions that have a relevance to the market, so that their answer can get a channel to society in general. What was becoming clear was the need to systematize these brokering and sharing activities.

4. RIA IN THE MAKING: MOBILIZING INNOVATIONS MOMENTUM

The experience that Risø accumulated needed to become more structured in order to be institutionalized in the organization (Selznick, 1984 [1957]). A collection of stories and experiments led to increased enthusiasm and awareness for integrating innovation, yet much of the activity was spearheaded by the Vice Presidents office, which lacked funds and a permanent locale on the organizational chart. What was needed was money and durability and dedicated staff. Following the Governments action in 2003 plan on "New ways of interaction between research and industry – turning science into business" the Ministry of Science, Technology and Innovation (VTU) issued funds in 2005 to come up with "New concepts for technology transfer". This came at perfect moment for the innovation activities at Risø and they handed in an application to institutionalize their experiences into a more organized structure.

This boundary spanning organizational task force – and their collected experiments, stories and initiatives – was named Risø Innovation Activities (RIA) and had as their major mission to enact a "market driven innovation system" for a research institute. Here the vision stated by Jessen, the first head of RIA:

> The Vision is to create a market driven innovation system, that on the background of identified market needs can utilize the latest research results to create innovative products, who's sale will result in economic success and more knowledge intensive work places." (Jessen, 2005)

The idea was simple: since Risø had vast expanses of knowledge within many areas, the people working with innovation should find problems that the industry had and channel them to the right knowledge. RIA was formed to broker such knowledge transfer.

To create this market driven innovation system Risø wanted to intensify the interaction between researchers and industry, change the culture of Risø, and expose the researchers to what they called a "problem storm". It was believed that if only industries' problems could be siphoned into Risø, the collective knowledge of Risø's scientists could prevail over solution. Yet while this kind of extroversion was happening in pockets of Risø, it was acknowledged that the insular, fenced-in attitudes rampant at Risø would need to be overcome for need driven innovation to occur. The task of the newly formed RIA was then to work at the cultural transformation by serving as a knowledge broker facilitating the relation between problems and knowledge (Hargadon, 2006; Hargadon & Sutton, 1997).

The idea for RIA was to have a mix of different expertise so that the group as a collective could understand the whole range *between* business and technology. The staff at RIA were not to innovate; they where to

facilitate the link between business and research to generate innovation. In this sense Risø could continue to work with its long term strategic areas (develop technology for sustainable energy supply and for the health care sector) and on occasion take on short term innovation projects induced by industry and mediated by RIA.

To facilitate this broker activity – to enact an innovation practice that would attract industry and to change the culture and attitude of the researchers at Risø – RIA harnessed the early innovation activities and developed a range of concepts that captured their vision and structured their work practice.

This story of RIA will show how innovation becomes, to some degree, institutionalized at a national laboratory. In this it is a story told from the within the national laboratory how innovation is perceived and what cooperation with industry came to be. This is a story about demystifying innovation, where innovation is not just about spontaneous creativity but also pragmatic routines, communicative practices, and organizational strategy. With the funding the learning enters into a new phase now the practice that has evolved in a small community (Brown & Duguid, 1991) grows into a distinctive competence of the organization (Selznick, 1984 [1957]).

4.1. INSTITUTIONALIZING INNOVATION: CREATING NEW CONCEPTS AND NETWORKS

For RIA, in order to transform Risø from an organization primarily focused on long term strategic research to an organization that also engages short

term innovation projects, two things had to happen: building up a network with industry and preparing the minds of researchers to embrace innovation.

The work to build up a network with industry has been primarily focused on establishing contact and nurturing relationships with Danish companies that can help build up a reputation for Risø. This work covers a range of activities from participating in local business networks and development initiatives to talking with firms that work in the technological areas in which Risø has expertise.

For the internal cultural change, the first step taken was to identify the scientists already working with industry and professionalize their understandings of innovation. Even though many researchers have an applicative understanding of market knowledge, the culture of Risø remains detached from short term industrial innovation strategies, and remains entrenched in a basic research landscape.

In order to model innovation for the researchers at Risø, RIA began to collect and circulate on a weekly basis positive stories about innovation activities in the intranet and the internal magazine. The gospel of innovation is further spread in departmental meetings, conferences, and other informal settings. For instance, RIA hosts many outsiders who take an interest in new technologies. Following the 12+12 meetings, many designers and architects have taken an interest in Risø. For example, as a technology watcher from an Architectural firm wants to learn about new materials and staff at RIA organizes a tour. RIA scouts out varied meetings around Risø to identify possible collaborators. In this sense 12+12 is still very much alive

and there is talk of hosting similar events in order to boost external relations.

With regards to preparing the minds of the researchers to embrace innovation, the main strategy of the newly minted RIA was conceptual development. Bunkenborg aimed to promote newly developed concepts to grasp innovation and help the researchers incorporate such a vocabulary in order to change the researchers work practices, and shift their identity and transform their ways of professing knowledge. To be clear, such conceptual development is not absolutely distinct from network development. We can see that even the conceptual models have a social function and that the networking activities are branded. These activities have both concept-like and social diffusion-like dimensions. These concepts thus work as an "actants" (Latour, 1987) in that they both manifest and push a social development.

This is to highlight that RIA plays many different roles and many of them can be seen as dimensions of an act or a concept. That is, every act of RIA seldom fulfils only one function of RIA. For instance, when the people of RIA hold a meeting with a head of a department, it is not only to inform them about where they can go for funding or to support a promising idea, but also to spread a new culture at Risø and to implement some of the concepts of innovation that they have created. The work of RIA has to be seen as multi dimensional ensemble. As such, the people of RIA have come to think in many dimensions about every new activity/project that they engage themselves in.

This makes RIA's work highly ambiguous, which may just be an illustration of the multiplicity of innovation per se. However, to mitigate this multiplicity, RIA has developed and implemented a set of concepts and tools to give structure to themselves and to the innovative activities at Risø. As all structuring and categorizing of ambiguous social phenomena faces, RIA also contends with the problem of interpreting the actual innovation activities within their developed concepts.

This problem presents a deeper major challenge for RIA: not to get too content with the concepts and tools that they work with, while at the same time, keeping the concept and tools stable enough to give power to the organizational change process. This balance between giving power to the innovation activities without becoming to harsh and myopic in the evaluation of the actual innovation practices demands that RIA stays alert and becomes comfortable with some degree of ambiguity. RIA is then forced to model a learning culture for the rest of the organization, one open to change and revision, yet organized enough to further their operational objectives. The concepts that are institutionalized work as a practical routine; they come in use as a situation presents an innovation opportunity.

The following is a tour through some of the activities of RIA, with attention to how the concepts and activities became formalized. These sections tend to what works and what doesn't and moves to explicate how innovation was (and continues to be) being institutionalized.

4.2. GAP FUNDING

One of the instruments that RIA used to encourage innovation was gap funding. When the innovation activities started, Risø's budget was

decentralized to the head of departments and earmarked to develop technologies that would later be used by industries. In the early innovation activities, this frustrated Petersen because it meant that he did not have money to incentivize researchers to work differently. It was first with the grant from the Ministry of Science, Technology and Innovation that RIA was given money to fund internal innovation projects based on the new need driven innovation concept. Part of these funds was earmarked for 'innovation projects' which allowed RIA to work with researchers and departments to develop promising ideas. These funds allowed a change in practice from one where researchers had to "steal" money from other projects or use their spare time for ideas that could not be placed in the traditional long-term projects.

Today this kind of funding goes under heading of Gap Funding and focuses on the early stages of innovation. The aim is to take an idea to proof of concept, so that it will be easier to attract venture capital or firms that are interested in a joint venture, alliance or license. This financial organization has given Risø a better chance of creating innovation since money is already budgeted for innovation activities and therefore a researcher who has a potential innovation can apply for Gap Funding. Traditionally many projects die in this early stage since researchers, although they might have a passion for the idea, they do not see the point in working for free. Usually, a researcher would rather pursue well-funded projects that guarantee problem solving satisfaction. However, when given the budgetary possibility to pursue subsidiary ideas, they regularly did so. The design co-operation that

led to a 100% decomposable chair, mentioned above, was funded with the help of this Gap Funding.

Hence, in general the researchers at Risø take an interest in innovation projects, but if the hurdle is too high their will is usually not strong enough to persist. To state in the strategy that short term innovation is a strategic area- without supporting it financially- made it hard for the organization to live up to the strategy. By addressing this budgetary constraint, the GAP funding made the strategy of Risø more realistic.

4.3. THE GOLDEN TRIANGLE

RIA felt that in order for need driven innovation to be effective, researchers needed to be taught to spot innovation potential. The Golden Triangle is a mediating device that serves as a means to decide what innovation projects Risø is to support. Based on a critique of an idea's problem (need assessment), financial viability and likelihood of solving the problem, RIA is able to make quick, consistent evaluations of potential innovation projects. When all three – Problem, Money/Sales, Solution – are in place, RIA deems the innovation project worth pursuing and will start to coach the project along its innovation process. RIA might also finance the project (through gap funding) until the project is ready to seek money from customary venture capital channels.

Figure 1

The golden triangle is one of the most prominent examples of the way that RIA is thinking about innovation. First, it illustrates that the market is a

part of their thinking. Second, it is a very simple sketch of innovation. And lastly, it is a tool not only to judge ideas with but also to teach researchers about innovation. Hence, the Golden Triangle is as much directed at the potential ideas as it is at the user of the concept.

In addition to an evaluative procedure for new ideas, the Golden Triangle has become a way that the people of RIA identify themselves and their successes. The icon of the Golden Triangle communicates a very simplistic and natural and obvious way to see innovation, the only new thing with it was that it has a value of being simple – a researcher is not expected to be an expert in innovation, they only needed a tool that indicates innovation potential. Being connected to market, commercialization and needs in society, the Golden Triangle is highly connected to and relevant for the need-driven approach and the new Risø strategy.

However, RIA also wants this concept to work for itself in the organization, so that people working with innovation employ it to make initial assessments of a new project. The spread of the concept is also important so that a common vocabulary of innovation develops at Risø. In this way, the role of RIA in relation to the golden triangle is also to spread the gospel of the Golden Triangle and then anchor it in organizational practices. When the people of RIA meet others, both formally and informally, they promote the Golden Triangle. Bunkenborg here speaks of the importance of dialogue to get an understanding of the activities of RIA and for its concepts: “but of course it all ends up to talking to people in the cantina ‘oh you have a new job Helle [Bunkenborg], what are you doing’

you know it was really dialogue on all levels." (Bunkenborg, 2006 35 min 20 sec)

4.4. Risk Reduction and Busienss Development

Once the Golden Triangle is satisfied, thus suggesting that the idea has market potential, the next stage is to work with risk reduction and business development. The simple Golden Triangle shifts into a diamond where the points represent facets of market demand. From Risø's perspective, managing technical risk is standard practice, but managing market risk involves skills that the researchers are not accustomed to. The RIA group exposes the project to questions of scalability, funding and exit strategies, execution and operation, and in doing so facilitates the development of the project into an innovation. This is also the stage where relevant cooperation partners are contacted and involved. The partnerships are negotiated to find the right fit in terms of institutional set-ups, company formation, licensing agreements, service contracts, and the like.

Figure 2

Here the design chair previously mentioned is an illustrative example of RIA's business development process. First, need was established through RIA's contact with a designer through the 12 + 12 process; the designer wanted a material that was biologically decomposable and had the similar functionalities as plywood. Next, researchers at Risø were identified and tasked with investigating new materials. The project then received Gap Funding from RIA to come up with a proof of concept, which was

successful thus leading to a patented process. Strengthened by the success of inventing a new functional material and a patent that would enable a start up, the designer and researcher set out to form their new company. However, the patent was owned by Risø together with the designer which meant that the Risø employee had limits on their financial gains, so a negotiation started to investigate the innovation potential of the invention, given such constraints.

Here RIA with their analysis step in to assess the market viability of the innovation. It was determined that the process patent was too weak to be licensed and the prospects to start a furniture company on the patent were too risky. If the patent was transferred to an existing furniture company, such ownership rights would hinder further development of the process and material at Risø. The solution was a start up that sold the material in bulk in the form of boards that easily could be transformed into furniture or other stuff. RIA also picked a CEO for the start-up that was not part of the invention team, mainly because he had more business experience and a good network in the Danish furniture and design milieu.

Here we can see how the RIA group facilitated business development (including finding a suitable CEO) to an invention made at Risø. The project started as a need from a designer and by integrating market understanding into the project early on, RIA managed to come up with a business model that was viable for the invention. A further benefit for Risø with this business model was that the researcher at Risø was hired on consultancy basis both to implement the technology at the production facility as well as to further develop the technology for other applications.

4.5. THE WORKSHOP

One day when Jessen was visiting a company, he suggested a new way to broker knowledge between them and Risø: a workshop. The workshop would be a brainstorming session that focused on some pre-identified problems of the company and involved specially selected researchers at Risø that may have relevant expertise. Individuals from the company and Risø sat down and discussed possible solutions and the event was deemed a success. The workshop is an institutionalized meeting forum to bring the problems of the industry together with the researchers at Risø. Usually it takes place at the company, to make more apparent the organizational culture (thereby following the logic of von Hippel's sticky information) and taking into account that problems are highly contextual (Rosenberg, 1982; Stankiewicz, 2000; von Hippel, 1994; von Hippel & Tyre, 1995). The idea is to get the company to define the problem fairly well so that RIA can hook them up with relevant researcher. The people of RIA act as brokers to facilitate the process while the researchers provide ideas and possible solutions. The workshop is the best illustration for how RIA has institutionalized its ideas of need driven innovation. It is a meeting and integration of different kinds of knowledge – business and research – where new questions are to be asked so that old and new knowledge can come alive in contemporary problems.

One important ground rule of the workshops is that the company representatives should be diverse (in terms of research and organizational responsibilities). In this way, the spread of different perspectives is believed

to allow a multi-voiced, multi-dimensional presentation of the problems during the idea generation phase. Yet this diversity is also seen as a way to involve those with different decision making powers as a means to up the chances for the execution and implementation of solutions. Execution is a subject that RIA discusses a great deal in most activities – there is a focus on the actionability of the ideas and RIA has slowly learned that industry works with a different mindset and different governance structures that impinge upon who has power to put innovation into practice.

Also here the ideas of the 1999 course in SPIN (Situation, Problem, Implication, and Need-payoff) come into play. The philosophy of SPIN is to learn to listen to the customers problems in a dialogic way. Hence, rather then just tell a story of the brilliance of the research done at Risø, the researcher should stand back and listen to want the needs of the industry are. In this sense the SPIN course from 1999 has come to live again in the practice of the workshop. SPIN together with the experience of the DentoFit case has given a structure to the workshop that is dialogic, social and focused on learning. Even though there has been a stated demand that the company ordering a workshop should have a formulated problem, part of the workshop has always been directed at listening to the company's formulation of the problem, and if necessary, open dialogue to reinterpret the problem.

Hence the structure of the workshop follows the same logic of experience as we could see in the DentoFit case above. Different experiences are important for Pasteur's dictum, but the differences that meet in the workshop (Leonard & Straus, 1997) should come into dialogue,

where also the formulation of the problem is ripe for reinterpretation. As we saw in the DentoFit case a new technology – the use of zirconia – applied to a problem, reinterpreted the entire problem of dental filling.

This framing and reframing should be understood in relation to a tension between openness to the new and familiarity with the old. The experience with and knowledge of dental filings allowed a pushing through to consider radically different possibilities. The researchers had an experience that readied them to be open to new experience. Again we can use Gadamer's hermeneutics to better understand the role of experience in knowledge flow- or *brokering*- of knowledge. The openness is what constitutes Gadamer's understanding of dialogue and shows the importance of prior experience- the SPIN course, dental filings, etc.- to foster such experience. Thus in the words of Gadamer "this openness does not exist only for the person who speaks; rather, any one who listens is fundamentally open" (Gadamer, 1989 [1975, 1960] p. 361) Hence, to be experienced is to be open is to be in dialogue is to listen. The workshop in practice constitutes an open dialogue between technology and market.

Gadamer too draws attention to the finiteness of each individual experience and the possibility to reformulate the questions (Gadamer, 1989 [1975, 1960]). Hence, the idea with the workshop is to create a social situation where new contacts between questions and answers can solve concrete problems. It is not important whether the knowledge is new (patentable) or old, but that the questions triggers a new way to apply a broad spectrum of experiences.

The first workshop was organized highly ad hoc yet laid the groundwork and rational for future workshops. In Jessen's first workshop, the company laid out a well defined problem and solutions were found[7]. The interpretation of the first workshop's success followed an innovation perspective: problems lay around outside, ready for technical solutions. However, the consequential workshops had different stagings. There weren't always problem easily identified. Sometimes the company was not open to brainstorming but wanted specific lab analysis run. However, by some measures, the workshops were a success as more requests for workshops were coming from industry.

What RIA was learning however, was that each new encounter with industry in a workshop was a new experience. Both RIA and the companies had to learn to be open to different expectations, needs and outcomes. These surprising encounters led RIA to discuss what the success criteria of a workshop should be. Empirically it is far too narrow to define the criteria as giving a solution to a well defined problem. However, as long as the customers were satisfied and kept coming, RIA decided that strict success criteria for the workshops were not necessary. The main purpose was to bring the knowledge of Risø into play with industry.

As the workshop became The Workshop, it became a concept well distributed throughout the organization. Several companies were either informed by a researcher, or contacted by RIA, and lined up to participate. In this way, the initiation of a closer relation between Risø and industry is

[7] However, there was no funding to test the viability of the solution and it took nearly a year for the researchers at Risø to return to the company with their final analysis.

carried not only by specific RIA activities, but also through the flight of the concept Workshop. Hence, as with the case of the Golden Triangle, the Workshop has been spread in the organization and is doing its work in the way it should as an actant in its own right.

RIA realized that a set agenda and process management techniques were needed to shape the rather open-ended discussions to deal with the inexperience of industry in working with outside scientists. Both RIA and the industry contacts needed to develop a shared understanding of how knowledge sharing for innovation was to be pursued. So while the original expectations of the workshop were unfulfilled, new learning and dialogue emerged and steps were taken to become acquainted. As Bunkenborg said, "even the workshop should be need-driven" and in this way, the workshop had success though outside the original conceptualization. Thus the managers at RIA showed that their relation to experience where open and undogmatic. They walked their talk. As Gadamer notes, "As a rule we experience the course of events as something that continually changes our plans and expectations. Someone who tries to stick to his plans discovers precisely how powerless his reason is." (Gadamer, 1989 [1975, 1960] p. 372) Today the workshops are discussed not only in terms of discovering a technical need-solution, but also as a network building activity and business development[8].

[8] Interesting for the general discussion on licensing and patents in the technology transfer literature is that no workshop has involved any patents or licenses. Rather, much of the knowledge utilized by the researchers in the workshop is obvious to the researchers. In this sense the workshops has revealed that much of the knowledge sharing activities in the context of RIA does not show up on usual technology transfer indicators like licenses and patents. Hence, many of the workshops have turned out to be consultancy assignments where researchers advice companies to do or make things a certain way. Risø is selling its

4.6. SUPPLEMENTARY TRAINING

RIA also designs and co-ordinates courses for industry to teach them the latest in their field of technology. This is an initiative that has grown stronger in response to requests from small and medium sized companies, a significant constituency in Danish society. Also this is a result of the need driven thinking of RIA and the realization that the workshop could not fulfill the spectrum of needs in industry. Supplementary training aligns very well with the need driven innovation initiative in that it explicitly increases the interaction with industry and helps to diffuse the knowledge of the technologies that are being developed at Risø. Such outreach activities are a means to generate new projects and to continue the identity shift (both internal and external) toward a more innovation friendly atmosphere.

4.7. INNOVATION PILOT TRAINING AND CO-ORDINATION

The success of project pilots at the polymer department (also of DentoFit fame), triggered Risø to introduce this role also for other departments as well. However, in line with the newly focus on innovation they where called Innovation Pilots and had a slightly different role. Rather than only working with requests coming into the organization, they where to actively engage with industry to identify problems and pushing the technology of the department. This has shown to be a very good way of institutionalizing gatekeepers, but it has also come to be an illustration for the inertia of culture. The innovation pilot at the optics department, where Lynov is head of the department – noted above for his early work with Musicon Valley –

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know-how, rather then breaking new grounds of research, and industry are invited to explore this know-how for its innovation potential.

had a whole portfolio of business ideas. However, at another department the innovation pilot was set to do all kinds of unrelated administrative work.

The innovation pilots were a decentralized role answering to their respective head of department. RIA organized a network for the innovation pilots so they could exchange experience with each other and with RIA and so that RIA could inform them about courses on business plans, various technology transfer issues, and the like. In this sense, RIA could advise, train and network with the innovation pilots, but had no authority over them. In practice this meant that the pilots housed in departments that did not yet take a great interest in innovation were used as a versatile, general resource for the department.

5. Discussion: Making sense of RIA

RIA is the institutionalization of innovation at Risø, it harbors the experience, the network and the concepts that Risø has under the heading of innovation (Selznick, 1984 [1957]). Thus we can not speak of a massive cultural change of Risø that has fashioned the laboratory into an innovation machine. The initial vision of Petersen has not been realized. Nevertheless, RIA routinely prepares Risø for innovation by enacting concepts and networks within and outside of Risø that makes it possible to channel innovation when possibilities arise.

> And I think RIA was a change agent a big part of what RIA was about was actually to change the way people looked and developed ways of working. There was both a development project, there was the of how we do things, there was a change project of how people look at things

> and there was the actual pipe of projects that where funded through the budget of RIA and all three had equal like merit you couldn't do one without the others, so to speak. (Jessen, 2006 17 min 30 sec)

The experience and learning about innovation encapsulated in the practices of RIA has evolved to become a distinctive competence for the laboratory. There is no need to eradicate the "old" insular culture of Risoe. Instead there are a cadre of experienced and open innovation agents lit up through the laboratory. These agents- RIA managers, innovation savvy researchers, scientific entrepreneurs- work as gate keepers internally and externally for different innovation activities. RIA managers are there too to source knowledge from researchers that are not interested in innovation activities and they heighten their knowledge brokering roles.

5.1. KNOWLEDGE BROKERING: EXPEREINCE BASED DIALOGUE

The overarching thrust of RIA is to broker knowledge, to bring together market knowledge with research. By using industry as a problem or idea generator Risø pursues its support of Danish society through innovation (Rosenberg, 1982; von Hippel, 1986). In this sense the role that RIA came to play was to broker problems and knowledge (Hargadon, 2006; Hargadon & Sutton, 1997) between scientists that develop technology and industry that is in the business of technology. In this way, the story of RIA is a story of institutionalizing and developing practices for knowledge brokering (Hargadon, 2006) in the context of technology transfer.

RIA can be seen as an intermediary. In his article on intermediation, Howells identifies four different roles that an intermediary agent plays: diffusion and technology transfer, innovation management, systems and network management, and service organization (Howells, 2006). With their focus on need driven innovation RIA adds to this categorization a fifth role-- that of pooling industrial problems to the laboratory. Thus, they play the opposite role of how the "middle men" are traditionally described in business (Utterback, 1971). Instead of pooling new technologies to the firm, RIA pools business and industrial problems and knowledge to a research institute. In this sense, RIA's brokering is an upgrading of market knowledge from the point of view of the laboratory. Instead of maintaining the corollary to the ivory tower- the lab benches of the asylum of basic research- researchers at Risoe learned, through RIA, the importance of market knowledge and business acuity.

This element of exchange is why we use the term "knowledge brokering" rather than "technology transfer". Technology transfer has a feel of one way traffic (Williams & Gibson, 1990). Knowledge brokering on the other hand gives the impression that all sources of knowledge are important: business knowledge, the problematics and experience gathered within industry, and scientific research and problem solving. RIA's place is in the middle of these dynamic environments and its main role is to bring them together to generate innovation.

The trials and experiences of the managers at RIA and the laboratory researchers points to the import of openness. Though not open to everything, but towards the tensions what we have learned and what we

might learn. We need to find the cracks in our problems and switch pivotal points around which we turn it. According to Gadamer, this is the fundamental insight that experience can teach us.

> The truth of experience always implies an orientation toward new experience. That is why a person who is called experienced has become so not only *through* experience but is also open *to* new experience. (Gadamer, 1989 [1975, 1960] p. 355)

In this sense the knowledge brokering situation is like a hermeneutical situation.

> We always find ourselves within a situation, and throwing light on it is a task that is never entirely finished. This is also true of the hermeneutic situation – i.e., the situation in which we find ourselves with regard to the tradition that we are trying to understand. (Gadamer, 1989 [1975, 1960] p. 302)

The insight that we are limited makes us open to others and to the boarders of our knowledge. We never break free we only reinterpret. This is as much a reinterpretation of ourselves as the problem that we are trying to solve we need to reinterpret how we got here. And we need to carry with us both the ambiguity and the insights that tradition handed down to us.

Brokering knowledge is then to re-contextualize with the help of knowledge. Not to dig deeper in our knowledge, but to open up and let others and different knowledge redefine our problem. We need to recognize both the finitude and the possibilities of our own experience and how it

changes meaning in different contexts. Depending on the questions that we ask, the problematics that the knowledge carries with it transforms. When it transforms knowledge into something new that fulfils a need we call it innovation. How to work with the needs of industry (or society) to re-contextualize the knowledge of a research lab became the essential question of RIA.

We saw this iteration between experience and openness most clearly in the DentoFit case which then influenced the way RIA began to understand the workshop. The experience of dental filing was needed to understand the problem, but it was also required in order to see the traditional way of interpreting the problem as finite. Only the experienced could see that the experience about the problem was not enough. The re-questioning opened up for re-interpreting the problem. To invoke and guide this re-questioning into an open dialogue is the practice of knowledge brokering that became formalized through RIA.

In a brokering situation there is however no need to create ambiguity. The multitude of experiences that arise around a problem are vast enough to invoke questions that reinterpret and transform the situation. The major tasks are rather to tame, harness and make productive the ambiguities that are already present. Hence in a brokering situation you are working with a tension between ambiguity and focus that evolves dynamically in a converging and diverging way (Leonard & Sensiper, 1998).

Others have also given a more ambiguous, dynamic and focusing view of how we transform history to enact the future. Thomas Kuhn addresses the relation between history and the formation of new paradigms

and calls it “the essential tension” (Kuhn, 1977). Spinoza, Flores and Dreyfus emphasize the importance of holding onto an anomaly when they define entrepreneurship thus raising the spectre of novelty and difference (Spinosa, Flores, & Dreyfus, 1997 p. 50). Both emphasise the structuring as well as the ambiguity of a innovative situation; two features which come clearest in an understanding of finitude (Gadamer, 1989 [1975, 1960]) A brokering situation should not just aim to bring knowledge to the table, but to see the finitude of the different knowledges and what structuring can bring them together. This helps the players to ask new questions, questions that will transform history into a prosperous future.

5.2. READINESS: THE CORE COMPETENCE OF KNOWELDGE BROKERING

Each dimension of RIA’s operation – concept formulation, networking, training, spreading stories of innovation and evaluation – contributed to the institutionalization of readiness. To be ready for innovation, means understanding an innovative situation when you are in it. The concept Golden Triangle is a good illustration of this principle. From an identity perspective it is a palatable way of introducing a complex phenomena to an organization that also has a more consolidated identity that it needs to keep.

At Risø, the main working task is to apply and develop technologies within long term projects. The Golden Triangle concept allows researchers to adhere to that mission as it does not demand that everybody should go around and think innovation all the time. It only asks for readiness in specific situations and to apply individual knowledge to some other problems at some occasions.

The most important feature of the work of RIA is to get market and technology to meet in a very concrete manner and with high degrees of openness and vibrancy. As the experiences with the Workshops illustrate, this cannot be done with well defined structure and rigidity. Here also we can see how readiness is an important feature of the competence that RIA has institutionalized which also points to a broader hermeneutical insight. “The hermeneutical consciousness culminates not in methodological certainty, but in the same readiness of experience that distinguishes the experienced man from the man captivated by dogma” (Gadamer, 1989 [1975, 1960] p. 362). There is no general method for bringing technology and market together, but RIA can helpfully develop a vocabulary – a set of concepts – that guides innovation activities.

These concepts are evident when applied in the practice of bringing market and technology together. That is, the practice of a workshop takes definition as the different experiences come into dialogue. Following Gadamer, a true dialogue should not have a predefined end. Rather it unfolds itself as the interlocutors start their conversation:

> No one knows in advance what will “come out” of a conversation. Understanding or its failure is like an event that happens to us. Thus we can say that something was a good conversation or that it was ill fated. All this shows that a conversation has a spirit of its won, and that the language in which it is conducted bears its own truth within it – i.e. that allows something to “emerge” which henceforth exists. (Gadamer, 1989 [1975, 1960] p. 383)

As we gleaned from RIA's experience with trying to develop success criteria for The Workshop, the ultimate outcomes were emergent. The Workshop was a success when something emerged from it. From an innovation perspective – and from RIA's perspective – this something should have a value on the market.

The other crucial element to these emergent practices – in addition to the qualities of openness and readiness – is the dialogic character. RIA advocated for the researchers (in a Workshop, in working with the Diamond Hunt, in constructing a start-up) to be open for re-framing and re-interpreting. Likewise, in a reflexive move, the managers at RIA were themselves open to learn anew. Their methods for governing the workshop shifted with each new experience instead of following a dogmatic cycle. In this way, both the managers of the innovation processes at RIA as well as the scientists in the laboratory are called upon to work beyond their own experience and develop concepts that are open enough to harbour their readiness.

6. CONCLUSIONS

Fresh encounters with problems, policy statements, tools, strategic concepts, inventions, industrial needs and market dynamics are all implicated in a learning process that both illustrates an innovation system, but also changes the innovation system. RIA is the centre of this swirling learning process yet without victimology. Rather we can see a proactive, productive stance to the types of tools and concepts spurred to action by those at RIA. To be sure,

RIA enacts the policy recommendations, yet in doing so they develop tools that extend policy and industries' expectations of a research lab.

The internal learning process of RIA is an illustration of local innovation philosophy. They learned from the problems that they encountered and while institutionalizing some dimensions they also held open some institutionalizations. Instead of setting up rigorous structures that might indeed defy habitability, RIA came to understand their role as one characterizing openness and readiness for change. For RIA, it is impossible to facilitate within predefined structures and processes. Yet, to be sure, some degree of institutionalization is necessary for sustainability.

Cultural change alone cannot be expected to reinvigorate a research organization like a national laboratory into an extroverted benefit to society. Quite simply, most people working in such an organization have personal agendas that are not easy to change. However, what can be done is a more structured internal network that promotes and handles innovation activities and provides a language and lens from which to identify innovation. The sub-central actors then work to siphon innovation initiatives coming from industry to the central innovation agency (RIA) for handling.

Funding is an essential sort of formalization. Without internal and external funding, RIA would not have developed. Many of the projects that received Gap Funding from RIA would have withered without it. To have a money bag ready at hand for innovation projects – organizational as well as technological – is essential for successfully institutionalizing innovation. There was a small task force for innovation before RIA, but not with the same intensity and vigour as the group formed on the basis of real funding.

Additionally before the formation of RIA many of the innovation projects were financed with spare time and through “stealing” time from other projects. Serious funding gave spine to the initiatives induced by the different actors.

Last, innovation within technology transfer is dialogical and has to be that way. Most innovations require a kind of interdisciplinary which mandates a meeting and brokering of different experiences. An institionalized innovation process succeeds in so far as such different experiences are mediated with openness and readiness. Otherwise, knowledge is the trap and unfocused monologues reign with little meeting of the minds. RIA has been able to develop a framework that structures the multitude of experiences that meet in the no-man’s-land between research and market into a constructive dialogue. However, since both research and market are dynamic and ambiguous entities, the dialogue is wise to shy from a predefined goal, rather it should be judged based on what has emerged in the dialogue.

WEB:

Risø Strategy

http://www.risoe.dk/Risoe_dk/Home/About_risoe/fakta_risoe/Strategien/tek

nologi_konkurrence.aspx

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