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Socio-technical, organizational and political dimensions of idea work in a mature industrial R&D setting

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PhD dissertation

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Socio-technical, organizational and political dimensions of idea work in a mature industrial R&D setting

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"Ideas are a primary source of our advances. Ideas are pervasive. An idea is intangible and evidenced indirectly. Many ideas become part of the fabric of our lives, our organizations, our existence, and our world: they are a potentiality, and they offer us something else. Ideas are usually disruptive: they can arise from inside or outside of conventional wisdom, and they tend to challenge orthodoxy. We acknowledge the importance of some ideas, while also resisting others: ideas can be lauded and espoused, at the same time as they are effectively suppressed. In our organizations, this paradox continues." (Rothberg 2005).

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Summary

Ideas are viewed as an essential element in industrial companies' product development activities and are the beginning of all innovative endeavors. The present study comprises an examination of the idea work practices currently being carried out in the R&D department at the Danish pump manufacturer, Grundfos. The PhD study has aimed at understanding both conducive and hampering aspects in the work with ideas at Grundfos, as well as contributing to an internal learning process. Moreover, the study has aimed at developing a new understanding of idea work for use both in academia and in practice. The overall research questions posed are: 1) how do designers work with ideas in a mature industrial R&D setting? And 2) how can work with ideas in a mature industrial R&D setting be stimulated and supported? These questions are examined in four research papers and finally answered in the conclusion of this synthesizing dissertation.

The empirical data forming the basis of the present PhD study have been collected through qualitative research methods, such as case study methodology and qualitative research interviews. Sixty interviews were conducted, mainly with R&D professionals, but also with other organizational members and managers at all levels. Especially, the development of the Alpha Pro circulator has been used as a case in the study. The Alpha Pro circulator is a small circulation pump used in one- and two-family houses to circulate hot water. The special feature about the Alpha Pro circulator is that it was significantly more energy efficient than other circulators at that time; it was therefore also the first circulator ever to achieve an energy label[1] in category "A". The idea work leading to the development of the Alpha Pro circulator can be traced back almost twenty years and gives insights into all the challenges idea work also meets. In addition to the Alpha Pro case, a profound body of the interview data also investigates how the engineering designers approach idea work on a more individual basis. To interpret and analyze the data and develop a new understanding of idea work, theories and concepts from especially Science and Technology Studies (STS) and the political process perspective have been applied.

In this dissertation, idea work refers to the interactions, processes and practices in which ideas are constituted and developed over time, and it includes generating, recognizing, negotiating, gaining support, materializing, and implementing the ideas. Focus in this dissertation is therefore not on the distinct activities but the interrelation between them, and the interaction of the involved actors as well as the individual and collective strategies they employ to advance their ideas in the organization. The aggregated findings from the four research papers can be summarized as follows: 1) Ideas are initially fragile, and constituted by a variety of knowledge fragments and past experiences. 2) Formal instrumentation of idea work supplements and/or hampers the informal processes of idea work. 3) Ideas need support in order to survive and grow in an organization, and 4) Work with ideas requires a wide range of competencies beyond technological skills. The implications of these findings are also presented in the dissertation.

The main contribution of the study is to be found in two important aspects: 1) it is the real processes of idea work that are examined and described; and 2) by drawing on Science and Technology Studies, a new understanding of idea work is developed and presented, which emphasizes that ideas are constituted in and through the processes of their articulation and representation. In this view, ideas are more than fixed entities with inherent qualities waiting to be harvested; ideas are also open to interpretive flexibility. Thus, the quality and advancement of ideas is dependent on the mobilization of actors and resources in the organization, as well as the involved actors' interaction. This mobilization is essentially a productive process, but it is characterized by being political, and can at times give rise to controversies when world views are too dissimilar and not in congruence.

[1] Energy labels are also known from the white goods industry and light bulbs.

Dansk resume

Det er en udbredt opfattelse at ideer er vigtige elementer i industrielle virksomheders aktiviteter med innovation og produktudvikling. Nærværende ph.d. afhandling omfatter en undersøgelse af praksisser med idearbejde i R&D afdelingen i pumpe virksomheden Grundfos A/S. Formålet med studiet har været at opnå indsigt i og forståelse af hvilke forhold der henholdsvis er fremmende og begrænsende for idearbejdet i Grundfos, samt at bidrage til en intern læringsproces i virksomheden. Derudover har studiet også sigtet mod at udvikle en ny forståelse af idearbejde til brug i bredere praksis, samt den akademiske verden. De overordnede forskningsspørgsmål afhandlingen forsøger at besvare er: 1) Hvordan arbejder designere med ideer i et modent industrielt R&D miljø? Og 2) hvordan kan arbejdet med ideer i et modent industrielt R&D miljø blive stimuleret og støttet? Forskningsspørgsmålene besvares gennem fire forskningsartikler, samt en sammenfattende afhandling. Ph.d. projektet bygger på kvalitative forskningsmetoder. Herunder er tres interviews blevet gennemført med R&D professionelle, især ingeniører, men også med andre faggrupper i Grundfos, samt ledere på alle niveauer. Projektets analytiske ramme baserer sig især på teorier og koncepter fra Science and Technology Studies (STS) og politisk proces teori.

I afhandlingen referer idearbejde til de interaktioner, processer og praksisser som ideer konstitueres igennem over tid. Idearbejde inkluderer derfor genereringen, erkendelsen, udviklingen, forhandlingen, støtten, materialisering og implementering af ideer. Fokus i afhandlingen har dog ikke været på de enkelte aktiviteter, men derimod sammenhængen mellem dem, samt interaktionen mellem de involverede aktører. Herudover fokuseres der også på både de individuelle og kollektive strategier designerne benytter til at fremme ideer i organisationen. Overordnet kan afhandlingens resultater opsummeres til: 1) Ideer er skrøbelige i deres vorden og konstitueres af mange forskellige viden fragmenter og tidligere erfaringer. 2) Formel instrumentering af idearbejde kan både supplere og hæmme de uformelle processer med idearbejde. 3) Ideer har brug for støtte hvis de skal overleve og vokse i organisationen. Og 4) arbejdet med ideer kræver mange forskellige kompetencer ud over teknisk formåen. Afhandlingens hovedbidrag skal findes i to vigtige aspekter: 1) Det er 'virkelige' idearbejdsprocesser der studeres og beskrives, og 2) der tilbydes en ny forståelse af idearbejde ved at trække på koncepter fra Science and Technology Studies og politisk proces teori. Den nye forståelse af idearbejde lægger især vægt på at ideer er konstitueret i og gennem processen med at artikulere og repræsentere dem. Ideer anskues for at være åbne over for fortolkningsmæssig fleksibilitet. Og kvaliteten og udviklingen af ideer er afhængig af mobiliseringen af aktører og ressourcer i organisationen, samt aktørernes interaktion. Denne mobiliseringsproces er især kendetegnet ved at være politisk og kan give anledning til kontroverser når verdensanskuelser bliver for forskellige. Afhandlingen bidrager ved at introducere et nyt aktør og proces perspektiv i et forskningsfelt, der har været domineret af traditioner fra Engineering Design og Innovation Management. Desuden bidrager afhandlingen ved at bringe et STS perspektiv ind i innovationsforskningen.

Preface and acknowledgement

The present PhD dissertation is the outcome of a five-year research project initiated in January 2007 at DTU Management, Innovation and Sustainability. The study was financed partly by Grundfos, partly by the Technical University of Denmark (DTU), and partly by the Danish Ministry of Science, Technology and Development. It was carried out during the period from January 2007 to December 2011, although interrupted twice. The first interruption was due to maternity leave when I gave birth to my daughter Annika, which gave a pause from the project of almost nine months. The next interruption was due to a seven-month leave, when I took over the teaching responsibilities for my main supervisor while he was visiting professor at University of Southern Denmark.

Many things have probably been said about conducting a PhD study, but for me, this project has provided me with a great opportunity to research an important and interesting topic, namely idea work in one of Denmark's largest industrial companies, Grundfos, and it has also tested my endurance. Five years is a long time to be engaged with the same project; however, many people have helped to make it fun and an inspirational, challenging, intellectually stimulating, knowledge gaining and endurable experience.

First, I would like to thank John Gammelgaard, who made this project happen in the first place. It has been inspirational to see how he has made idea work the center of his professional efforts, especially with respect to nurturing other people's work with ideas through several initiatives. Thank you for our discussions and for helping to figure out what this was all about. Here, I also wish to thank Jan Strandgaard for giving the project financial support, and Anne Schou and Jørgen Due for following the project in the initial stages and introducing me to colleagues at Grundfos.

When John Gammelgaard left the organization for another job, I had the great opportunity to discuss the project's scope and findings with Poul Toft Frederiksen. I would like to thank you for your philosophical take on things, the inspirational discussions we have had, and for your support in both professional and personal matters. In this connection, I also wish to thank Henrik Ørskov Pedersen and Carsten Skovmose Kallesøe, who together with Poul Toft Frederiksen, have enthusiastically commented, discussed and challenged my work. Another person at Grundfos I wish to thank is Karin Maria Rapp – you made it fun to stay in Bjerringbro.

I would also like to thank all the interviewees at Grundfos for their openness and for kindly sharing their stories, and all the employees at Grundfos who showed interest in my research whenever I had the chance to present it.

During the project, I have of course also received highly qualified guidance from my two supervisors, Christian Clausen and Claus Thorp Hansen. First, I would like to thank you, Christian, for helping me unfold my empirical material and writings and giving me a sense of what interesting narratives and leads to follow from the huge amounts of data I had collected. I am also grateful for the time you have taken to comment on my writings and the flexibility you showed when quickly responding when my papers were nearing their deadlines. Claus, I would like to thank you for giving constructive feedback on my writings, and also helpful suggestions for illustrations that help make it easier to understand the text and make it less heavy. Also, thanks for always seeing the details – nothing escapes you.

Else Nalholm, our librarian at DTU Management, was a great help when I needed literature from other libraries. And I would especially like to thank her for her help and persistence in taming RefWorks (the electronic reference system I have used to manage my references).

Along with the PhD study, I facilitated a series of meetings with participants from Danish industry and universities, in a so-called ERFA[2] group. At each meeting, an innovation-related topic was discussed. Until now, six meetings have been held, and one is in the pipeline. In this group, there have been participants (in alphabetic order) from Aalborg University, Absolute Lean, Alpha Laval, Coloplast, Danfoss, Eye-D, Foss, GN Resound, Grundfos, Kompan, Linak, NNIT, Novozymes, Pink Cat Innovation, Robocluster, Siemens, Technical University of Denmark, Universefonden and Velux. I would like to thank you all for openly sharing and discussing the innovation dilemmas and challenges you have faced in your companies and research over the last four years.

Another group of people have made it fun to go to work and be a PhD student: Thank you Sophie Nyborg, Elisabeth Jacobsen Heimdal, Joakim Juhl, Andrés Felipe Valderrama Pineda, and Signe Poulsen. Thank you also, Signe, for sharing the last hard working months with me. You have made it a true pleasure to come to work every day.

Louise Møller Nielsen, my true friend, thank you for sharing the PhD journey with me.

And then my family deserves special thanks. My dear Jesper, thank you for your patience, thoughtful care and being at my side throughout this journey. Thank you for accepting being dragged to Bjerringbro in the middle of the winter to become a stay-at-home dad for nearly four months to help my research happen. And thank you, Annika, for always giving me something to look forward to come home to. And thanks to my mother for helping us with an extra set of hands in a busy work week. We couldn't have done it without you.

Kgs. Lyngby, December 2011

Liv Gish

[2] ERFA is a Danish abbreviation for "erfaring", which means experience.

1 Introduction

About four hours from Copenhagen by train, in the middle of Jutland, you will find a small town called Bjerringbro. It is not just any town but the home of one of Denmark's largest product development and manufacturing companies, namely Grundfos. In the northeastern corner of the town, at the top of a small hill, is where the 'heart' of Grundfos is found, its Business Development Centre. This is where new innovative solutions for the pump industry are envisioned and developed, and therefore also where only Grundfos employees who have business there are allowed access. Meetings with external guests are directed to a nearby building. When you enter the Business Development Centre, you are greeted by Poul Due Jensen, founder of Grundfos and his son Niels Due Jensen. They are represented by large portraits hanging on the wall facing towards the sliding doors, to remind you what a proud and advanced technological company you are a part of and are now about to enter.

The present dissertation is based on the empirical work I have been so privileged to carry out in the Business Development Centre over a four-year period. By interviewing, observing, making presentations to, and discussing with engineering designers, business developers and managers at different organizational levels, I have gained insights into how different organizational members perceive, approach and evaluate idea work in a product development context. The overall aim of the PhD project has been to understand the nature of the idea work carried out in such a mature industrial R&D organization, and also to learn more about how idea work can be stimulated and supported. The findings and results presented in this dissertation are based on four research papers, to be found in appendices. They are referred to in the text when relevant. There are some repetitions or overlaps between the dissertation and the papers; however, the dissertation seeks to provide more information on the background of the research and tie the four papers together, in order to illustrate and discuss how they collectively contribute to answering the overall research question. This introductory chapter first presents the background for the study and the challenges Grundfos is currently facing and ends with an outline of the rest of the dissertation.

1.1 Background

To understand why the present PhD project was initiated and partly sponsored by Grundfos, we have to look at some of the activities going on at that time in the organization. The year 2006 was announced 'Innovation Year' at Grundfos. This meant that increased focus was on innovation activities, and especially on how they could be staged in the company. Employees learned about ten different kinds of innovation, symbolized by an innovation piano, which was a model of a piano with ten keys. Each key represented a particular kind of innovation. In this model, innovation did not include only product innovation but also processes, business models and customer experience, among other things. Furthermore, this innovation model was developed and introduced to all employees in order to support their work with ideas in a more creative and structured manner. Innovation competitions were held, and the employee suggestion system was relaunched and labeled iShare. All these events indicated that Grundfos not only focused on developing innovative products, but also on how to facilitate, stimulate and support innovation activities in daily practice. The 'Innovation Year' and its accompanying activities worked indirectly as a fertilizer for the PhD project – or the awareness of and attention given to managing innovation that led to the 'Innovation Year' also led to the PhD project. It was John Gammelgaard (my first contact person within Grundfos) who championed the project internally at Grundfos and found the necessary funding. John had been a key person in many of the activities conducted during the 'Innovation Year'. He was manager of iShare, took initiative to organize yearly idea and innovation days, and was also involved in the creative@work group,

which offered internal creativity courses to project teams in Grundfos. All in all, John had negotiated himself into a position at Grundfos where he had a budget and the freedom to experiment and explore how to work with ideas and innovation. This freedom allowed involvement of master students, a design internship, and finally the project that became my PhD project.

The idea for the project grew out of a series of meetings held between representatives from Grundfos and DTU in the spring of 2006 in which John Gammelgaard, among others, and my two supervisors; Christian Clausen and Claus Thorp Hansen participated. They discussed the challenges Grundfos was currently facing with respect to product development and innovation activities, and they finally formulated a project proposal. These challenges are discussed in more detail in section 1.2 Grundfos' challenges. The meetings came about because Grundfos had contacted DTU's management since they wished to strengthen their collaboration with DTU. A visit to Grundfos was arranged, and the Dean of Research at DTU issued an open invitation to any DTU employees who might be interested in future collaboration with Grundfos. My supervisors, Christian Clausen and Claus Thorp Hansen, considered this an interesting opportunity, since they wanted to develop and strengthen their research efforts in design and innovation. Recently, a new engineering education, Design and Innovation, was developed and launched in collaboration between Christian's research group, Innovation and Sustainability, and Claus' research group, Engineering Design and Product Development. Furthermore, Christian and Claus were also engaged in a range of CIPU[3] workshops with participants from industry, where recent university research in innovation and product development was presented and where representatives of industry presented their challenges. With respect to the Dean's invitation, Christian and Claus marked their interest and took part in the first meeting with Grundfos. Here, Grundfos' Research Manager made a presentation focusing on some of the challenges Grundfos was currently facing, and in the afternoon representatives from DTU and Grundfos employees were divided into different discussion groups. It was here the contact between John Gammelgaard, Christian Clausen and Claus Thorp Hansen was established and paved the way for further collaboration.

My own motivation for entering the project was based on my growing interest for innovation and product development, which developed during my master studies at DTU with focus on product development planning and innovation management in an organizational context. It was during work on my master thesis that this interest took root. I conducted the thesis in the technology and product development department of a Danish hearing aid company. For one-half year, I followed a project team and their endeavors in developing and validating a new technology for use in a future instrument. I observed how engineers of various educational backgrounds and disciplines struggled to integrate their different sets of technologies, their joy when their laboratory model finally showed the desired values, and their disappointment when a part in the laboratory model broke due to an accident. And I also observed how they imagined and discussed how the future user of the instrument would use it. Even more important, I witnessed how the project manager applied his political skills to negotiate more resources, calming stakeholders and carefully selecting what information to present at stage-gate meetings and in the minutes of meetings. It was during my master thesis that I laid the foundation for my interest and understanding of product development and innovation processes. These processes are not just about developing new technologies and products for implementation on the market; they also entail working across professional boundaries and technical domains, understanding users, understanding the

[3] CIPU is the abbreviation (in Danish) of Center for Innovation in Product Development. This center was part of an attempt to strengthen product development efforts in Denmark through collaboration between Danish universities and Danish industry.

organizational context being navigated and all the other related socio-technical, political and organizational challenges. When I saw the project proposal for what was to be the present PhD project, I recognized the opportunity to explore further these and related challenges in a new organizational context.

1.2 Grundfos' challenges

What makes Grundfos relevant and interesting to examine as a case in relation to this PhD study is found in the challenges they are currently facing in connection with their product development and innovation activities. These challenges are: 1) being a family-owned company; 2) globalization; 3) the transition from research and technology development to product development; and 4) the shift from being much focused on technology development to also becoming more oriented towards business development, obtaining a better understanding of markets, and involving users. Although Grundfos addresses these challenges in its own particular way, other companies of the same size and structure are most likely experiencing similar or related challenges, and this is what makes Grundfos interesting and relevant as the context for a case study about idea work.

In itself, being a family owned company is not a problem; however, the challenge lies in some of the characteristics Grundfos has developed over the years due to the owners it has had. Since both Poul Due Jensen and Niels Due Jensen have been charismatic leaders with a preference for developing the technological content of their products, technology development has obtained especially important status and priority in the organization. Furthermore, Poul and Niels have been willing to take risks and make radical decisions. The concern expressed by some Grundfos employees is who should be able to continue the pioneering spirit and decision-making power represented especially by Niels Due Jensen over the last many years? And for how long can technological development maintain its dominant position in Grundfos?

Like many other companies, Grundfos is experiencing the effects of globalization. This means increased competition, especially from counterfeit products, and directly competing products from Asia can be a threat. This also means that Grundfos needs to act as a global company and manifest itself in many countries. Over the years, Grundfos has established sales organizations and production facilities all over the world, and more recently, they have also established product development departments in both USA and China. These product development departments have until now been engaged in delimited projects. However, in its move towards being a more globally operating company, the question is whether these remote development departments should take over more of the core development tasks, such as research, concept studies and idea work. Or should these activities be confined to the Danish development site?

Grundfos has invested many resources in developing its technological knowledge domain and has been successful in applying this knowledge in new products. However, it has recently been questioned whether this strong emphasis on developing the technological content of products can stand alone. *"…unfortunately in our excitement for technology, we have encountered that we have a very interesting product with respect to technology, but we forgot to find out whether we could sell it"* (Niels Due Jensen). Along with an increasing focus on developing new markets, new forces are advocating for strengthening business development and user involvement. This new trend in development activities raises the question of how idea work should be driven in the future and is thus closely related to the transition from research and technological development to product development.

The challenges mentioned above, and all the responses to them, influence in some way how Grundfos should manage and stimulate idea work in the future.

1.3 Dissertation outline

The remainder of the dissertation is structured as follows. Chapter 2 gives a short introduction to Grundfos and its history and organizational context. Chapter 3 elaborates on the research challenge this dissertation builds on and the research questions that have guided the study. Chapter 4 presents the state-of-the-art literature concerning existing understandings of idea work and positions the present study. Chapter 5 presents the analytical framework and thus the theories used to analyze the empirical data. Chapter 6 introduces the research framework. Chapter 7 provides an overview and short resume of each of the four research papers. Chapter 8 presents an aggregated summary of the findings and results and discusses the interrelatedness between the four research papers and formulates the contribution of the present study. Chapter 9 presents the implications of the study. Chapter 10 discusses some of the perspectives of the dissertation which have not explicitly been addressed in the papers. Chapter 11 concludes the study, answers the research questions, and proposes ideas for future research. Chapter 12 finally presents my reflections on the PhD process. Two appendices contain a list of the transcribed interviews and the research papers, respectively.

2 Grundfos – The case company

This chapter introduces the case company, Grundfos. First, a general presentation of the company is given, and next the focus is on the R&D organization and how it has advanced over the years, especially during the last three decades. The respective roles played be the founder Poul Due Jensen and his son Niels Due Jensen are also reflected upon, as well as how they have influenced the strategies that have been pursued. Some of this contextual information is already presented sporadically in the research papers. but here, a more complete picture is drawn in order to give the reader an impression of what kind of company we are actually dealing with. The information in this chapter has partly been found on Grundfos' homepage and intranet, and partly gained through interviews. External sources have also been used.

2.1 History and facts

Grundfos was founded in 1945 by Poul Due Jensen. The company was first named Bjerringbro Die-Casting and Machine Factory (in Danish, of course). But the company name was changed several times, and in 1967, Grundfos chose its current name. Poul Due Jensen died in 1977, and the following year his son, Niels Due Jensen, took over management of the company and became Group President. From 2003 to 2011, he was Group Chairman. Today, he is Chairman of the Poul Due Jensen Foundation. The Poul Due Jensen Foundation was established in 1975 as a self-governing organization. Today, the Foundation owns 86.7 percent of the shares in Grundfos Holding A/S, while the staff holds 2.0 percent and the founder's family 11.3 percent. The aim of the Foundation is to enlarge and strengthen the financial basis for the continuous development of Grundfos. The profits and capital of the Foundation are used only for the growth of the organization, and profits are re-invested in Grundfos.

Grundfos' headquarters is in Bjerringbro, but the Grundfos Group is represented by 82 companies in 45 countries. Grundfos is one of the world's leading pump manufacturers and employs more than 16,500 people throughout the world. Annual production of more than 16 million pump units makes Grundfos one of the largest pump manufacturers. The types of pumps include centrifugal pumps, submersible pumps, and circulation pumps, and Grundfos covers approximately 50 percent of the circulation pump market. In addition to pumps, Grundfos produces standard and submersible motors as well as state-of-the-art electronics for monitoring and controlling pumps. Additional products are produced in the BioBooster and Lifelink divisions, which are part of the company's new business activities. In 2010, Grundfos' net turnover was €2633m, and profit before taxes was €322m.

2.2 The Grundfos legacy and spirit

Since Grundfos was established in 1945, it has developed from being a small artisan company to becoming a truly global corporation. Traditionally, Grundfos has attributed huge importance to research and development. The first pump was developed on request from a local farmer to install an automatic water board. This demanded an efficient pump, which Poul Due Jensen could not find anywhere. So he began designing the pump himself, a characteristic that has followed the company ever since – "we'll do it ourselves". Poul Due Jensen was a skilled mechanic, and he studied for a bachelor in mechanical engineering but never finished his studies. The welcome brochure from Grundfos' internal museum states that *"[the first pump] became a norm for Poul Due Jensen's work and the requirements he gave himself and his employees: A new product can only be justified if it is different and better"*. And the brochure continues: *"Poul Due Jensen was however, not a man who was satisfied with a great result: The pump had to be improved further*

[…]". Poul Due Jensen also encouraged collaboration among his employees. His motto was: *"There is not much a single person can accomplish alone; but there are no limits to what several people working together can accomplish"*. And this still applies. Christensen (2002) describes how Grundfos has had a consistent commitment to realizing economies of scale through high quality mass production, and Poul Due Jensen was a driving force in shaping this strategic focus. But because it was not possible to find any standard production machinery that could mass produce the Grundfos circulators, Grundfos started to design and built its own machinery. This concept was so successful that today most Grundfos pumps are produced on custom-built machines manufactured by a separate department in Grundfos. Moreover, two of the machines Poul Due Jensen designed back then are still operating, which again is a sign of the "we'll do it ourselves" philosophy.

Figure 1 These pictures of Poul Due Jensen and Niels Due Jensen hang in the hall of the main entrance to the Business Development Center.

When conducting my study at Grundfos, not many of the current employees had met Poul Due Jensen, but they had met Niels Due Jensen and felt his engagement in development activities as well as his visionary mindset: *"If he had not done these things and said this is how it should be, then we would not have the products we have today. […] We should just be thankful that somebody has stepped forward and said; 'we shall have this', and then forced it through" (Product developer 1).* Another developer describes him as *"a gift from God …in the way that he has made us do things all reasonable people would advise not to. With the benefit of hindsight, I think that that has been very fortunate for Grundfos"*. Many similar statements can be found in the interview material, and they tell us that even though Niels Due Jensen is no longer formally engaged in the daily routines at Grundfos, he still plays an important role with respect to innovation activities and *"is contributing to keep a high level of ambition" (Product developer 2).* Some of the important technological milestones have also been reached with Niels Due Jensen in front. In 1985, an opportunity arose. By using smart power chips, it was possible to integrate the frequency converter with the motor and pump. The frequency converter is also referred to as an electronic controller. In 1991, the first circulation pump was launched with a built-in

frequency converter: the UPE. This was the first 'intelligent' pump in the world and set a trend in the whole industry. Before the UPE was developed, Grundfos decided to start its own production of electronic controls for the pumps. Grundfos Electronics was only a tiny department to begin with: three assembly staff and one technician. Whereas Poul Due Jensen was strongly dedicated to developing a high-quality mass production capability, Niels Due Jensen was dedicated to environmental responsibility and making Grundfos a company that produces sustainable products. Thus, Grundfos received the international environmental qualification ISO 14001 in 1996. And in 1998, sustainable development was announced to be the first out of eight corporate values. "*Sustainable development is a key concept at Grundfos. It is vital that our pumps demonstrate respect for the environment, especially in terms of energy consumption and use of materials*" (Grundfos communication). Environmental responsibility and sustainable development were further cemented when the branding project, "Be, Think, Innovate", was initiated to communicate the essence of Grundfos' fundamental values to customers, employees and other partners in 2001.

2.3 The transitions

Like many companies with almost 70 years of history, Grundfos has also experienced many changes. In the following, two such changes or transitions are discussed, since they are relevant for understanding the challenges Grundfos is currently facing with respect to innovation activities.

2.3.1 From craftsmanship to R&D – becoming an engineering workplace

As already mentioned, while Grundfos started out as a small artisan company, Grundfos has now become a real engineering workplace with respect to research and development activities. Many other technical educational backgrounds are also represented. Product development has always been a cornerstone of the company. The book, "Grundfos – more than pumps" (Ballisager 2007) describes how Poul Due Jensen imagined the products he wanted to create in his head, and how he preferred to experiment with steel and machines and make prototypes that could be continuously improved rather than making sketches or technical drawings. Only very few records still exist. Poul did have requirements for the products' aesthetic form, however; the product had to look good. Over the years, there was always a close interaction between product development and production tools and machines. Since the 1950s, working processes have been rationalized, and it is reported that Poul Due Jensen preferred that Grundfos do everything themselves; thus, he made experiments to find out how machines could be built together in order to integrate work processes. In "Grundfos - more than pumps" (Ballisager 2007), a former employee reports: "*We worked day and night. But it was also easier to make mistakes then and to correct the mistakes"*. This quote emphasizes the trial-and-error approach that characterized the product development environment at that time. Niels Due Jensen started with an apprenticeship as a machine operator in Grundfos, but later achieved a bachelor degree in mechanical engineering. Since Niels Due Jensen started his career with training as an artisan, he had the same hands-on experience and practical approach to product development as his father. *"I have in many years worked with basis in a technical background in Grundfos, and I have always been interested in new technology"* (Niels Due Jensen). Nevertheless, it became the norm to employ engineers to be involved in the product development activities; their level of education corresponded to what we today denote as a bachelor's degree. In the 1970s, Grundfos also began to develop and manufacture motors, and as the products became more complex, a greater variety of professional competences were needed. Especially the electronics domain grew during the 1980s and 1990s, and thus the requirements for even more specialized knowledge increased. This meant employment of engineers with a master's degree as well as PhD degrees, and thus a transition from a very

'practical' approach to product development towards a more 'theoretical' approach ensued. An interviewee reports: *"I think we are 20, 22 ,25 with a PhD degree, the rest hold master degrees and there are not many technicians. That means that the professional level is much higher, and the basis for ideas is also much higher"* (Product developer 3). Another interviewee at Grundfos told me that in the beginning Niels Due Jensen had some resistance to this development, although he today acknowledges that it is essential for Grundfos' further advancement. Whereas in the beginning, product development was the cornerstone of the company, research has over the years, qua all the PhDs, also become a very important activity. Another reason for the increase during the last couple of decades in employment of engineers with master and PhD degrees can also be related to the fact that Aalborg University (in north Jutland, 1½ hours from Bjerringbro by car) was established in 1974.

2.3.2 From R&D to business development

R&D activities have been fundamental to Grundfos' success and could be called the heart of Grundfos. The engagement and strong focus on R&D activities, and the technological content of the products, can also be seen within Grundfos' top management. Whereas CEOs are usually concerned with financial matters and growth rates, Grundfos' CEO, as well as selected members of the board, are also concerned with R&D activities and participate in the so-called Research and Technology Committee (RTC) meetings, where new inventions and concepts are presented and discussed. However, Grundfos' management is also aware that a narrow focus on technology alone is not enough to face the challenges of the world today. Innovation should be embraced with a broader view; therefore, in 2008, they launched Innovation Intent, and reorganized the business and R&D departments in order to support a transition towards a better balance between technological development and business development

3 Realizing the research challenge

This chapter first presents how the research problem was initially presented; next how the problem was initially approached; and finally, the research questions that have guided the final study.

3.1 How the research problem was presented initially

Figure 2 below is an unofficial illustration of Grundfos' innovation process as it was presented in the years 2005-2008. The illustration is unofficial, since it did not appear in the official databases, but was distributed through emails and power point presentations. Starting from the left, the yellow stars symbolize ideas, opportunities or solutions that are ready to be screened. Next, a staircase with five steps, T1 to T5, symbolizes the process of maturing technologies from least mature (T1) to most mature (T5). CP0 and CP1 symbolize the phases of a concept study, which is made to evaluate the feasibility of ideas that are characterized by high uncertainty. The concept study is fundamentally different from product development projects given the high uncertainty. On the right-hand side of the illustration, the 'Decision Point' process is showed, which is referred to as the DP process in everyday speech.

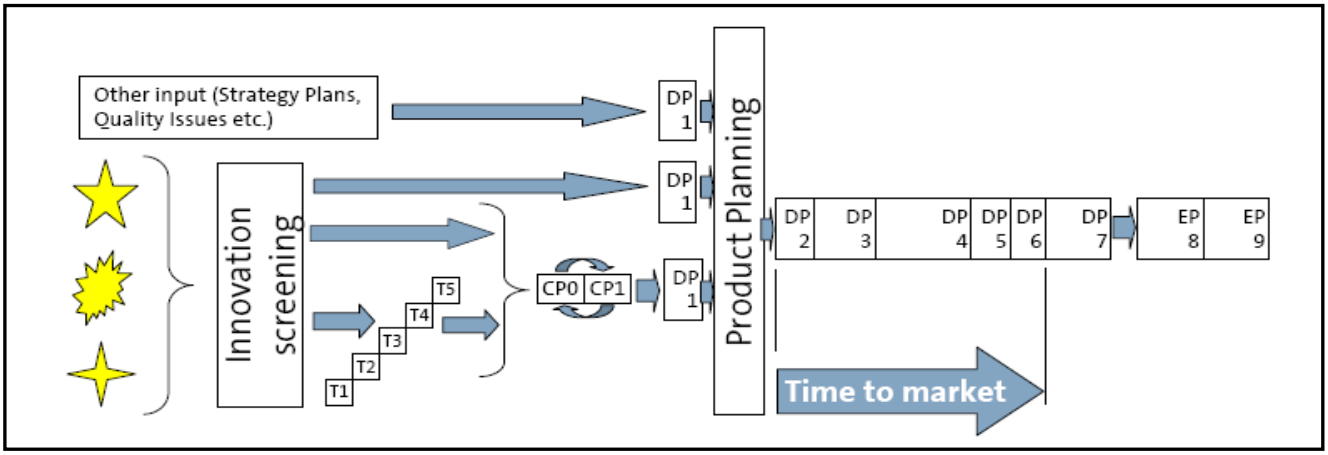

Figure 2 An unofficial illustration of Grundfos' innovation process

The DP process is Grundfos' version of the widely known stage-gate product development process (Cooper 2001). While refining this process over the last decades, Grundfos has gradually improved its success in conducting the underlying activities. Therefore, in initiating the PhD project, Grundfos sought to know more about the earlier phases – the phases in which ideas are generated and before project proposals are selected and funded, which happens just before entering the stage called DP1. During my many talks with John Gammelgaard, he emphasized that the aim of the project was to investigate the yellow-star area. When interviewing John's boss about this he answered:

> *"Well, a lot of things happen out here* [he was pointing at the yellow stars], *and it can be difficult to pin down what it is. […] Where do the ideas come from in such an organization?"* (John's boss)

He went on to talk about some of the things he and John initially had discussed with regard to the aim of the PhD project:

> *"It's a combination of [already] having something and having focus on what it is you generate ideas about. Plus we have to accept, or even try to express, that we need [to look at] the indefinable, because that's where the cash cow just might appear some day. And how do you handle it in a professional way? How do you get a hold of those ideas that might be out there? How do you do it in a way so people get an overview and are able to evaluate [the ideas] in relation to each other?"* (John's boss)

In the end, John narrowed the problem down to: ***"What is happening with ideas in the early phases of product development?"*** This is also in compliance with the original title[4] of the PhD project. But John was also interested in another phenomenon. He had noticed that some ideas are accepted or rejected more easily than others. In one of the interviews with John, I asked him about a particular idea that is being utilized today in a very strategic project, but which John initially rejected when it arrived on his desk:

> *"But it is also interesting how hard it was to get [the idea] accepted. How come this idea was turned into reality, and why was it not one of the rejected ideas that became reality?"* (John Gammelgaard)

In the same interview, he starts talking about filters:

> *"What's interesting is what are these filters? And by filters, I mean the opposite. There's nothing that stops anything – there is nothing that is stopped; the question is whether it gets started. It's not like someone says: I have an idea! You can't work with that! That's not the way it is. Someone has an idea, and someone says it is a good idea. There are people who sit out there who say it's fine, let's try to work on it a little further; and then maybe it goes nowhere. So then instead of calling it a filter, it is perhaps more an amplifier"* (John Gammelgaard).

This filter phenomenon – whether a 'brake' that impedes ideas or an 'amplifier' that facilitates them – was something he also wanted the project to look into: ***"What kind of organizational filters impede or facilitate work with ideas?"*** This was the point of departure for the PhD project and the initial theoretical and empirical investigations.

3.2 How the research problem was approached initially

Within the first research year, the project was very focused on finding out what early idea work was all about. This soon led me to the literature about the Fuzzy Front End (FFE) (Smith and Reinertsen 1998). Although many different definitions exist, the Fuzzy Front End can be understood as the notion concerning the activities conducted before any resources and any formal project team members are assigned to an official product development project (Khurana and Rosenthal 1998). In the FFE literature, it was taken for granted what an idea was. A definition was rarely given, and the content of ideas was seldom touched upon. But there was a linear or sequential understanding of the development process; namely, an idea is first generated; then, a concept is developed and so on. In studying one of the Grundfos cases (the Alpha Pro case), it proved to be difficult to talk about only one 'original' idea, as it seemed that many different ideas had been pieced together over time. It also proved to be hard to accept that the generation of ideas or the work with them should be confined to the front end of the innovation process, as was

[4] Socio-technical and organizational dimensions in the early phases of product development.

implied by many FFE scholars in their models. In any case, when I started to interview the engineering designers at Grundfos, I was still keen on finding out what early idea work was and where the 'yellow stars' in Grundfos' unofficial illustration of the innovation process came from. This proved difficult, so I confronted John Gammelgaard once again in a kind of interview setting and asked him to pin down what he meant about early idea work. At that time, I was quite confused, because I could not seem to detect it. The audio-recorded conversation with John was one of the first milestones in altering my understanding of idea work and what it was I was searching for. It became clear that until that point in time, I had looked for ideas as small blinking light bulbs – as fixed entities waiting to be discovered at the beginning of the development process, like Latour's 'black boxes'. In order to understand technology, Latour (1987) argues that we have to open up the 'black box', get inside and follow actors as they engage in making technology. Black boxing idea work had an effect on how I approached the interviews, the kind of questions I asked, and what stories I wanted the interviewees to elaborate on. The audio-recorded conversation also shows that John had begun altering his understanding of idea work, too. It now became apparent to me that different understandings of idea work existed, both in the literature and in practice. With this new insight, the interviews could be read and interpreted in a new light. Moreover, the initial research questions could be revised.

3.3 Research questions

Although John Gammelgaard had initially emphasized that it was the early phases that Grundfos was interested in, it became clear that not only is the generation of ideas important. Development, promotion, acknowledgement and evaluation of ideas are equally interesting and important to understand. Therefore, the phenomenon studied in this dissertation is 'the work with ideas'. It is the relationship between the idea, the designer and the rest of the organization that is under investigation. The overall theme for the dissertation can be framed by the following question: What is the nature of idea work? But a more operational question is needed in order to delimit the object of investigation:

- How do designers work with ideas in a mature industrial R&D setting?
- How can work with ideas in a mature industrial R&D setting be stimulated and supported?

Here, the term designers refers especially to engineering designers, but also encompasses other R&D professionals with similar backgrounds. A mature industrial R&D setting should be understood in a Danish context, where Grundfos is perceived to be one of the biggest industrial companies in Denmark. The R&D setting is perceived to be mature, since Grundfos is over sixty years old and has worked with product development throughout all these years.

The research questions as formulated above are still very broad in nature; however, in each of the four papers more specific questions are posed. And in this sense, the above questions serve to unite the papers.

4 State-of-the-art

The purpose of this chapter is to present the state-of-the-art literature on idea work in order to detect current challenges, position the present study, and identify the gap in the literature, which this study attempts to fill with new insights and knowledge. Each of the four research papers in this dissertation presents on its own relevant state-of-the-art literature; thus, this chapter is in many ways more of a supplement to the articles. It draws the big picture and links different fields of theory and understandings of idea work, although some overlap and repetition does occur.

4.1 Increasing focus on ideas

In the 1990s in innovation and product development research, the focus was on time-to market and faster development and implementation of new products. As Cooper (2001) states: "*The ability to accelerate product innovation – to get products to market ahead of competition and within the window of opportunity – is more than ever central to success*". Product development models were offered and implemented in companies in order to achieve this goal, and today most product developing companies use some sort of stage-gate model to plan and conduct their product development activities. In the 2000s, upstream activities at the so-called 'fuzzy front end' came into focus, because they were recognized as being critical to the whole innovation process and were considered to offer one of the greatest opportunities for improvement (Khurana and Rosenthal 1998; Rubenstein 1994; Koen et al. 2002). Particularly, the question of how to find more and better ideas was addressed, as ideas were found to be *"the technical lifeblood of the firm"* (Rubenstein 1994), *"the feedstock or trigger to the new product process"* (Cooper 2001), and *"critical for the ultimate success of organizations"* (Rothberg 2004). This increasing focus on ideas and the consensus that ideas constitute the starting point of innovation endeavors resulted in many different studies. In the following, I provide a review of a selection of these studies, which are divided into three categories: 1) idea quantity and quality, 2) idea management, and 3) idea champions and informal networks.

4.2 Idea quantity and quality

Stevens and Burley (1997) state that only a very small percentage of the initial ideas for new products – namely one out of three thousand – leads to commercial success. This supports the statement that a steady flow of ideas is needed in order to ensure long-term competiveness (Björk and Magnusson 2009). Such statements indicate that the quantity of ideas matter. In order to secure a steady flow of ideas, it is relevant to know the sources of ideas as well as how they can be generated. Thus, many empirical studies have been conducted in order to understand the sources of ideas (Cooper and Kleinschmidt 1986; Peterson 1988; Yoon and Lilien 1988; Koen and Kohli 1998), and theoretical frameworks have also been developed (Stasch et al. 1992). These contributions identify both internal and external sources of ideas. Focus within the 2000s has especially been on how external R&D sources and resources of ideas can be utilized. In this vein, such concepts as democratized innovation (von Hippel 2005), participatory innovation (Buur and Matthews 2008), open innovation (Chesbrough 2007), wisdom of the crowds (Surowiecki 2005) and high involvement innovation (Bessant 2003; Hallgren 2008) have evolved. Whereas high involvement innovation focuses especially on involving all employees, the other concepts focus on external sources, which involve users. With respect to generation of ideas, a wide range of problem-solving and creative techniques have evolved, both intuitive methods such as brainstorming (in all its different designs), first proposed by Osborn (1965); stimulation word analysis, and picture confrontation: and structured methods such as

morphological analysis, developed by Zwicky (1969), and TRIZ (Theory of Inventive Problem Solving), developed by Altshuller (Altshuller and Shulyak 1998).
Besides securing a constant flow of ideas, discussions have also pointed towards the quality of ideas. Goldhar et al. (1976) argue that the quality of new ideas is the key to improving the R&D productivity. One line of thought is that quantity yields quality. If the initial pool of ideas is enlarged, the chances of finding ideas of a certain quality will be increased (Shah et al. 2003; Yang 2009). Vandenbosch et al. (2006), however, conclude that everyone has ideas all the time. According to this viewpoint, it is not a problem to provide the organization with new ideas; the problem is rather which ones to choose. Different parameters have been suggested for judging the quality of ideas. Shah et al. (2003) have evaluated the effectiveness of idea generation methods, and in this connection they define idea quality as "*the measure of the feasibility of an idea and how close it comes to meet the design specifications*". Kudrowitz and Wallace (2010) also suggest that idea quality is linked to feasibility, and also to the degree of creativity and usefulness. Approaches to how the best ideas or R&D projects are selected have also been researched. Several selection methods have been suggested, ranging from unstructured peer review, over scoring, to mathematical models and programming (Henriksen and Traynor 1999).

Many studies concerned with idea generation examine how individuals or groups generate ideas or concepts of a predefined problem in a fixed setting, such as a meeting room (Perttula and Sipila 2007; Liikkanen and Perttula 2010; Howard et al. 2010; Howard et al. 2011). Such studies can tell us much about how individuals or groups can be stimulated in their idea generation, but they presuppose that work with ideas goes on in fixed settings with a specific problem outlined from the beginning. This situation occurs, of course, in large organizational settings, especially when project teams need new ideas for a certain solution or product. However, work with ideas also goes on in organizations without being requested by management and outside prescheduled meetings. As illustrated above, much literature is concerned with the sources of ideas, the generation of ideas and the selection of ideas. Although each of these aspects is important in order to understand designers' work with ideas, their focus is very narrow and only relates to a few distinct activities out of the many involved in idea work. In this dissertation, I wish to develop an understanding of designers' work with ideas in a mature industrial R&D setting. Given the challenges outlined in the introduction, this includes more than identifying the sources of ideas, more than understanding the individual designer's moment of creation and the cognitive skills in idea generation, and more than a set of selection methods. Rather, it involves a wider perspective on idea work, which also including activities such as the development of ideas, the recognition of ideas, the support of ideas and the implementation of ideas. Still, these activities are not interesting as separate and distinct activities, but as elements in a process undertaken in an organizational context.

4.3 Idea management

Idea management has recently become very popular, both within academia and industry. Many organizations experiment with different systems; researchers prescribe guidelines for establishing the systems; and suppliers provide the specialized IT-platforms needed for running them. The thought behind idea management is that organizations can steer the flow of ideas. When new ideas are needed, management can call for ideas and thereby increase their flow, and when ideas do not have a specific address, they can be collected for future use. Vandenbosch et al. (2006) argue that idea management is not only concerned with the generation of ideas, thus recognizing the need for ideas and the need to evaluate them are also central aspects of the process. Although idea management is not confined to an IT-based system for handling ideas, many accounts and empirical studies in the literature are concerned with this systemic aspect (Nilsson et al. 2002;

van Dijk and van den Ende 2002; Detterfelt et al. 2009). Nilsson et al. (2002) define an idea management system as a "*formalized system that captures, examines, nurtures and develops ideas proposed within the organization*". The aim of idea management systems is to increase the number of generated ideas, the exchange of ideas, and the collection/storage of ideas. Nilsson et al. (2002) argue further that idea management systems are the natural place to submit ideas and that the focus is on the ideas generated outside the formal product development process. Another reason to implement idea management, besides becoming able to steer the flow of ideas, is to lower the risk of losing ideas forever when they are not collected or acted on immediately.

Much of the literature on idea management emphasizes all the advantages that can be gained by implementing idea management systems, such as providing innovators with encouragement, helping decision makers make informed decisions, increasing the flow of ideas and collecting ideas that would otherwise be lost. However, van Dijk and van den Ende (2002) argue that companies experience varied success when implementing these systems, and Björk et al. (2010) argue that companies even experience negative consequences from formalizing ideation practices. Especially radical innovation ideas are viewed as being difficult to fit into formal idea management systems. For example, Sandström and Björk (2010) argue that existing idea management literature primarily views idea management systems as a structured process for managing incremental innovation ideas, and that incremental and radical innovation ideas cannot go through the same funnel; different processes and evaluation criteria should therefore be applied. Benner and Tushman (2003) also distinguish between how incremental and radical innovation should be addressed. They argue that process management activities can facilitate incremental innovation but dampen radical innovation. Following this argument, it would be very difficult to design an idea management system that can cover radical innovation – and especially both types of innovation in the same system.

Much of the literature in the idea management field is prescriptive and based on studies of best practices. This means that focus is primarily on a streamlined system and not on the more wide-ranging idea work capabilities that are also present in the company as well the more informal approaches to idea work, such as idea champions and social networks. In order to understand how designers work with ideas, I also have to acknowledge and consider the more informal approaches to idea work used in organizations.

4.4 Idea champions and informal networks

In their study of ideation capabilities, Björk et al. (2010) observe that the companies they study apply very different types of processes for managing ideas. Some companies concentrate on developing formal systems, whereas others rely more on smaller informal networks and entrepreneurial individuals. Generally, the champion literature acknowledges that champions are necessary to negotiate resources and support, as a supplement to formal systems (Schon 1963; Chakrabarti 1974; Howell and Higgins 1990; Shane 1994; Howell and Boies 2004). Schon (1963) was the first to coin the term champion about organizational members who are willing to fail in their effort to convince others about the greatness of their ideas, and who are also "… *capable of using any and every means of informal sales and pressure in order to succeed*". Schon (1963) examines how technical innovations are disseminated in the US military and argues that ideas need active internal sales promotion. Since Schon's first article on champions was published, a large body of literature has appeared on champion behavior and the different aspects of this role, which especially treats the individual attributes of the champion, influence tactics, and the utilization of formal and informal processes. A more detailed description of the champion literature can be found in research paper 3. Besides champions, other roles important for the innovation process have also been proposed, which include the 'the expert', who generates the idea (Chakrabarti and Hauschildt 1989); 'the sponsor', who provides project sanctioning and

resources (Chakrabarti and Hauschildt 1989; Markham et al. 2010), and 'the gatekeeper', who establishes criteria and makes decisions about the future of the project, and who controls information sharing between the environment and the organization (Markham et al. 2010; Reid and de Brentani 2004). Kijkuit and van den Ende (2007) have studied the importance of actors and networks in idea work, and elaborate to some extent on the champion literature. They propose that an idea is surrounded by a network of employees who discuss it and thereby affect both the quality of the idea and its chances for adoption. Once an opportunity or idea is identified, they argue, it is the social interaction carried out with respect to the idea that determines the idea's further development and its evaluation. In the initial phase, it would be the idea generator's personal network that affects the creation of the idea, but with time, the network can expand to also include other actors in the organization. Both during the idea generation and idea development activity, mutual understanding among the network actors is required in order to recognize the value of diverse and complex knowledge, and also in order to actively transfer this complex knowledge. Finally, mutual understanding is mainly important to obtain support from decision makers. Kijkuit and van den Ende (2007) conclude that from a non-redundant, heterogeneous structure with many weak ties and a weak degree of decision-maker involvement, networks of ideas should be able to evolve into a smaller, more cohesive network, which in the development phase has stronger ties to decision makers.
Koch and Leitner (2008) have studied how ideas develop through self-organization. They separate the evolution of a self-organized innovation into five stages: idea generation, coalition building and networking, prototyping, persuasion of key actors, and reaction after top-management decision making. A self-organized innovation starts when an actor in the organization, without any explicit order from management, searches for opportunities to innovate. This activity is driven by the employee's own motivation, but personal networks play an important role as sources of ideas or opportunities. After a concretization of the idea, the idea generator tries to mobilize interest and support the idea through negotiation. Through this process, a coalition is built and, hereafter, the inventors start with the first step of implementing the idea through prototyping. Prototyping takes place alongside normal work, and the inventors use the company's equipment unofficially, e.g. after working hours. At some point, official organizational support is required for further implementation, but since R&D managers are usually aware of the self-organized work, official organizational support means top-management support. If the top-management accepts the idea, a formal project team and resources are designated, and the project receives an organizational priority. If the idea is rejected, the inventors will sometimes continue to work on it.

Both the champion literature and the informal network perspective acknowledge that organizational members act outside the formal organizational processes in order to set idea work in motion. Furthermore, organizational members are dependent on building support among other organizational members and management in order to develop momentum. It has been questioned, however, whether such champion behavior is always productive, and champion literature has been accused of relying on anecdotes (Markham and Griffin 1998). There is also a bias towards reporting past successes, while experiences from failed projects are missing. Markham and Griffin (1998) thus argue: "*Selective retention of championing stories helps reinforce the statistically unsubstantiated belief that champions positively impact NPD*". However, this literature, as well as the informal network perspective, does help us focus on *the actors* in idea work instead of only the formal structures, tools and systems for generating and selecting ideas. This is important, since these activities alone are not sufficient to bring about innovation or understand the process.

4.5 Positioning of this study

The aim of this study is to examine how designers work with ideas in a mature industrial R&D setting, and moreover, how this work is best stimulated and supported. As implied earlier, since this is a broad aim, it is necessary to demarcate the examination into smaller components or delimited perspectives. However, the key here is not to separate the distinct idea work activities into separate units such as generation, selection, or implementation of ideas. Rather the key is to make some interesting cross-sections through the whole process, as illustrated in Figure 3, and to examine these closer.

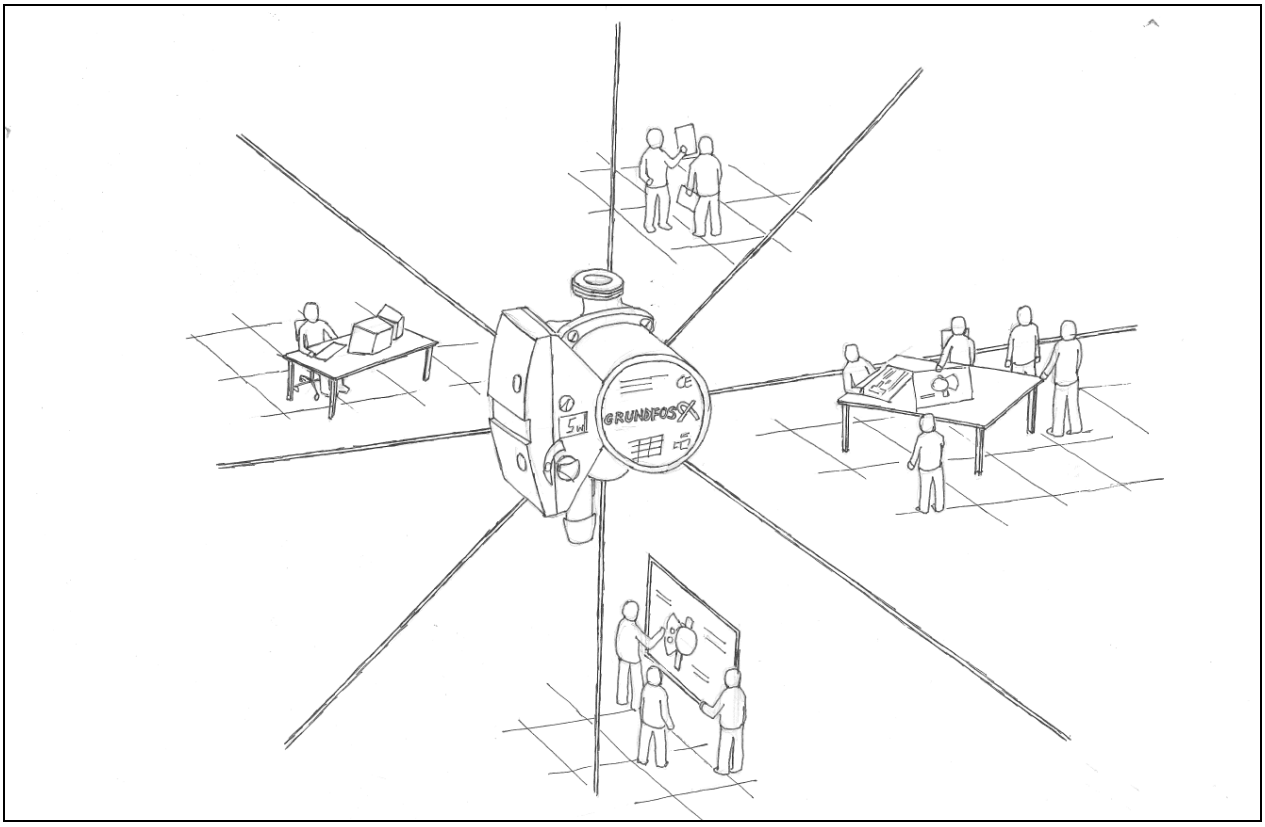

Figure 3 A cross-section of designers working with ideas.

As established in the previous sections, much literature examines the distinct idea work activities and/or tends to be prescriptive in nature. Van de Ven et al. (2000) argue: "*Too many innovation scholars and consultants have jumped to prescriptions with little or no substantiated evidence on how innovations actually develop over time and what processes are associated with success or failure*". The intention of the present study is to examine the 'real-life' organizational micro processes to find out how ideas develop over time. Both the champion literature and the informal network perspective have provided us with valuable insights along these lines, especially regarding the more informal processes involved in the work with ideas, as well as how actors relate to each other in the process. However, when studying idea work processes, we also need to address the content of idea work – such as what role technologies, visions, users, markets, competitors, and competencies, all together, play in the designer's work with ideas. Hansen and Andreasen (Hansen and Andreasen 2005) have proposed the framework shown in Figure 4. It

shows the different dimensions of a product idea and thus what elements have to be considered in the work with ideas.

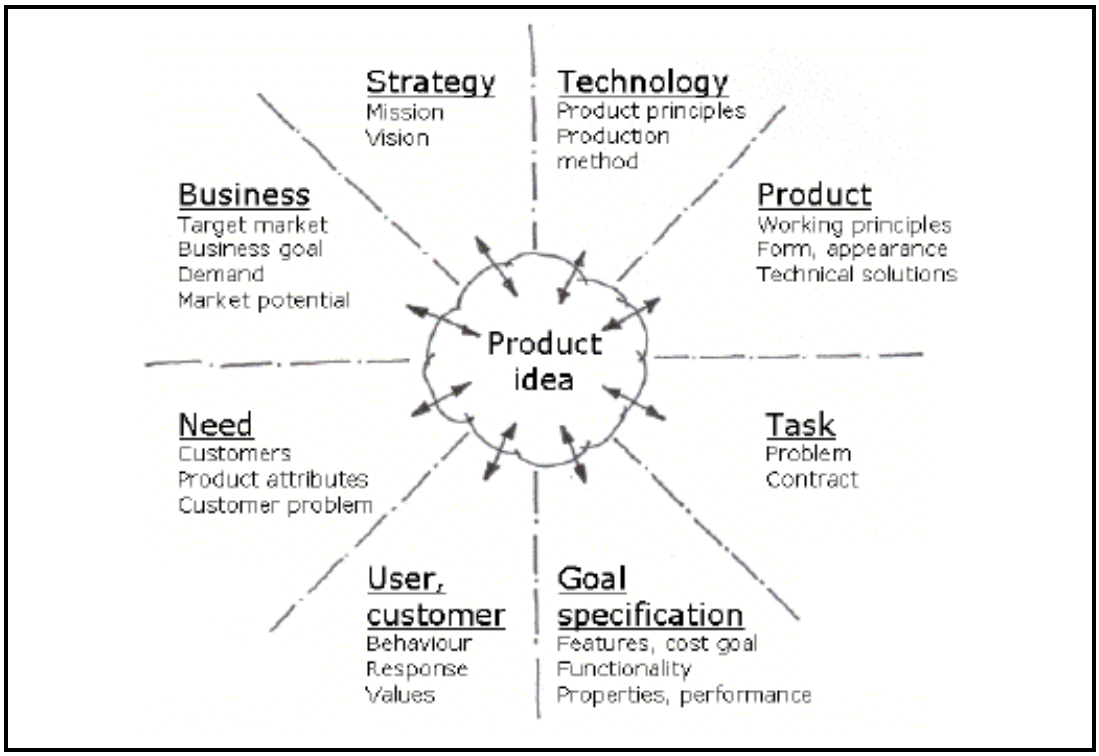

Figure 4 A framework summing up the dimensions of a product idea (Hansen and Andreasen 2005)

The framework not only comprises the material elements, such as technology and products, but also the immaterial elements, such as needs and strategy. all elements that can help steer the direction of work with ideas. There is however an important aspect that is not present in the framework with regard to our understanding idea work – the actors, or more precisely, what guides the actors' actions and interactions.

McGuinness (1989) argues: "*…the academic literature [is not] much help in understanding how ideas get going in organizations. A recent text, for instance, deals extensively with the source of ideas and techniques for generating ideas, but says very little about how an idea moves from a vague, incomplete notion in the mind of one person to become a well defined, formal organizational priority, ready for development*". In order to understand designer's work with ideas in a mature industrial R&D setting and the aspects outlined above, I find help in two theoretical traditions, Science and Technology Studies and the political process perspective. They can help illuminate the organizational processes that develop incomplete ideas so they receive organizational priorities. These theories are presented in the next chapter: "Analytical framework".

The present study fills a gap in the existing literature and makes a contribution by approaching idea work more holistically, and by focusing on the *work* in idea work. This means that emphasis is on all the many heterogeneous elements that guide the interaction involved in idea work, such as visions, competences, formal systems, informal processes, navigational skills, conflicts, collaboration, and political astuteness. Focus is thus not on distinct processes, systems or actors in the organization in themselves, but on the interplay between them over time.

5 Analytical framework

In this section, I present the theories that have been applied as the underlying perspective for understanding idea work, as well as a lens to analyze and interpret the empirical data. The theories presented belong to the field of Science and Technology Studies and the political process perspective.

5.1 Science and Technology Studies

Science and Technology Studies (STS) is a collective name for a range of theories and positions focusing on an interdisciplinary and constructivist approach to analyzing organizations, society, science, technology, innovations and the like (Jensen et al. 2007). STS scholars are interested in a variety of problems and have studied everything from scallops (Callon 1986a) to large technological systems (Hughes 1987). Common for STS scholars is that they look at how the things they study are constructed (Hackett 2007). In relation to understanding idea work, which is the aim of this dissertation, the STS perspective is relevant, because it especially seeks to open up the black box of technology (Latour 1987) and helps provide insights into human as well as non-human interaction. Thus, the STS perspective represents a view of organizational innovation practices that does not only include social elements and actors, but also material aspects, such as documents, the physical surroundings and technical objects (Jensen et al. 2007). Moreover, the STS perspective works as an alternative to the more rationalistic and management-oriented approaches presented in organizational management literature today. Linear understandings of innovation processes have been discussed and criticized for a long time, not only in the STS field but also in other research fields. Cooper (2008) even published a paper in *Journal of Product Innovation Management* to accommodate the many years of criticism and misunderstandings associated with his stage-gate model. In the STS field, innovation processes are thus appreciated as complex processes. They involve many different actors and social groups with dissimilar competences, which negotiate interests that can be conflicting at times. They make heterogeneous and often confused decisions, the significance of which is difficult to determine beforehand (Akrich et al. 2002). The innovation process is also very much perceived as a collective process. Regarding this, Akrich et al. (2002) argue: "*The individual qualities of insight, intuition, sense of anticipation, quick reactions, skillfulness, must all be reinvented and reformulated in the language of the organization. They are no longer the property of an individual, but become collective virtues, during the emergence of which the art of governing and managing play a key role"*. Focus in this dissertation is not on innovation processes as such, but on idea work that hopefully leads to innovation. However, the messiness, complexity and collectivity that characterize innovation processes are also presumed to characterize idea work.

Engineering designers' work with ideas has not previously been studied from an STS perspective. However, Woolgar (2004) has touched upon ideas in a marketing context. The understanding that technological artifacts do not have intrinsic properties but are socially constructed is central in his understanding of ideas. Woolgar (2004) suggests three different analytical perspectives on ideas: the romantic, modified romanticism, and the constitutive. In the *romantic* perspective, the idea is viewed as having its own life, disregarding the designers working on it or the context in which it appears. It possesses intrinsic qualities (is intrinsically good or bad), and thus needs no promotion in the organization; it will sell itself. In the *modified romanticism* perspective, an idea may need to have some help in order to be disseminated in the organization; however, the essence of the idea is presumed to be unchanged, retaining its intrinsic qualities. In the *constitutive* perspective, ideas are viewed as being "*constituted in and through the processes of their articulation and representation*". In this sense, ideas need promotion, and through the promoting process, ideas

are affected and reshaped. It is the third perspective (the constitutive perspective) that the author of this dissertation supports, uses, and studies. But the former perspectives are met frequently, both in literature and industry. Woolgar (2004) also argues that varying embodiments exist of what gets to count as an idea in different contexts. In this sense it can be very difficult to define what an idea is and when something is perceived as an idea, because it is so context-dependent. The understanding developed of idea work in this dissertation is strongly inspired by Woolgar's constitutive perspective. But in order to understand idea work practices at Grundfos, a range of other STS perspectives have also been applied.

Especially two frameworks within the STS field have been applied to analyze and interpret the empirical data. These are the social construction of technology (SCOT) and actor-network theory (ANT). More specifically, Pinch and Bijker's (Pinch and Bijker 1987; Bijker 1995) technological frames are used within the SCOT framework, as well as Callon's (1986a, 1986b) process of translation and Akrich's (1992) scripts, both of which lie within the framework of actor-network theory. In research paper 1, no specific concepts from the STS field are explicitly mentioned, although the analysis is strongly inspired by this line of literature and acknowledges that socio-technical competencies are important for engineering designers. In the remaining three research papers, concepts from the STS field are applied more explicitly. The concept of technological frames is applied in research paper 2; the process of translation is applied in research paper 3; and script analysis is applied in research paper 4. Although each of these concepts or theories have only been applied in one of the papers, the underlying STS perspective of social constructivism has shaped and inspired the general approach and analytical strategies applied in this dissertation. Thus, the aim has been to make a socio-technical analysis with emphasis on how social elements influence and construct technology and vice versa. In the following, technological frames, process of translation, and script analysis are briefly presented.

Technological frames can help explain how actors attribute and negotiate meaning to objects and events, as well as how they act and interact with other actors. Pinch and Bijker (Pinch and Bijker 1987; Bijker 1995) emphasize that technological frames are not an individual characteristic but rather something that is located between actors and structures their interaction, and also the outcomes of the interaction. Technological frames thus emerge when interaction around an artifact begins. A technological frame comprises the concepts and techniques a community employs in its problem-solving – e.g. goals, key problems, problem-solving strategies, tacit knowledge, testing procedures, engineering or use practices etc. Lauritsen (2007) argues that a technological frame holds the resources applied in the construction of a technology or an artifact. An actor can be part of several technological frames, but with more or less inclusion in these frames. An actor's degree of inclusion in a technological frame indicates how much he is steered by that frame and thereby how he thinks, acts and interacts with other actors, as well as how much he has integrated the key problems, problem-solving strategies, practices etc. In research paper 2, a more detailed description and discussion of this framework is provided, and references are also made to other scholars engaged in technological frames.

Process of translation: In actor-network theory, innovation is viewed as the art of interesting an increasing number of allies, who will then make your ideas stronger and stronger (Akrich et al. 2002). The process of translation (Callon 1986a) can be used to analyze how relations are established between actors. In the process of translation key actors attempt to structure power relations by developing and negotiating a central actor-network in which all the actors agree that the network is worth building and defending. Actors are here viewed as heterogeneous entities, both human and non-human. The premise that not only social actors but also objects and technical artifacts constitute the actor network is very central in the actor-network theory. Callon (1986a) has articulated four moments of translation: problematization, interessement, enrollment

and mobilization of allies. These can overlap in reality. During problematization, the key spokesperson(s) of the network problematizes a certain issue or situation, and by offering a solution, tries to establish an obligatory passage point (OPP) between the other actors and the network so that it becomes indispensable. In interessement, other actors are made interested in the network and convinced to accept the roles that have been defined for them. Enrollment of actors happens when the actors have accepted the roles that have been defined for them during interessement. Mobilization of allies is a reality when the associated actors in the network can be considered to represent the masses. Christiansen and Varnes (2007) have proposed this network process perspective as an alternative to linear process understandings.

Scripts are the materialization of a designer's more or less informed presumptions, visions and predictions about the relations between an artifact and the human actors surrounding it (Fallan 2008). A script analysis can be used to analyze the difference between a designer's intention in connection with a technical object, how he inscribes the world into it and thereby views the user, and on the other hand, the real user who may describe the technical object differently. With the script concept, Akrich (1992) tries to capture how technological objects enable or constrain human relations as well as relationships between people and things. Script analysis is rooted in actor-network theory, and Akrich (1992) argues that technical objects participate in building heterogeneous networks that bring together both human and non-human actors of all types and sizes. Akrich further argues: *"Designers thus define actors with specific tastes, competencies, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of 'inscribing' this vision of (or prediction about) the world in the technical content of the new object. I call the end product of this work a 'script' or a 'scenario'"*.

5.1.1 Differences between processes of translation and technological frames

A relevant question could be why I have chosen to apply the process of translation in one paper and technological frames in another – what is the difference between the two concepts?

In actor-network theory or the process of translation (Callon 1986a), focus is primarily on the individual network builder and his or her strategies for enrolling other actors. With respect to SCOT or technological frames (Pinch and Bijker 1987; Bijker 1995), it can be argued that the analytical perspective is more democratic. Focus is distributed among many different social groups and their individual as well as collective strategies. Another difference between the two concepts regards the status of different types of actors. In actor-network theory, non-human actors are viewed as equally important as human actors when analyzing an actor-network. Non-human actors also have agency. In SCOT, materiality or non-human actors of course play a vital role in the interactions among human actors, but they are not associated with the same degree of agency as in actor-network theory. These two significant differences between the two concepts result in two very different kinds of analysis, although they both focus on interaction and negotiation processes. In the actor-network analysis, focus is on how the actor-network can grow and eventually stabilize, but this is primarily viewed from a single network builder's perspective. The strength of an actor-network analysis thus is that it makes the analyst aware of the fact that actors (human and non-human) are important in the making of an actor-network, and that this can help explain both successes and failures. The weakness in an actor-network analysis is that it does not invite to investigate the motives and different world views of the involved actors. This is however the strength of technological frames. Technological frames also invite us to investigate the involved actors' histories and backgrounds. A weakness, however, is that it does not help illuminate, to the same degree as actor-network theory, which actors have to be enrolled in order to make something become a success.

The two theories help us illuminate different aspects of the interaction and negotiation processes. In research paper 2, I have chosen to apply technological frames, since focus in this paper is on the collective development of a pump, and thus on the negotiations of these different collectives. Here, the motives and worldviews of the different collectives or social groups play an important role in understanding the development of the pump and the final outcome. The concept of technological frames has therefore been found appropriate as an analytical tool. In research paper 3, focus has been to a larger extent on the individual engineering designer and his strategies and reflections about how he can promote his ideas in the organization. The process of translation therefore seems a suitable tool for analysis, since focus is on how the network builder can expand the actor-network and enrol other actors.

5.2 The political process perspective

The political process perspective points at the contextual, political, open-ended and emergent nature of decision making and change processes (Dawson et al. 2000) and analyzes the different rationalities and perspectives taken up and pursued by interest groups and actors in the organization. Buchanan and Badham (2008) define power as "*the ability to get other people to do what you want them to do*" and politics as "*power in action, using a range of techniques and tactics*". Frost and Egri (1991) argue that within the organizational politics framework, politics is viewed as enacted power, as power in action. Pfeffer (1992) argues that large organizations are like governments in that they are fundamentally political entities. Along the same line, Knights and Murray (1994) characterize organizational politics as the motor of organizational life. They argue further that organizational politics is the mechanism through which the reality or competing realities of organizational life are constructed. In this sense, political processes are not static in nature; they change and are dependent on a number of different circumstances. Knights and Murray suggest three important dimensions of organizational political processes: the intensity of the process, the degree of institutionalization of the process, and the organizational actor's awareness of political process as a self-conscious activity. The interrelation between these dimensions is as follows: In periods of rapid organizational change, institutionalized rules and regulation decrease, which is likely to make the political intensity increase. And while accepted norms are undermined in this process, organizational actors' self-consciousness will increase regarding the role of individual and organizational strategies. In extant literature, however, there are differences in the value placed on political processes. In some fields, organizational political processes are viewed as productive and should therefore be catered for, whereas in other fields, political processes are identified as deviant, informal and irrational activity, which disrupt the smooth running of the organization and the efficient achievement of its goals and strategies should therefore be prevented or reduced. In the first chapter in "Managers Divided", Knights and Murray review extant fields of research in order to establish the research focus and political position in these fields. An overview of this review is provided in Figure 5. On the left in the figure, research fields that view organizational politics as disruptive are shown, and on the right, research fields that view organizational politics as inescapable. From the top down, the figure indicates the focus of research from localized to globalized.

Focus of research	Political position: Politics as disruptive	Political position: Politics as inescapable
Localised	Pluralist and processual theory	Constructivism and actor-network theory
	Socio-technical systems theory Technological determinism	Social shaping
Globalised	Functionalism	Marxism Feminism

Figure 5 A classification of theoretical approaches to technological change (Knights and Murray 1994)

Although I choose to treat the political process perspective separately, in a section for itself, it is strongly related to STS (constructivism and actor-network theory), as depicted in Figure 5. Dawson et al. (2000) argue that there is a "…*need for a broader conception of politics which goes beyond notions of class division and control, and simple representations of manipulation, vested interest and consent, towards a conception which extends political process to include elements, such as culture, the historical legacy of past events and the social construction of a dominant discourse around technology and change*". According to Knights and Murray (1994) organizational politics are viewed as inescapable in the STS field. They further conclude: "*While the actor-network approach is predominantly oriented towards local empirically available instances of the reconfiguration of the boundaries and relationships between technical and social intermediaries (e.g. artifacts, texts, skills, actors, money, etc.), it identifies power as an irremediable aspect of actor-network formation and transformation*".

In the context of this PhD dissertation, the political process perspective is interesting in relation to innovation processes. Frost and Egri (1991) point at the contested nature of innovation, and how the innovator in pursuing his innovation has to justify and eventually adapt the content of the idea in order to meet the needs of a wider constituency. Through engaging actors with different perspectives, coalitions of interest may be formed around the idea or innovation. In this process of coalition building, some actors and their concerns may be included at the expense of others. Insights from political process theory can also contribute to a reflexive understanding of design as the staging of socio-technical relations and processes that cut across boundaries of diverse organizational, political and knowledge domains (Clausen and Yoshinaka 2007).

Change agents or champions are also discussed within the political process perspective. Buchanan and Badham (2008) argue: "*The change agent who is not politically skilled will fail. This means that it is necessary to be able and willing to intervene in the political processes of organization, to push particular agendas, to influence decisions and decision makers, to cope with resistance, and to deal with, and if necessary silence, criticism and challenge*". With inspiration from Dawson (2000), the change agent or champion can be viewed as a navigator. The navigator does not have a strict plan to follow, but must continuously revise his navigational decisions to meet unpredictable and unfolding events and conditions. Navigators are thus not

neutral facilitators who apply appropriate techniques in order to encourage information sharing, joint problem solving and collaborative action planning among organizational actors. Rather, they have an understanding of organizational politics and are willing to engage in the organization's political processes.

5.3 The contribution of the chosen analytical perspectives

Both the STS perspective and the political process perspective are chosen as analytical perspectives for analyzing the empirical data and developing a new understanding of idea work, because they focus on processes and how actors act and interact in the development of technologies; and because idea work is characterised as a process in which different actors act as well as interact to bring forth and promote new ideas in the pursuit of the development of new product concepts. It could be questioned, however, how well the STS perspective complies with the political process perspective, and I could reply, "Well". Because whereas the analytical concepts within the STS field underpin important aspects and outcomes of interaction, the political process perspective underpins the motives and provides us with an understanding of the strategies followed by the involved actors. The journal, *Technology Analysis and Strategic Management* has also dedicated a special issue to "*political processes in management, organization and social shaping of technology*" in which many of the papers combine the political process perspective with concepts from the STS field.

6 Research framework

The purpose of this chapter is to present the research framework used to plan and conduct the study, and to discuss my choice and combination of methodology and methods. Besides presenting the headlines for the chosen methodologies and data collection methods, this chapter also describes how the study has been conducted and presents the empirical data collected from two cases and a body of interviews. In the research papers, an outline of the methods used, as well as parts of the empirical data, has already been presented. However, I find further elaboration and clarification appropriate in order to present a joint overview of methods and data.

6.1 Methods and methodologies

I have mainly applied two research methodologies, which are from the phenomenological paradigm: the case study methodology (Eisenhardt 1989; Yin 2009; Flyvbjerg 2011) and the grounded theory methodology (Corbin and Strauss 2008; Bryant and Charmaz 2010; 2007). Yin (2009) argues that a mixed method(ology) allows the researcher to address more complicated research questions, as well as collect a richer and stronger array of evidence than a single method(ology) would allow. Whether case studies are referred to as a method or a methodology makes a difference. Corbin and Strauss (2008) define methodology as a way of thinking about and studying social phenomena, and methods as the techniques and procedures used for gathering and analyzing data. I apply the same definitions. Yin (2009), however, uses the term method about case studies, whereas Flyvbjerg (2011) uses the term methodology. Although case studies can also encompass quantitative methods, only qualitative methods have been used for this study. Especially conducting interviews (Kvale 1996) has been a central data collection method.

Every methodology has an underlying set of assumptions and a particular worldview (Corbin and Strauss 2008). In this chapter, however, it is not my intention to discuss or contrast such underlying philosophical or theoretical standpoints for the applied methodologies. I do subscribe to an understanding that views the world as complex – e.g. events are the result of many different factors, which come together and interact in complex and often unanticipated ways. And I believe, like Corbin and Straus (2008), "*that it is important to capture as much of this complexity as possible, at the same time knowing that capturing it all is virtually impossible*". My attitude towards the selected methodologies and methods is thus characterized by being more pragmatic rather than being concerned with the philosophical implications. And the aim of choosing the methodologies and methods I have used has been to develop knowledge that can guide practice. In the following, I present the case study methodology, the grounded theory methodology and then the interview method. How I conducted the study in practice and the characteristics of the study are presented in the subsequent section. Finally, I reflect on the validity of the study.

6.1.1 The Case Study methodology

Case study research has become popular, especially in sociology and other areas of social analysis in recent times (Flyvbjerg 2011; Hammersley and Gomm 2000). The case study has been criticized, however, for not being scientific enough for a research methodology. The generalization of the case study has especially been discussed, as well as its applicability. Moreover, the phrase 'case study' has not been used in a clear and fixed way (Hammersley and Gomm 2000), and contrasting strategies of data analysis are offered. In the following, I introduce the content of case study research. In section 6.3 "Methodological reflections", I discuss the 'misunderstandings' which have traditionally been related to the methodology.

Yin (2009) defines a case study as: "*an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident*". He argues that the case study method allows researchers to retain the holistic and meaningful characteristics of real-life events such as individual life cycles, small group behavior, and organizational and managerial processes, among other examples. Eisenhardt's (1989) definition of a case study resonates with Yin's. She defines a case study as "*a research strategy which focuses on understanding the dynamics present within single settings*". However, Eisenhardt does not believe that extant literature explains the strengths and weaknesses of theory building from case study research, nor does it identify situations when case study research is the most effective research tool. Yin, on the other hand, argues that the case study method(ology) has a distinct advantage when the research question(s) posed contains 'how' or 'why' questions. Flyvbjerg (2011) finds the strength of the case study methodology lies in understanding a phenomenon with any degree of thoroughness.

Different case study designs exist. Yin (2009) operates with four overall designs, which are presented in Figure 6: type 1) a single case with a single unit of analysis; type 2) a single case with multiple units of analysis; type 3) a multiple-case with single units of analysis, and type 4) a multiple-case with multiple units of analysis. In relation to this PhD study, it is only the single case designs (types 1 and 2) that are relevant, since only one company, Grundfos, has been investigated.

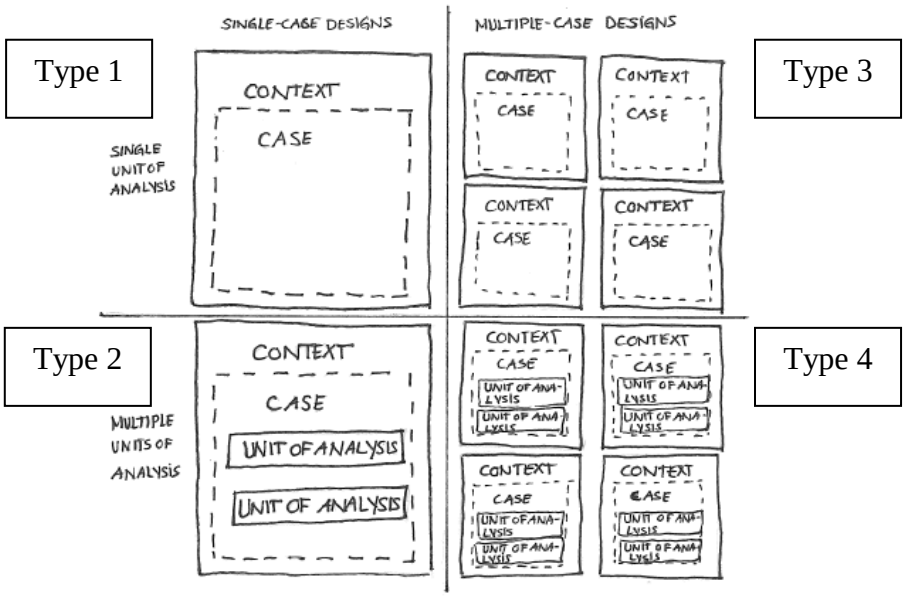

Figure 6 Yin's (2009) four types of case designs

Yin (2009) also advocates that five rationales exist for the single-case study, referred to as the representative/typical case, the critical case, the extreme/unique case, the revelatory case, and the longitudinal case. Flyvbjerg (2011) also works with different rationales for choosing cases – the typical case, the critical case and the extreme case – which resonate with Yin's rationales. Flyvbjerg also operates with the paradigmatic case. The typical case captures the circumstances and conditions of an everyday or commonplace situation (Yin 2009). Flyvbjerg (2011) argues, however, that choosing a representative case or a random sample is not the most appropriate strategy, because often such cases do not provide the richest information. For a case to be a critical case, it has to meet all of the predefined conditions that can influence what is being tested.

When generalizing from a critical case, it can be argued that if something is (not) valid for the critical case, it is (not) valid for all or many cases. The extreme/unique case refers to rare situations or phenomena. Flyvbjerg argues that such cases often reveal more information, because they activate more actors and more basic mechanisms in the situation being studied. The revelatory case exists when the researcher has the opportunity to observe and analyze a phenomenon that has not previously been accessible to social inquiry. A case can be characterized as a longitudinal case when the researcher studies the case at two or more different points in time. A paradigmatic case highlights more general characteristics of the societies in question; no standard exists for the paradigmatic case, because it sets the standard. Yin argues that more rationales could exist for choosing a case, and Flyvbjerg argues that a case can be characterized by more than one of the rationales.

When building theory from case study methodology, Yin (2009) proposes a step-wise but iterative process. The steps of the case study process comprise: plan, design, prepare, collect, analyze and share. The process is shown in Figure 7.

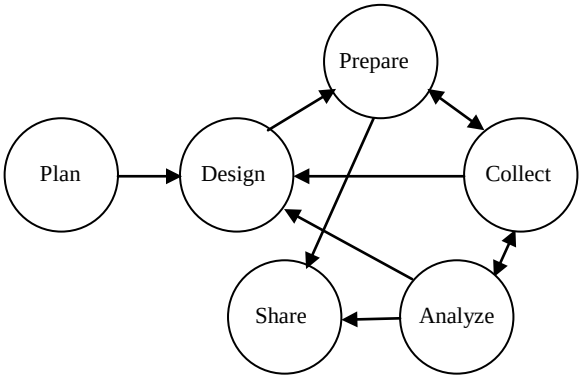

Figure 7 Yin's (2009) step-wise, and iterative, case study research process

I do not go into detail with each of the steps here, since I comment on them in section 6.2 "Carrying out a case- and interview study at Grundfos". However, I do comment on theory building: With respect to theory and developing propositions, Yin (2009) advocates that it is important to construct a preliminary theory related to the topic of the study from the outset. And the goal of the theory construction is to have a blueprint for the study, or a hypothetical story about why acts, events, structure and thoughts occur. This contradicts the position Eisenhardt (1989) takes. Eisenhardt advocates that "*theory-building research … [be] begun as close as possible to the ideal of no theory under consideration and no hypotheses to test*", although Eisenhardt also admits that this can be difficult to follow in practice. Eisenhardt's approach to theory building is very reminiscent of the methodology of grounded theory.

6.1.2 The Grounded Theory methodology

Grounded theory is a qualitative research methodology. The purpose of grounded theory is to build a theory about a phenomenon on the basis of empirical data through observation and interviews (Bryant and Charmaz 2010; 2007). Grounded theory is suitable for both very open problems, such as 'What is going on?', and for more closed problems, such as 'How are the group norms?' (Boolsen 2010). The methodology applies a set of procedures to develop an inductively derived theory about the phenomenon under investigation. This means that generalizations are based on the collected data. It is suggested that the researcher enter the research setting with as few predetermined ideas as possible, because any view held prior to the

study may restrict the researcher's perception of the phenomenon in question (Hussey 2003). Corbin and Strauss (2008) recommend a continual interplay between collecting data and conducting the analysis. Thus, they argue that analysis starts as soon as the first empirical data is collected. And the analysis is an interplay between data and the researcher (Strauss and Corbin 1998). In order to analyze data, a coding procedure is suggested. The coding procedure is shown in Figure 8.

1) **Build rather than test theory**
2) **Provide researcher with analytical tools for handling masses of raw data**
3) **Help analysis to consider alternative meanings of phenomena**
4) **Be systematic and creative simultaneously**
5) **Identify, develop and relate the concepts that are building blocks of theory**

Figure 8: Strauss and Corbin's (1998) coding procedure

When coding, data are broken down, conceptualized and put back together in new ways. Strauss and Corbin (1990) argue that two analytic procedures are basic to the coding process: making comparisons and asking questions. The three major types of codes that can be applied are: a) open coding, b) axial coding, and c) selective coding (Strauss and Corbin 1990). Open coding is the first step, where each discrete incident in an observation, a sentence or a paragraph is given a name that represents the phenomenon. These labels are called concepts. Along this process, questions are asked, such as "What is this?", and different incidents are compared. When the researcher has identified particular phenomena in the data and attached concepts to them, these concepts can then be grouped, which is called categorizing. Whereas open coding fractures the data, axial coding unites data in new ways by making connections between a category and its sub-categories. In axial coding, the researcher focuses on the conditions that give rise to the category (phenomenon), the context in which it is embedded, the interactional strategies by which it is handled and the consequences of these strategies. Selective coding is the process of selecting the core category, systematically relating it to other categories, validating the relationships, and filling in categories that need further refinement and development. This is not necessarily a linear sequence; in practice, the researcher moves back and forth between them. Strauss and Corbin (1990) argue that the researcher will probably move among the different forms of coding, and that the researcher should not adhere to the prescribed procedures and techniques in a rigid way. The procedure and techniques are intended for the researcher to question his/her empirical material.

6.1.3 The interview study

The main source of data in the present study is collected through interviews with organizational members at Grundfos. The purpose of the qualitative research interview is to obtain descriptions of the interviewees' lived world in relation to interpretations of the meaning of the described phenomena (Kvale 1996). Kvale (1996) divides the process of conducting an interview study into seven stages: thematizing, designing, interviewing, transcribing, analyzing, verifying and reporting. This process is shown in Figure 9.

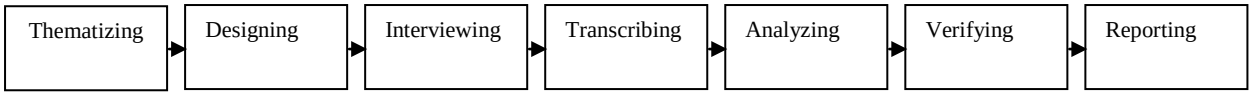

Figure 9 Kvale's (1996) seven stages of the interview study

In order to provide an open and flexible interview study with some structure, Kvale emphasizes a linear progression through the seven stages. This linearity stands in contrast to Corbin and Strauss' (2008) more iterative approach, where analysis should be begun after the first set of data is collected. Kvale (1996) argues that a conceptual and theoretical understanding of the investigated phenomenon has to be developed prior to conducting the interviews, in order to establish the base into which new knowledge can be added and integrated. This corresponds with Yin's (2009) ideas but contrasts with grounded theory. Kvale (1996) further argues that it is central to keep the endpoint in sight and develop a view over the entire study before starting interviewing. Before interviewing, it should be decided how many informants are needed and who would be interviewed. Kvale recommends interviewing as many subjects as necessary in order to gain the necessary knowledge, but the average number of interviews in current interview studies is about 15±10. Prior to the interviews, an interview guide has to be developed. Different interview forms exist. In the present PhD study, primarily the semi-structured interview form has been applied. This type of interview requires openness to changes in the sequence and forms of questions in order to follow up on the answers given and stories told by the interviewee. An interview guide is designed with an outline of the topics to be covered and related questions. Kvale operates with eight types of questions: introductory questions, follow-up questions, probing questions, specifying questions, direct questions, indirect questions, structuring questions, and interpreting questions. Kvale also operates with silence when interviewing, to allow time for reflection. He describes interviewing as a craft closer to art than to standardized social science methods. He therefore advocates that the interviewer must understand the interview situation with its many on-the-spot decisions. The interviewer needs conversational skills and a sense for good stories. On the other hand, Kvale claims that becoming a good interviewer takes places through practice.

Prior to the interview, the interviewees are informed about the purpose of the interview, and if necessary, they are asked to give their consent. In order to capture the interview, field notes can be written, or the interviewer can use audio or video recording. In order to analyze the data, interviews must transcribed and thus transformed into written text. Kvale notes that the process of transcribing involves translation from oral language, which has a certain set of rules, to a written language, with another set of rules. Kvale thus perceives transcriptions as interpretive constructions, and he emphasizes that the transcript is not the same as the interview. When the interviews are transcribed, they are ready for analysis. Analysis is the stage when meaning condensation and interpretation of data take place. Kvale suggests a range of different approaches for analysis. Here, I only mention those that are relevant in connection with this PhD study. Both Kvale (1996) and Yin (2009) operate with narratives. Yin (2009) describes the transformation of the collected data into a narrative as the beginning of a case study analysis, whereas Kvale (1996) treats the narrative as a strategy of analysis on its own. He argues that the researcher has to alternate between finding narratives in the data material and creating narratives by molding the many different happenings into a coherent story. Another strategy of analysis that Kvale (1996) operates with is what he calls ad hoc meaning generation, which involves the use of and free interplay between different approaches to meaning generation. In this sense, the ad hoc strategy also comprises all other strategies/techniques, such as Yin's (2009) five analytic techniques: pattern matching, explanation building, time-series analysis, logic models and cross-case

synthesis and Kvale's (1996): condensation, categorization, narrative and interpretation. Both Kvale (1996) and Yin (2009) argue that validity is constructed throughout a study in each step taken, by making sound theoretical propositions, by selecting appropriate methods and interview subjects, by triangulation of data, by making coherent analysis of data and presenting it in a valid form.

6.2 Carrying out a case- and interview study at Grundfos

In the previous sections, I have presented the methodologies and methods used in the present study, as well as outlined the procedures and steps recommended in order to reach valid research results when conducting a case and interview study. Doing things in theory is one thing, however, often characterized by a straightforward approach and continuous progress. In reality, things can be messier, iterative and intertwined. In the following, I describe how the PhD study was carried out in practice. The timeline for conducting the PhD study is shown in Figure 10.

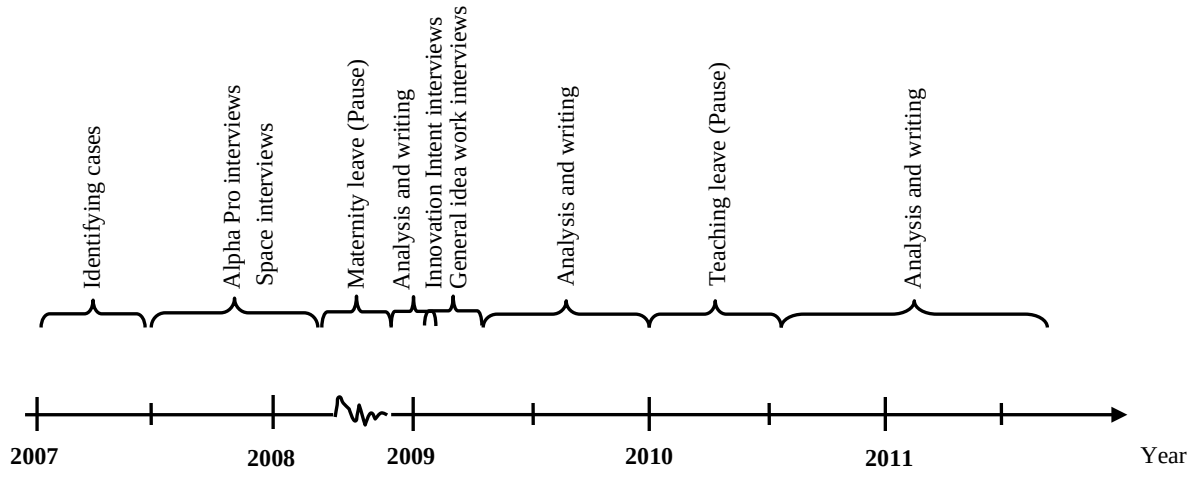

Figure 10 Time line for conducting the PhD study

6.2.1 Developing rapport and access

It was specified from the beginning that Grundfos should be the subject of inquiry, as they had partly financed the study. Since Grundfos is located in Bjerringbro (Jutland), much travelling was necessary between this site and Copenhagen, where DTU is located. During the first half year, I was provided with a Grundfos apartment in Bjerringbro, making it possible to stay at Grundfos for one or two weeks at a time. This also provided me with the flexibility to plan what meetings and events I wanted to participate in at Grundfos. From the first day, I was given an access pass, my own desk, computer and Grundfos e-mail address, and was placed in front of John Gammelgaard in an open office space among heads of departments, engineers, technical assistants and secretaries. From the beginning, I was met with openness and responsiveness. On my first night in Bjerringbro, I was impulsively invited attend an evening meeting in Århus with IKI.[5] This meeting gave me the opportunity to talk with John Gammelgaard, who had invited me,

[5] IKI is the initiative for creativity and innovation, a voluntary network, which aims at creating the right setting for developing creativity and innovation in the meeting between people and companies.

and two of his colleagues in an informal setting, and understand their interest in creativity and innovation.

Prior to my first workday at Grundfos, I had a meeting at DTU with my supervisors, Christian Clausen and Claus Thorp Hansen, John Gammelgaard and two other Grundfos employees: Anne Schou and Jørgen Due.[6] Thus, I already knew three persons at Grundfos who I could ask for help before developing my own network. Within the first month, I talked with John, Anne and Jørgen, and they showed me around, not only within the Business Development Centre (BDC), where I had my desk, but also in other more remote places, where project groups were placed in barracks or other settings due to lack of space at BDC to house all projects. Within the next month, I talked and had meetings with a range of different organizational members at Grundfos in order to detect cases that could be interesting and relevant to investigate further.

Navigating in a new organization was not new to me. I had experienced the same situation when I conducted my master thesis at a hearing aid company; however, Grundfos is much bigger. Having access to the intranet helped me place organizational members in their respective departments and understand organizational planning processes, at least conceptually. My experience from my master thesis, where I had conducted more than thirty interviews, was that the interview is a useful tool when you want to understand a phenomenon more thoroughly and analyze the underlying explanations. This is especially true when followed up by observational studies. I also experienced that although I prepared two interviews in the same way, with the same interview guide, they developed quite differently. Some interviewees start talking even before being asked, while others need many questions and still only answer with very short sentences. Even so, I also experienced confidentiality in the interview situation, and the interviewees showed curiosity for the work I was doing. At the exam, when discussing research methods with the external examiner, I was asked why, since I had audio-recorded all the other interviews I made, I did not video- or audio-record the stage gate meeting I had attended, but only made field notes. I answered that at that stage, I did not think I could ask for such a thing. The examiner replied that it is often not the informants that set the limits for what the researcher can do but the researcher herself. I have had the same experience at Grundfos when collecting data. It was my own boundaries I had to overcome and never the interviewees'. They were willing to answer my questions, even those of political character. Only once was the audio-recorder stopped in the middle of an interview so the interviewee could say something off the record.

6.2.2 Identifying cases and collecting data

Strauss and Corbin (1990) argue that researchers see problems from a specific perspective (e.g. qualitative or quantitative), given their personal orientation, training or convictions. Given my background and my prior experience with qualitative research methods (such as conducting case studies and interviews), I have had a preference for these methods. It was therefore a logical choice for the present study.

With help from John Gammelgaard, different potential cases within Grundfos were identified. These included concepts studies, ongoing projects, successfully finished projects and projects stopped before time. Both Yin (2009) and Flyvbjerg (2011) describe a set of rationales for selecting cases, but it can be difficult to determine beforehand a particular case's characteristics, since it has not yet been investigated. For example, Flyvbjerg (2006) describes how he thought his Aalborg case was a critical case, but it turned out to be an extreme case. Therefore, the cases were not selected only in the basis of Yin's and Flyvbjerg's rationales (which is more of an after-rationalization), but also due to another set of factors that include: the learning potential for

[6] No relation to the Due Jensen family, although it took me a while to figure this out.

Grundfos, contrasting cases (a successful project and a project stopped before time), and the scope and magnitude of the cases. With respect to the latter, some of the cases initially identified turned out to be too 'small' with respect to the number of persons involved and the significance of the solutions developed. The concern was that these cases would not be sufficient to allow an extensive analysis. At the end of June 2007, based on these additional factors, two cases were selected, which are summarized in Figure 11.

1) **The Alpha Pro circulator. The development project was finished in March 2005, only 15 months after it had been initiated. Grundfos views this case as one of the biggest successes in recent times, both with respect to the execution of the actual development process, and also with respect to the market offering; an energy-labeled circulation pump – which was the first of its kind.**
2) **The Space concept study. The aim of this study was to develop three different concepts for a submersible pump at an ambitious fixed cost target. The concept study was finished in 2005, and all three solutions were rendered probable to meet the cost target. One of the concepts was recommended, the one that was viewed to be easiest to develop and most likely to be accepted on the market at that time. None of the concepts were ever used in any products, however, even though especially one concept has been regularly debated after that time.**

Figure 11: Summary of the Alpha Pro case and the Space case

The Alpha Pro case was chosen to represent a successful project, and the Space concept study was chosen to represent the contrasting "failed" project. Retrospectively, the Alpha Pro case turned out to be a unique case. An illustration of the Alpha Pro circulator and one of the Space[7] concepts is shown in Figure 12. In the fall of 2007, interviews were conducted with persons involved in the two cases. Initially, two persons were identified by the Grundfos contact person as case representatives, one for each case. Prior to the formal interviews in the fall of 2007, clarifying meetings and presentations were held in connection with the case selection process. Therefore, some information was already collected and could be used as input in developing the interview guide, as well as searching the internet, internal databases and other documents and archival material. Details on how the interview guide was developed and formed can be found in the methodology chapter of the first research paper. Interview persons were in both cases identified by snowballing (Bryman 2001), which means that interviewees are asked to recommend new relevant interviewees.

[7] Space was spelled SPace in the project. SP is an abbreviation for submersible pump, and 'ace' referred to the ace in a deck of cards. I have, however, chosen to spell it with a small p in this dissertation.

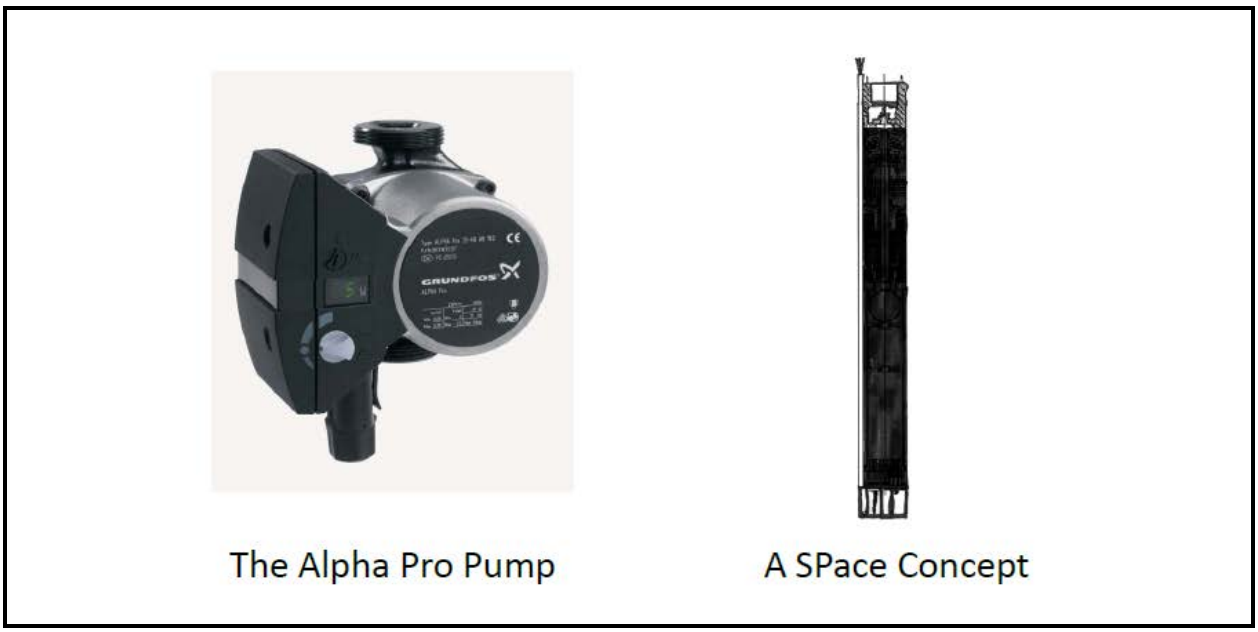

Figure 12 Illustration of the Alpha Pro pump and one of the Space concepts, respectively

The aim of the interviews was to track where the initial idea for the projects came from and how the work with the ideas had been approached by the involved actors. A second aim was to understand Niels Due Jensen's role, as he had been mentioned in relation to both cases at the initial meetings and presentations. This circumstance points back to the industrial challenge: the fact that Grundfos is a family-owned company, as explained in section 1.2 "Grundfos' challenges". A third aim with the interviews was to identify differences between the two cases. An asymmetry between the two cases became obvious, however, quite early in the process. Along with an increasing need to present the empirical data on different occasions, such as PhD courses and conferences, it became clear that it was difficult to discuss the Space concept study, since the concepts were never implemented in any products and therefore still had to be kept secret to the outside world. This meant that the Alpha Pro case from the beginning received more attention and working hours from my side. The more I worked with the Alpha case, the more interviews I needed, so that today I have three times as many transcribed interviews on the Alpha case than the Space case (see appendix A for a list of the transcribed interviews). Therefore, the Space case has not been used as a case on its own. The Space interviews have been used for more general purposes, such as understanding the culture and history of Grundfos and collecting small narratives to support other findings. The Alpha Pro case is the empirical foundation for research papers 1 and 2.

In March 2008, I went on maternity leave and therefore did not work on the project again until December 2008. When I returned, I arranged to stay with my family in a Grundfos apartment in Bjerringbro for 3½ months (January to April). During 2008, while I had been away, Grundfos had undergone some radical organizational changes. It was decided that my present anchoring in the organization (the Industry and Water Service business unit) was not coherent, so I was moved to Research and Technology (R&T) with the Innovation Manager as the new sponsor for my project. I now became a more integrated part of one of the departments: Discovery and Design. Being placed in R&T on a daily basis allowed me to observe the interaction between the engineering designers when ideas were exchanged or issues discussed, although I must admit that 90 percent of the time people were looking into their computer screens, going to meetings behind closed doors or elsewhere. But occasionally I could feel the enthusiasm of the designers and see

how the posters and prototypes attracted the attention and questions of people coming by, including Niels Due Jensen. I could also sense the atmosphere of nervousness and excitement prior to Research and Technology Committee (RTC) meetings, at which Niels Due Jensen sat at the head of the table and new technologies and concepts are presented. On such days, the informal jeans were dropped in favor of a suit. When I was placed in the Industry and Water Service business unit, I also had the chance, of course, to observe and overhear conversations and interactions. But since mainly heads of departments, technical assistants and secretaries were placed in the area where I had my desk, I did not experience the same type of 'life' as in R&T. The longer consecutive stay at Grundfos gave me an opportunity to observe, as stated above, and and make a new round of interviews. The Alpha pro case gave me insights into how a specific project was conducted and the numerous actors involved, but because I had chosen not to work further with the Space project as a comparative case, I felt I needed to find some other cases. Also, it did not seem that the Alpha Pro case could provide me with insights into how the individual engineering designer approaches idea work and in this connection what he perceives to be impediments, challenges or facilitators. Since this was an issue I was still interested in investigating, I decided to carry out a range of interviews focusing on the individual engineering designer's approach to idea work. During 2008, Carsten Bjerg, CEO, had toured many of Grundfos' companies around the world to present a new innovation vision, 'Innovation Intent', reaching to 2025. In collaboration with the Innovation Manager, it was decided that I use Innovation Intent as another case; thus, a series of interviews about Innovation Intent were conducted. The rationale for choosing Innovation Intent as a case was to understand how an innovation vision could influence idea work more strategically. In Figure 13 information about Innovation Intent is presented.

Innovation Intent is a vision reaching to 2025. It is the Grundfos dream, which involves, among other goals:

- **Employ 75,000 people**
- **50% of the growth is to come from technology platforms that were not invented in 2007**
- **1/3 of the turnover comes from other products than pumps**

Figure 13 Information about Innovation Intent

The interviews about the engineering designers' approaches to idea work and the Innovation Intent case form the foundation for research papers 3 and 4. Table 1 shows how many interviews were conducted and transcribed in each case. In total, sixty interviews were conducted.

	Alpha Pro	*Space*	*Idea work*	*Innovation Intent*
Number of interviews	15	5	29	11

Table 1 Number of interviews conducted in each 'case'

Besides conducting interviews and making observations, data was also collected through diverse forms of documentation, such as emails, process descriptions, power point presentations, reports, intranet sites, posters, films, books, websites, and articles. Most data were collected within Grundfos, but external sources were also used.

6.2.3 Analysis and writing papers

In section 6.1 "Methods and methodologies", I presented the case-study methodology, grounded theory and the interview study. These methodologies have some common features, but they are also contradictory, especially with respect to two areas: 1) the adaptability of research questions throughout the research process, and 2) the strategies for analysis they recommend. Both Yin (2009) and Kvale (1996) argue that some kind of end goal for the study should be formulated from the beginning. Yin (2009) further advocates that research questions should be defined from the outset, and the researcher should stick to them all the way. If the case study fails to answer the questions, a new case study has to be conducted. Eisenhardt (1989), on the other hand, perceives the formulation of research questions as a more iterative process. A set of initial research questions should be formulated, but these can change as the data analyses produce new insights. This is also in line with the grounded methodology, where the initial question starts out broadly to become narrowed down throughout the process (Strauss and Corbin 1990).

With respect to having the end goal in view from the beginning, I have applied a more "we see what happens along the way" attitude. This approach should not be mistaken for being careless or unconsidered. It rather expresses the openness I have to new interesting cases or information that might turn up and illuminate the research problem. It also expresses the fact that I did not know exactly what I was looking for and therefore followed an explorative approach. With respect to research questions, I have from the start circled around the question: What is the nature of idea work? But since this question is very broad, more specific questions were developed for the four research papers. As work with the research papers developed, the questions were reformulated and adjusted.

Whereas both Kvale (1996) and Yin (2009) divide the analysis and reporting steps into two separate research stages, I have used the writing process as a tool for thinking and analyzing as well as documenting and reporting findings. Preliminary analysis was also conducted during and between interviews, in accordance with grounded theory (Corbin and Strauss 2008). It has in this sense been a highly iterative process to develop the four research papers, although they were mainly produced during the second half of the study. But the ideas for them were developed and refined throughout the whole study, as new empirical evidence came to the surface.

When entering the interview situation, I was open-minded and followed a phenomenological approach; therefore, I did not have a specific theory in mind or a set of hypotheses to be tested. However, my way of reasoning was inspired by the STS field. With respect to analysis, I used different strategies and techniques for the different research papers. For papers 1 and 2, which are both based on the Alpha Pro case, I applied a narrative strategy. A timeline, shown in Figure 14, was used during the interviews in order to date events and decisions during the development of the Alpha Pro pump. Some interviewees wrote comments on the timeline during three interviews conducted on 12 November 2007. The comments are encircled with gray rings in Figure 14 and are in Danish; the interviews were also conducted in Danish.

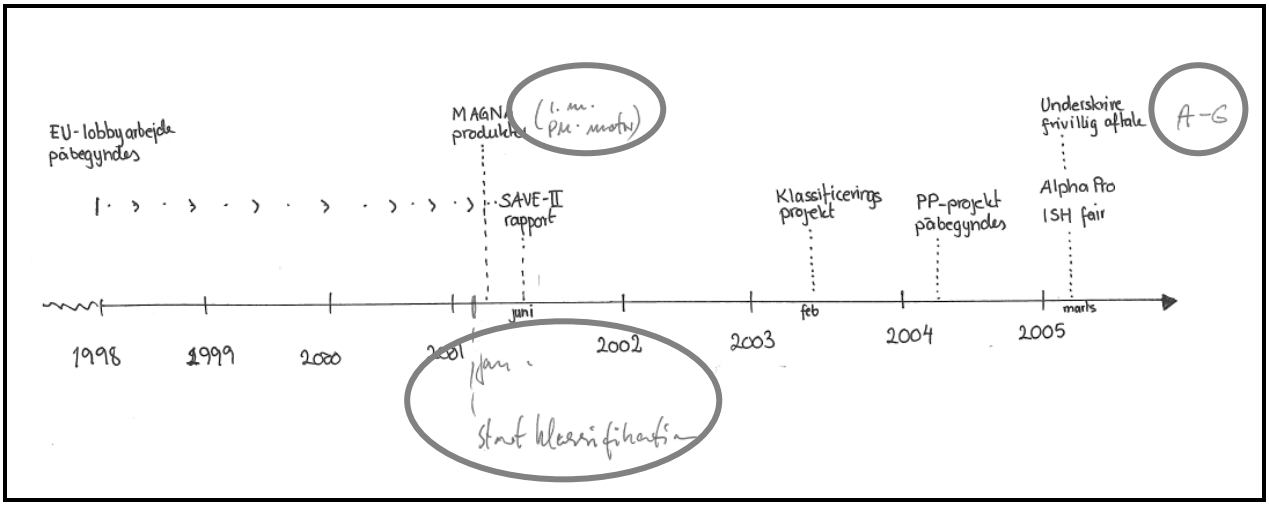

Figure 14 Timeline for the Alpha Pro case – tool used to identify actors and events

Thus, the timeline became more and more detailed for each interview conducted. Interviews were transcribed along the way as much as possible. Transcribed interviews and other collected empirical data were studied prior to new interviews so that new questions could be added to the interview guide if necessary. After collecting data about the involved actors, events, ideas and decisions, a narrative or chronological case-story was developed. In research paper 1, a condensed version of the narrative is presented. Although this narrative forms the foundation for both research papers 1 and 2, the subsequent analysis was approached differently. In research paper 1, the analysis was inspired by the grounded theory methodology, which means that theoretical propositions were not developed prior to the analysis; rather, the findings were grounded in the empirical data. In research paper 2, a theoretical framework was developed prior to the analysis and applied to code and categorize data. The empirical foundation for research papers 3 and 4 was based on the interviews concerning Innovation Intent and the individual designer's approach to idea work. The analysis conducted in relation to paper 3 is also inspired by grounded theory, whereas a theoretical framework was developed prior to the analysis in paper 4. For all papers, manual coding procedures were used. Using a digital tool such as NVivo or ATLAS.ti was considered, but since there has been no tradition for using such tools in my research community, I decided to do the coding manually.

6.3 Methodological reflections and validation

In this section, I share some of my reflections about the methodological choices I have made, and the methodological challenges I have encountered in the process.

Qualitative research has long been criticized, and many qualitative scholars have therefore developed counter-arguments to defend the method. I do not intend to enter this discussion, but I do, address the critique of case studies, which is especially aimed at generalization of research results. Yin (2009) argues that case studies are generalizable to theoretical propositions, but not to populations or universes. Flyvbjerg (2011) also addresses the critique and argues that formal generalization is considerably overrated as the main source of scientific progress, and that formal generalization is only one of many ways by which people gain and accumulate knowledge. He thus corrects the misunderstanding relating to generalizations of case studies in the following way: "*One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas 'the force of example' and transferability are underestimated*". With respect to developing general propositions and theories on the basis of specific case studies, Flyvbjerg argues: "*It is correct that summarizing case studies is often difficult, especially as concerns case process. It is less correct as regards case outcomes. The problems in summarizing case studies, however, are due more often to the properties of the reality studied than to the case study as a research method. Often it is not desirable to summarize and generalize case studies. Good studies should be read as narratives in their entirety*".

With respect to interviews, it can be viewed as problematic that the information given depends on retrospective reconstruction. In this sense, this study has the limitation that the interviews and the were conducted after the Alpha Pro circulator and the Space project were finished. The drawback associated with this approach is that potentially relevant actors had left the organization, and those remaining may have forgotten certain details or remembered some aspects or years incorrectly, or more calculatingly chose to create narratives that portray certain actions in a certain light. In the case of Alpha Pro, I have accommodated this issue by facilitating two validation workshops, where facts and findings were presented to the interviewees as well as other Grundfos employees who had an interest in hearing more about the case. This validation process lowers the risk, as the participants have the chance to comment on the case freely. Since the Space case was not used to construct a narrative for use in the analysis, it was not relevant to facilitate a workshop to validate facts and findings. Another drawback of interviews is that people may relate what in their opinion is interesting stuff and not the everyday situation; therefore, it is important that the interviewer has this in mind and also tries to understand the more trivial circumstances.

With respect to the interviews regarding the individual designer's approach to idea work, it should be noted that the interviews were conducted during a period of recession and financial crisis in the winter and spring of 2009. This meant that layoffs had already been made and more were on the way, not only in the production, distribution and sales force but also among R&D personnel. This changed the atmosphere in the organization for a while; the general level of energy dropped and ongoing projects were reconsidered and reprioritized, with the result that some were closed and others put on stand-by. R&D personnel reconsidered what their key assignments were and resources were generally economized. This should be seen in contrast to the energetic R&D milieu observed by the author in 2007, and which was beginning to be reestablished during 2010. In the methodological context, this was taken into consideration when analyzing data.

Given that I conducted almost all of the interviews in a R&D setting, the interviewees were mainly men. Out of sixty interviewees only four were women, and two of the women are not from R&D but from People and Strategy, a corporate human resource function. This reflects primarily the industry's male dominance, but also a bias of the rolling-the-snowball method. In

the interviews about the individual designer's approach to idea work, there were no explicit constraints or criteria for interviewee relevance as with the Alpha Pro and Space cases, where involvement or knowledge about the cases were criteria for being interviewed. Interviewees in the interviews about individual designer's approach to idea work were therefore free to recommend whoever they thought would be interesting to talk with about idea work – which proved to be men with engineering or similar background. Interviewees with other backgrounds, occupations and gender were chosen by me in order to secure a certain balance between managers and employees and technology and business. The distribution of men is of course high, but one reason why women were not recommended as interviewees may be their occupations. They do not work with the core technologies but with project management, user involvement and design. Apparently, interviewees do not directly associate these occupations with idea work.

7 Findings and results

This chapter presents the findings and results of this dissertation, which are based on the four articles that are found in the appendices, in the form of four brief summaries of the articles. I recommend however that the reader read the articles in full, now or in continuation of this chapter.

7.1 Research paper 1

Title	*The nature of idea work in a large industrial company – a case study*
Submitted	• Research in Engineering Design
	• The paper builds on a conference paper entitled: "A Case Study of Idea Work in the Early Phases of Product Development". The paper was published in the proceedings of the 17th International Conference on Engineering Design (ICED09);
Case	• Alpha Pro
Research questions	• How do ideas emerge and gain momentum in a large industrial company? • How does idea work relate to front-end innovation?
Literature review	• Idea generation, stimulation of idea generation, sources of ideas, early phases of new product development, and informal processes: roles and networks
Analytical framework	• Draws on a socio-technical understanding
Findings	Three main findings are presented in the article: 1) Different ideas are pieced together into a product over time. 2) It is important to gain support from other actors, both inside and outside the organization, in order to bring ideas forward. This is done by using legitimate arguments. 3) Working with ideas requires more than technical engineering competences.
Implications	First, since ideas are pieced together over time, idea work cannot be confined to what we denote as front-end activities; therefore, idea work should be addressed and catered for independently of its potential front-end relevance. In the case of Alpha Pro, idea work was found to be an ongoing activity across projects, actors and departments. In relation to this, the paper also serves as a critique of the front-end literature's black-boxing of idea work and rather 'linear' understandings of it. Second, idea work requires more than a creative act. It is important for companies to recognize that a central aspect of idea work is that ideas have to be 'sold' to many different stakeholders in order to gain support. Therefore, idea champions have to be aware of how they persuade relevant stakeholders and develop their argumentation. They need to make their ideas relevant for implicated stakeholders. Third, idea work comprises more than technical engineering. The socio-technical dimensions of engineering, such as vision, negotiation skills, the ability to spot opportunities etc., are also relevant elements in idea work. Therefore, it is important for management to recognize the breadth of idea work, and that many diverse elements have to be managed in order to gain success.

7.2 Research paper 2

Title	*Framing ideas in the making*
Target journal	• Technology Assessment and Strategic Management
Case	• Alpha Pro
Research questions	• How can we open up the black box of idea work in order to understand what is going on?
Literature review	• The literature reviewed informs the analytical framework
Analytical framework	• Technological frames (Pinch and Bijker 1987; Bijker 1995)
Findings	The paper seeks to open up the black box of idea work and gain insights into the organizational micro processes that take place in the complex web of interactions while ideas are created and molded over time. It is found that different social groups within and outside the company attribute meaning and render significance to what they perceive as relevant ideas (problems and solutions). Focus is on how these different social groups react when other social groups present them with new ideas concerning aspects of technology or market. The case shows that the social groups frame their ideas in accordance with the technological frames in which they have high inclusion. The degree of congruence between the technological frames has implications for how likely an idea is to be accepted. Incongruence between frames can even cause conflict. The interesting finding in the case is that a new technological frame is created (the energy-saving frame), which over time changes what the implicated actors perceive as proper problems and solutions. This frame is cultivated from a Life Cycle Analysis project, which provides a new perspective on what could be a relevant 'feature' for the customer, namely energy savings. All actors do not accept this perspective immediately, but over time it becomes the dominating technological frame.
Implications	The study can help designers discuss and challenge their own ideas, because they are provided with a concept (technological frames) that labels different perspectives in an organization openly; thus, the difference between hidden agendas and constructive contributions becomes more transparent when dealing with assessment of ideas. For managers, the study indicates how they can help set a new direction for the company by introducing new strategic R&D projects and perspectives; however, this demands that they are not too immersed in existing frames and established practices, but can step aside and take a look from the outside in. Another implication is that managers have to learn how to work with multiple technological frames.

7.3 Research paper 3

Title	***Navigating organizational challenges in idea work: how actors promote their ideas by relating them to or challenging current practices, values and visions in the organization***
Published in	• The present edition of the paper is a revised version of a conference paper published in the proceedings of International Product Development Management Conference 2011. The changes regard: a) abbreviation of the literature review, b) removal of empirical content that is developed in research paper 2, c) expansion of the discussion. The changes are partly based on comments given at the conference.
Interviews	• Innovation Intent and the individual designer's approach to idea work
Research questions	• How do designers navigate their ideas through the organizational landscape?
Literature review	• Idea champions, issue selling, organizational impediments and facilitators for innovation
Analytical framework	• Actor-network theory (Callon 1986a) • Political process perspective (Dawson 2000)
Findings	The first finding is that it can be problematic to separate the idea and the idea navigator in the early stages. The idea is fragile in these stages due to its basis in the idea navigator's technical competences and knowledge domain, as well as his mindset and visions. Conveying these rather immaterial aspects is not easy. In order to realize the idea, however, the idea and the idea navigator become an actor-network that has to be expanded in the organization. It is here the challenges and dilemmas begin to emerge. These difficulties are presented through seven vignettes related to: 1) navigating time, 2) timing in relation to formal planning processes, 3) constituting the 'good' Grundfos idea, 4) circumventing the formal decision-making process, 5) navigating what counts as arguments, 6) navigating and negotiating evaluation criteria, and finally 7) navigating organizational limitations. The idea navigator employs different strategies to navigate these challenges, but he does not choose them from a fixed repertoire. He adjusts his actions to the particular situation he finds himself in.
Implications	Instead of disputing that organizational members employ informal and political processes to bring forward ideas in an organization, it is suggested that management focus on the learning potential these processes offer. I.e. what can be learned more generally about idea work from studying the political and navigational skills of organizational members? Management should thus also openly support reflection regarding these experiences.

7.4 Research paper 4

Title	*Experiences with idea-promoting initiatives – why they don't always work*
Published in	• The proceedings of International Conference on Engineering Design 2011.
Interviews	• Innovation Intent and the individual designer's approach to idea work
Research questions	• What makes an idea-promoting initiative 'work' or 'not work'? • What understanding of idea work is inscribed in the different idea-promoting initiatives? • And what role do the different idea-promoting initiatives play with respect to idea work?
Analytical framework	• Change processes as political, symbolic, and learning processes. (Kamp et al. 2005) • Scripts (Akrich 1992)
Findings	This paper focuses on the formal and instrumental aspects of idea work by examining three idea-promoting initiatives launched by Grundfos management. The initiatives are: the employee suggestion system iShare, the Research and Technology (R&T) Playground, and Innovation Intent. During the analysis of the three idea-promoting initiatives, understandings of idea work inscribed in them are compared with the understandings of idea work in practice. The analysis shows that there is not necessarily agreement between the inscribed understanding of idea work in the initiatives and the de-scribed understanding of idea work in practice – i.e. how engineering designers work with ideas in practice.
Implications	The implication of the study is that it is important to address and shape the interplay between the explicit processes, systems and roles and implicit daily practices with idea work. Thus, Idea Management is not a question of how formalized the processes, structures and roles are, which the company establishes to steer idea work, but rather how well they can make new initiatives match existing idea work practices and still challenge conventional thinking. Following this line of thought, it is important that those who configure the idea-promoting initiatives and the managers who implement them are aware of the understandings of idea work that are inscribed in the initiatives, and the norms and values that are embedded in the company's idea constitution.

8 Towards a new understanding of idea work

The purpose of this chapter is to relate the findings and results of the four research papers to each other and construct an aggregated summary of the findings in order to articulate a new understanding of idea work and thus emphasize the contribution of the present study.

8.1 Interrelation of the research papers

Although each research paper poses different research questions and in this sense examines different aspects of idea work, the underlying theme is to understand the nature of idea work, and challenge or build upon existing understandings of idea work proposed in literature. As the title of this dissertation also indicates, I have especially focused on the socio-technical, organizational and political dimensions of idea work, although emphasis on these dimensions in the four papers differs. To obtain a holistic understanding of idea work, the idea work in Grundfos has been studied with basis in primarily two aspects: the individual/collective aspect and the informal/formal aspect. Idea work consists of a range of both individual and collective activities, and these activities can be both formal and informal in nature.

The individual idea work can be compared with the 'early' idea work. This is when the idea has just been conceived and is fragile, and when relations have to be built and an actor-network is about to be established. The collective idea work, on the other hand, reflects the more mature processes of idea work in which relations start being built and an actor-network is established; but it is still very dynamic since negotiations are going on concerning the stabilization of the network. The informal aspect of idea work refers to processes, channels and social networks through which ideas are negotiated and processed. These are all the processes that are not planned or controlled by formal instrumentation or systems in an organization. The formal aspect of idea work, on the other hand, refers to the instrumentation, systems, and processes by which idea work is planned and controlled in an organization.

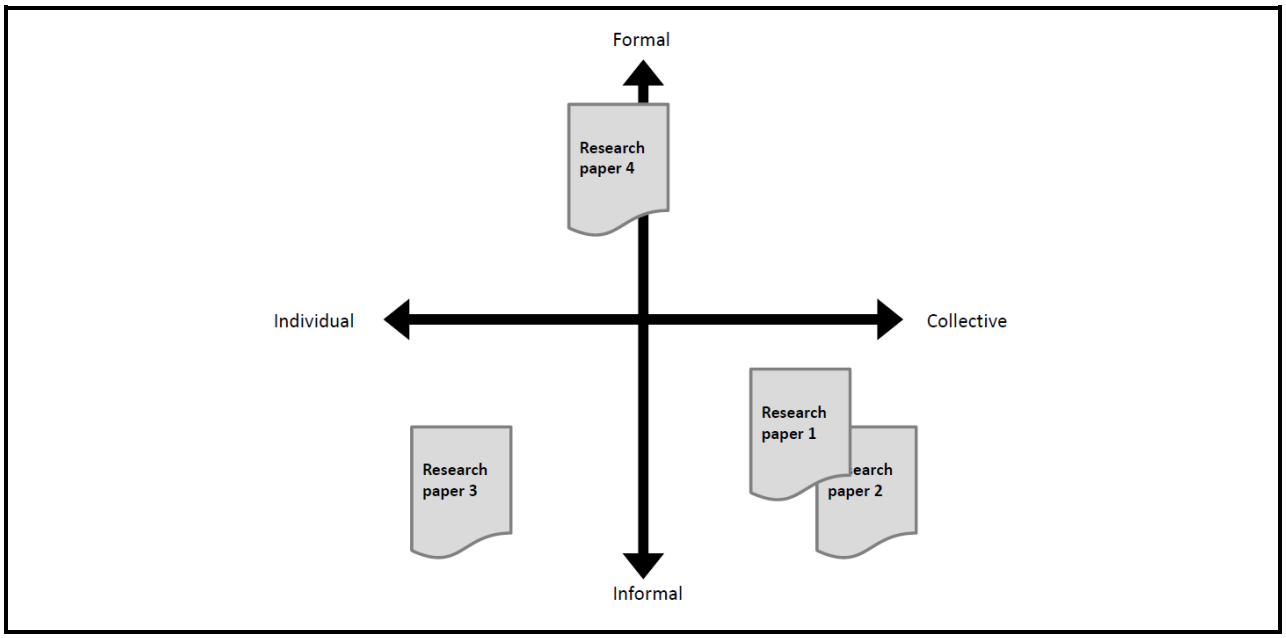

Figure 15 Illustration of the interrelatedness of the papers

The diagram in Figure 15 shows the individual/collective aspect along the horizontal axis and the informal/formal aspect along the vertical axis. The four research papers are positioned according to how they relate to the different aspects and each other. This positioning of the papers was not envisioned from the beginning of the study but is a post-rationalization. Hopefully, it can help the reader understand how the papers relate to each other and in this way help constitute a common thread through the papers and the dissertation.

Research paper 1 and research paper 2 (the Alpha Pro case) are positioned in the lower right corner, indicating that they focus on the collective and informal processes of idea work. Research paper 3, positioned in the lower left corner, focuses on the individual designer's informal work with ideas. However, idea work is not an individual activity for very long, since it soon becomes collective when the designer starts seeking support among colleagues. Many of the interviews forming the foundation for the analysis in research paper 3 focus however on the individual designer and his work with ideas. Research paper 4, positioned in the middle of the top of the diagram, focuses on the formal instrumentation of idea work and comprises both the individual and collective aspects, since the idea-promoting initiatives that are analyzed concern both aspects. The aggregated findings in the following therefore touch on both the individual and collective aspects of idea work as well as the formal and informal aspects.

8.2 Aggregated findings and results

Figure 16 summarizes the findings into a combined list. Each of the aggregated findings are explained and discussed in the following sections. There is some overlap between them due to their interrelatedness. Besides drawing on the research papers, I also add insights from the cases and interviews not presented in the papers, when this can contribute more richness to the findings or elaborate them further.

1) **Ideas are initially fragile and are constituted by a variety of knowledge fragments and past experiences.**
2) **Formal instrumentation of idea work supplements and/or hampers the informal processes of idea work.**
3) **Ideas need support in order to survive and grow in an organization.**
4) **Work with ideas requires a wide range of competencies beyond technological skills.**

Figure 16 List of aggregated findings

8.2.1 Aggregated finding 1

Ideas are fragile and are constituted of a variety of knowledge fragments and past experiences

Throughout the papers, I have not exerted much effort in coming up with a clear definition of what an idea is, as is otherwise often seen in extant literature. In research paper 2, however I quoted the definition in Riedl et al. (2009): "…*an explicit description of an invention or problem solution with the intention of implementation as a new or improved product, service or process*

within an organization". The generic descriptions of a product idea emphasize that such an idea emerges when the organization has the technical means or possibilities that can match a market need (Koen et al. 2002; Green et al. 1984; Cooper 1983). The virtue of such definitions is that they very clearly communicate what an idea is. Their shortcoming, however, is that they are also very simple and do not reflect ideas' more complex character. Rothberg (2004) defines an idea as "*an object of thought, intangible, and evidenced indirectly. While an idea cannot be seen, it can be represented, discussed and symbolized. Ideas may be implicit, taken for granted, encouraged or ignored. Ideas are understood relative to their framework*". Although Rothberg (2004) does not discuss product ideas but ideas in general, he comes a step closer to underpinning the complexity of its nature. My focus on idea work is particularly on the actual processes – the *work* with ideas – and not on the structural aspects; Therefore, I do not offer a clear-cut definition of what an idea is but attempt to describe elements of its nature, especially in research paper 1 and research paper 3.

In research paper 3, I emphasize the fragile nature of ideas. An idea's fragility results from its conception and initial connection to those who have conceived it. Not only are designers dedicated to their ideas, their ideas are so much a part of their individual technical competencies, visions and the technical domains they draw on that leaving a premature idea to the will of others is felt as a threat to the idea. The idea is in this sense fragile, and it thus depends on the idea navigator to know when it should be disseminated to the organization. But this does not mean that the idea navigator holds on to the idea, because he is afraid if it might be stolen by others. As one designer argues: *"Where I see a major strength is when you talk with others about your ideas and don't take ownership but gives ownership instead"* (Product developer 4). However, it can be difficult to give ownership until the value of the idea has been articulated and materialized to some degree. The finding that ideas are initially fragile relates to the individual aspect of idea work and characterizes its very early stages.

In research paper 1, the Alpha Pro case shows that an idea does not necessarily just have one point of origin but develops from many different pieces of knowledge, ideas, values, strategies and visions, combined over time by actors across as well as outside the company. This also corresponds to Björk and Magnusson's (2009) reflection that "*Innovation ideas evolve and develop over time and can also be recombined with other ideas over time*". The case thus shows that new ideas build on existing ideas in combination with the company's existing knowledge base, which is expanded for every new project executed, successful or not. The idea for the Alpha Pro circulator emerged as a result of designers' and managers' awareness of the possibilities to integrate relevant results in a new context. Over the years, Grundfos has added new knowledge to their existing knowledge base through research, developing new technologies and products and other activities. The finding that ideas are constituted of a variety of knowledge fragments and past experiences relates to the collective aspect of idea work and characterizes the more mature stages.
Both of the above findings indicate, as Woolgar (2004) also argues, that ideas are constituted in and through the processes of their articulation and representation.

8.2.2 Aggregated finding 2

Formal instrumentation of idea work supplements and/or hampers the informal processes of idea work

Companies approach idea work in very different ways, varying from employing very informal to structured processes (Björk et al. 2010). Based on a case study of four companies' approaches to idea work, Björk et al. (2010) explain that these differences are to some point a result of explicit differences in strategies and business environments, but they are also a function of differences in

company cultures. In the literature, focus is both on the importance of structured processes managed through tools and IT-systems, and on the inevitability of informal processes. Structured processes range from simple ideation techniques (Osborn 1965) to complex IT-based idea management systems (Nilsson, Elg and Bergman 2002). With respect to informal processes, these include championing (Schon 1963) and utilizing informal networks (Kijkuit and van den Ende 2007). In much of the literature, it is a strong perception that it is the formal instrumentation of idea work that comprises the 'valid' idea work processes and is thus the primary focus when studying idea work. The existence of informal idea work processes is acknowledged but viewed as secondary processes that have to be tamed or systemized in the long run. On the other hand, I view the informal idea work processes as the fundamental processes that bring about ideas in an organization; the ideas are constituted in and through the processes of their articulation and representation. Hence, formal instrumentation is rather a supplement to these inevitable processes.

In research paper 4, I analyze three idea-promoting initiatives in Grundfos that aim to structure and stimulate the work with ideas: the idea suggestion system, the R&T Playground, and Innovation Intent. The idea suggestion system and R&T Playground address the individual designer's, or a very small group of designers' work with ideas. Innovation Intent, on the other hand, addresses both the individual designer's and the collective's work with ideas. In many ways, the idea suggestion system does not work as intentioned. It has been referred to in the interviews as the '*parking lot*', '*the graveyard*', and '*the garbage bin*', indicating that once ideas land there, they are left to die. The suggestion system is also referred to by some as a '*safety valve*', meaning that if you do not know what to do with your ideas, you can always submit them to this system. The R&T Playground is perceived by designers as more successful than the idea suggestion system. One reason for this can be ascribed to the system's higher degree of compliance with designers own idea work practices, e.g. their access to resources, and responsibility of taking ownership and gaining support. In the idea suggestion system, resources are not granted nor does anyone feel any personal responsibility for bringing the idea further. By studying both the idea suggestion system and the R&T Playground, it became apparent that the designers at Grundfos had developed their own idea work practices, which were not built around the dedicated idea systems and initiatives but relied to a higher degree on informal processes.

It was not possible in research paper 4 to draw any conclusions about whether Innovation Intent had impacted idea work at Grundfos, since its vision has a timeframe extending to 2025 and the interviews were conducted only a year after its official introduction. However, from both the Alpha Pro case and other interviews, it is apparent that visions do play a role in idea work at Grundfos. According to Reid and de Brentani (2010), a vision implies: "*…knowledge, insight, and foresight as well as an image of a desired future state*". They argue that a vision is a statement of the company's goals. Especially the Alpha Pro case provides an example of how visions can help set the direction for idea work. The most distinct vision in the Alpha Pro case is the CEO's vision about making eco-friendly products and increasing Grundfos' market share of these products in the long run by banning low energy efficient circulators. Early on, Grundfos found that it was not possible to induce legislators to ban low energy efficient circulators, but it was possible to gain support for a voluntary energy label. Although at first the attempt to ban low energy efficient circulators did not succeed, the vision helped Grundfos create a market for their high efficient circulators. The vision finally succeeded however. Recently a ban was agreed upon, and in January 2013, new eco-design requirements will be introduced for circulators in heating systems. The requirements correspond to category A in the existing energy label system. In 2015, the requirements will be further tightened so that pumps not adhering to the requirements will not be able to be marketed in the EU.

The Space case is another example of how a vision helped direct idea work. In the Space case, the CEO had a vision about developing a submersible pump at an ambitious fixed cost price. This vision was articulated in the project and translated into "*an 'A' product for the cost of a 'B' product*". The project came up with three concepts, all of which fulfilled the vision, but none of them were realized as commercial products due to other reasons.

In the interviews about individual designer's approach to idea work, an e-vision was mentioned occasionally. It seems that about fifteen years ago, a couple of R&T employees formulated an e-vision, one part of which is described in the following quote: *"We had worked with electronics in Grundfos for many years and the aim was to make energy savings on our motors by controlling our pumps. We were reaching a point where it was difficult to [improve efficiency] more. So we asked, how can electronics increase its value for Grundfos"* (Product developer 5). They also asked themselves why it was only 10 percent of the pumps that were controlled at the time, and they concluded that it was due to cost. The e-vision was then formulated as "*variable speed at half the cost*". Since then, this vision has helped set the direction for electronics development.

The above observations indicate that at Grundfos formulating visions explicitly has been a repeated element in idea work practices and helped to set the direction for idea work. Moreover, it is both top managers and managers at lower levels in the hierarchy who have formulated these visions. Innovation Intent, however, can be viewed as a more formal or strategic attempt to employ visions, since it not only addresses small technological areas but all the processes at Grundfos, from R&D activities to logistics.

To sum up, idea work is conducted both through informal practices and through formal instrumentation. What makes idea systems and tools work seems to be that they can supplement the real idea work practices, by enhancing and systemizing the processes. However, it is important to be aware that when designing new initiatives, designers are still challenged with respect to incorporating new perspectives and thinking out of the box in order to secure long-term revitalization. The work with ideas has at all times been carried out by passionate inventors, engineering designers and the like in organizations; however, the strong focus on tools and systems to structure this work is a rather new development. When creating these systems and tools, it is therefore important not to ignore the real nature or practices of idea work. Formal instrumentation of idea work should be viewed as a supplement to informal idea work processes and not the primary processes or an aim in themselves, because then there is a risk that they become rigid and counter-productive.

8.2.3 Aggregated finding 3

Ideas need support in order to survive and grow in an organization

It is widely recognized that ideas need support in order to survive and grow in an organization (Chakrabarti and Hauschildt 1989; Kijkuit and van den Ende 2007; Koch and Leitner 2008; Frost abd Egri 1990; Howell et al. 2005), although this viewpoint is mostly held by those who examine the more informal aspects of idea work. Koch and Leitner (2008) argue: *"After the idea has become more concrete, the inventors try to draw the attention of other individuals to their idea to get support for further pursuit"*. Especially the champion literature has examined how champions apply different tactics in order to gain the support of others. However, these scholars focus especially on a fixed repertoire of tactics and characteristics, and do not shed light on the process of how support is actually gained. Both research paper 1, research paper 2 and research paper 3 touch upon the importance of support and provide examples of how support is gained.

In research paper 3, focus is on the individual designer's strategies and approach to idea work. The interviewees referred widely to certain strategies and key elements that can help designers

provide the necessary support. In the business units, particularly business plans are a key element in developing valid arguments for further investment in an idea. The use of business plans was also found in Dutton et al.'s (2001) studies to be an effective presentation tactic. In the technical departments, particularly materialization of the ideas, through drawings, prototypes and calculations, is the prevailing strategy. Many studies also emphasize the importance of physical objects in product development, because they help transform and convey knowledge from one knowledge domain to another. Such objects are often referred to as boundary objects (Henderson 1999; Carlile 2002). Another convincing way to gain support can also be to connect the idea to the company's business goals and visions: *"Some preparatory work had already been done [by Grundfos]; clean water to the world. […]. Then I wrote [in the presentation], 'Okay – we have a lot of nice headings but how should we do it? I have an idea for exactly how we do it and make a difference'"* (Product developer 4). The strategies mentioned above are not only to be employed by individual designers – collectives can also employ them.

In research papers 1 and 2, focus is on how collectives gain support, both inside the organization as well as outside. Inside the organization, it is the different knowledge domains and project teams that need support from other knowledge domains and managers. From outside the organization, support for the Alpha Pro project comes especially from governmental institutions such as the Danish Energy Agency and the EU, but also from the industry organization and competitors for establishing the energy label. Research paper 1 shows that constituting legitimate arguments is the key to gaining support. Research paper 2 elaborates on how ideas are framed. Applying the concept of technological frames makes apparent how organizational members with inclusion in different technological frames value ideas differently and therefore develop different arguments to convince others and gain their support. Congruence between technological frames is important when seeking support. If the technological frames of the involved social groups are too diverse or incongruent, conflicts are likely (Orlikowski and Gash 1994) and the idea risks losing momentum.

Building support is relevant throughout the development process until the actor-network is stabilized. Building support is therefore not confined to any specific stage; however, it can require different efforts and measures throughout the process, depending on the formality of the applied means and processes. In the initial stages, support is gained from the designer's own network, by presenting the idea and discussing its potentials. Later, when this support has been gained and the work with the idea becomes a collective process, support has to be gained from management and other knowledge domains in the organization, and if required, also from outside the organization as in the Alpha Pro case. It is however also these collective processes that cause the most controversies, because many perceptions are in play and power positions are at stake.

8.2.4 Aggregated finding 4

Work with ideas requires a wide range of competencies beyond technological skills

Technological skills and know-how are essential for many industries to be able to offer new products. Klofsten (2005) made a case study of five new ventures and found that it is technical know-how that often governs the early idea developing process. Although Grundfos is a large, established company, idea work and product development have traditionally also evolved from technological possibilities. Klofsten concludes that as a result of the founders' technical focus, the new ventures are not very well prepared, and they underestimate what he labels the "soft" aspect of idea development. Thus, further advancement of ideas only really gets going when the founders become more receptive to the world around them and involve external partners in the process.

There are of course some major differences, such as size, resources and challenges, between small new ventures and large established companies. But clear findings in the research papers point out that developing and preserving technological competences are only one part of being an engineering designer. As emphasized in research paper 1, idea work comprises more than the task of technical engineering. Being visionary, possessing negotiation skills, spotting opportunities, making risky investments, understanding markets etc. are also important elements in idea work. Or as formulated in a report for the strategic plan for engineering design in 2030 (Shah et al. 2004): "*Understanding the social aspects of engineering design, which underline these socio-technical interactions is, therefore, critical in future design research*". Research papers 2 and 3 also emphasize the political negotiations skills required to be a part of a large organization where many different actors compete in formulating problems and finding solutions. Idea work thus requires a wide range of competences beyond technological skills.

8.3 Contribution of the study

The contribution of the present study should especially be found in two important aspects: 1) I examine the real processes of idea work in a mature industrial R&D setting, and 2) by drawing on Science and Technology Studies, I develop and offer a new understanding of idea work.

Much of the literature engaged with idea work emphasizes how reality should be constructed, and thus proposes models and techniques that are normative in nature and can accommodate this construction. They thereby focus mainly on how to structure activities or how to explain activities structurally. Throughout the present study, I strongly emphasize studying real idea work practices and processes in Grundfos. Especially the analysis of the Alpha Pro case opens up the real processes of idea work and shows the complexity of the organizational interaction of various knowledge domains. The processual approach adopted here thus emphasizes emergence, dynamics and change in order to open up the content of what happens in the unfolding processes of idea work. It goes beyond a sheer labeling of the processes involved.
A parallel can be drawn between the understanding of idea work I offer in this dissertation and the understanding of knowledge some scholars offer within knowledge management, where they differentiate between two knowledge perspectives: the structural perspective and the processual perspective. In the structural perspective, knowledge is perceived as a discrete, objective, largely cognitive entity. In the processual perspective, knowledge is perceived as socially constructed and therefore rooted in practice, action and social relationships (Newell et al. 2002). It is the latter perspective that can be compared to the understanding of idea work I offer.

By applying the socio-technical perspectives from the STS literature throughout the papers, I have come closer to developing a new understanding of idea work that distances itself from the current understandings of idea work in relation to creativity, engineering design, and innovation management literature, where quantity yields quality and ideas are viewed as fixed entities just waiting to be harvested.

The understanding of idea work I develop identifies idea work in relation to the generation, recognition, promotion and advancement, support-building, evaluation, development, selection and implementation of ideas. But idea work is not a linear process as this list may imply. Idea work is iterative and involves definition and redefinition of problems, search for new solutions, negotiations, compromises and political disputes. This new understanding builds on Woolgar's (2004) understanding of ideas, where ideas are constituted in and through the processes of their articulation and representation. This means that ideas are not inherently good or bad, but are open to different interpretations and associations of meaning. This interpretative flexibility makes the interaction among the involved actors in idea work essential, since it is the outcome of their

negotiations that determine an ideas future potential and success. Idea work processes can be directed and stimulated by formal instrumentation, but such interventions must comply with the regular idea work practices in an organization, as these are the primary carriers of ideas.

9 Implications

In this chapter, I present the implications of the present study. Some implications have already been presented in the research papers; these are summarized and elaborated further. Emphasis is on how idea work can be supported and stimulated in a mature industrial R&D setting. The implications are valid for Grundfos primarily because they are based on a case study there; however, industrial companies that share the characteristics of Grundfos could also benefit from the suggested implications. Relevant implications concerning academia are also touched upon. A list of the implications (in headlines) is shown in Figure 17 and elaborated in the following.

1) **Develop shared understandings of the diverse practices of idea work**
2) **Develop socio-technical and political competencies**
3) **Acknowledge the past**
4) **Cater for different perspectives**
5) **Formulate visions for the future**
6) **Balance instrumentation of idea work**

Figure 17 List of implications

1) Develop shared understandings of the diverse practices of idea work

To support and stimulate idea work, it is important to develop shared understandings of the diverse practices of idea work existing in a company. In the process of developing shared understandings, it is expected that designers reflect more on their own practices in order articulate explicitly their advantages and shortcomings when discussing them with others. In this way, it also becomes more apparent that many different practices exist and that some work better in some situations than others. These discussions also provide the opportunity to share both individual and collective strategies and make more legitimate the practices that the designers perceive to be more 'informal'. It also provides managers with the opportunity to observe that more instrumentation of processes is not necessarily the only way to cultivate idea work.

2) Develop socio-technical and political competencies

It was found that ideas need support in order to survive and grow in an organization. An implication of this finding is that employees, whether working in 'hard core' technical domains, marketing or business development, also need to develop what I denote socio-technical and political competences. These are all the competencies that make the employee capable of understanding the socio-technical interaction and navigate in the organizational landscape in order to develop and promote ideas. Some of the designers at Grundfos already possess such competencies, and this makes them capable of promoting their ideas. However, although they understand how to promote their ideas, this is no guarantee that they offer the best ideas. By developing the socio-technical and political competencies of all the designers in the organization,

more designers would have the chance to promote their ideas successfully and the organization would thus become more collectively aware of all the idea work going on.

Developing socio-technical competencies and understanding socio-technical interaction involve the designers' understanding of how the development of, for example, technology or new products interacts with broader socio-material perspectives, such as development practices in different knowledge domains, use practices, business relations, and regulation, to mention a few. Understanding development practices in different knowledge domains involves developing knowledge of how the different domains interact; it also involves understanding what counts as relevant problems and solutions (ideas) and what means are preferred to transfer knowledge between these domains – e.g. business plans, drawings and prototypes. This relates to how ideas are best framed. Understanding use practices involves understanding the role of the user and how to integrate knowledge about this in the work with ideas. Understanding business relations involves developing knowledge about potential business partners and also understanding the mechanisms that regulate the interaction with them – e.g. the technological frames. Understanding regulation involves not only how this can restrict development, but also how this can be utilized in a positive manner, as in the Alpha Pro case.

Political competencies are to some degree included in the socio-technical competencies. I treat them separately in the following, however, in order to emphasize their importance in idea work. Navigating the organizational landscape includes the development of contextual knowledge as well as awareness of how to make use of it. Dutton et al. (2001) divide contextual knowledge into three categories: relational, normative and strategic knowledge. Designers need to develop relational knowledge in order to understand important social relations in the company – who are your friends and who are your opponents? Normative knowledge concerns the designers' understanding of what is perceived as appropriate behavior in the organization, such as: when is it appropriate to circumvent the system, and when should rules and norms be obeyed? Strategic knowledge concerns the wider perspective of the company, such as understanding the organizational goals. This is important in order to understand how the designer's own ideas relate to the company's greater scope.

Together, socio-technical and political competencies can help designers become more capable of making their own and colleagues' ideas appealing and win support. But in order for all designers at Grundfos to achieve these kinds of competencies, the designers need to be made aware of such competencies and be trained. This could be done through internal workshops and design games. But more formal education could also be provided. It should be noted, however, that the socio-technical and political competencies are a supplement to the designers' specialized, professional and technical competencies, as these are a first prerequisite for idea work.

3) Acknowledge the past

It was found that ideas are pieced together from previous results, ideas, events and development projects in the company. An implication of this finding is to acknowledge the past. To do this in practice involves first and foremost keeping the stories and knowledge of previous successes and failures alive, and in this context to remember that things are not inherently good or bad but social constructions that can be renegotiated when new knowledge, opportunities, and competencies become available or new actors enter the scene. In this sense, failures are in the short run opportunities to learn what not to do, as well as experiences that can add to the company's collective knowledge base. In the long run, however, failures can be turned into or contribute to future successes. Acknowledging the past, however, must never become a bad

excuse or a pretext for inaction, as when experienced designers argue that 'we have tried that before'. The tricky part of acknowledging the past is that you never know when a historical event becomes relevant again. The implication of this is not to make bigger documentation systems – although documenting data is important for revisiting the past – but to understand the context for why past events and projects became either successes or failures – e.g. material costs were too high; material quality too low; users were not involved early enough; too much internal resistance etc. This can still be done through reports and documentation, of course, but a project like the present PhD study also provides the opportunity to revisit the past in a more active manner, since it invites reflection, discussion and interaction between organizational members, and can hopefully also lead to future action.

4) Cater for different perspectives

The Alpha Pro case showed that many different organizational and professional perspectives came into play when developing the Alpha Pro circulator. Especially the LCA project helped create a new technological frame and thereby a new perspective on sustainability and its relevance in relation to product development. The implication of this finding is that new perspectives can be productive when they help designers alter their current understandings of problems and solutions and invite them to examine new opportunities not previously thought of. Designers and managers should therefore pursue new perspectives that can challenge current understandings and practices inside the company, as well as challenge competitors, users, markets and governmental institutions outside the company. New perspectives can enter the company in many ways. The LCA project was a research project conducted in collaboration with DTU and four Danish companies. The aim of the project was to develop a program that could show a product's impact on the environment during its lifetime. Although the output of the project was a piece of technology (an IT program), the project also provided a tool to understand context – the context in which the products appear, i.e. the use situation. This indicates that R&D projects that not only concern the development of a core technology or product, but also concern the context in which these technologies or products appear, can help provide a new perspective. The challenge here is that especially managers, who are entitled to make big decisions and initiate new R&D projects, know when it is appropriate to escape from the existing dominant technological frames in the company and be open to the opportunities a new perspective can provide.

5) Formulate visions for the future

Visions were found to be helpful in setting the direction for idea work. Until recently, this has not been formalized at Grundfos, but it has been an often used element in idea work when it was found suitable. With Innovation Intent, a corporate innovation vision has been launched, and it seems to be a promising initiative. Grundfos should therefore continue working with visions as guiding stars for the designers', as well as for the rest of the organization's idea work. It is important, however, to discuss who is responsible for breaking down the corporate innovation vision into smaller units, in order to make the vision more tangible and operational in the different knowledge domains. Moreover, it should be discussed how to do this. Visions should be used as instruments at all the different organizational levels, becoming more specific the lower the level – e.g. at the project level, product visions can be applied.

6) Balance instrumentation of idea work

It was found that formal instrumentation of idea work is not the primary idea work process; rather, it supplements the informal or regular processes of idea work. An implication of this finding is to balance the instrumentation of idea work with the informal processes and find out how they can complement each other instead of oppose each other. In the following, some aspects of this implication are discussed.

When developing new initiatives in order to guide or stimulate idea work, it is important that the initiative in some way matches the actual idea work practices in the company, as described in research paper 4. But it is also important to understand that one initiative does not do it alone. Different initiatives stimulate different practices, appeal to different employees, and cater for different outcomes. A part of balancing instrumentation is therefore also to understand the various scopes and aims of different initiatives and employ their different facets in different ways.

Balancing the instrumentation of idea work also concerns the balance between the persons, departments or companies in the organization that are addressed by the formal initiatives and instrumentation of idea work processes. Many of the R&D designers believe that a very essential part of their job, or even their duty, is to come up with ideas for new products and technologies and act upon them. Many of the idea-stimulating initiatives therefore also address the R&D professionals. However, these people are very close to Grundfos' decision makers on a regular basis, and therefore they not need these initiatives to the same degree as other employees placed in other parts of the organization, or in other countries, who do not have the same contact with decision makers. It could therefore be considered to differentiate the initiatives, depending on the group of employees to be targeted. Since the R&D employees are closer to decision makers, the challenge is not so much the lack of formal idea channels but rather understanding what colleagues are working on, and making idea work more visible in the organization. In the interviews, some designers pointed towards using more posters or TV screens to make idea work visible. Moreover, stimulation of interaction between colleagues and exposure to new networks within the organization are also relevant, since much idea work goes on in this interaction. Making formal idea channels available seems more relevant for employees outside the Business Development Centre (where R&D personnel are placed), because they do not have contact with decision makers on a regular basis, and formal channels, such as an idea suggestion system, may be their only way to communicate with decision makers.

In the spring of 2011, a new idea-stimulating initiative was launched – the Galapagos project. It is a new idea suggestion system, but in contrast to the old system, a new approach is applied to avoid the previous bad experiences. Two hundred employees were specifically selected to try out the new system. Instead of requesting all kinds of ideas, two innovation dilemmas were posted and only ideas for solving these dilemmas were requested. Among other features, the users are able to comment on each other's ideas and invest in them, like at a stock exchange. I have not made a systematic analysis of this new system, but talks with the idea manager indicate that those who were most active were also those who I identified as 'champions' in the interviews and who had strategies for how to put forward an idea that had not been requested by management. This observation indicates that those who want to promote their ideas in the organization, do it whether they utilize the formal instruments or do it more informally. The implication of this observation is to carefully discuss what the purpose of an idea-promoting initiative is, and also, as emphasized above, which employees should be targeted. Should it be the usual suspects who should be addressed, or should it be a group of employees not previously targeted, also within the R&D group?

To sum up, when designing idea-stimulating initiatives, it is important to consider a range of aspects: first, who does the initiative target? Is it actors who are used to working with ideas and who know how to work the system, or is it actors who do not usually work with ideas? Second, what kind of ideas are wanted? Some kind of direction should be set for the idea work in order to secure the relevance of the ideas developed. Third, some kind of ownership of the ideas should be inscribed in the initiatives in order to prevent the ideas from being left to die.

10 Discussion

In this dissertation, I offer an understanding of idea work that emphasizes that ideas are constituted in and through the processes of their articulation and representation. I argue that in order to understand the processes of idea work, we must open them up and study them closely in their real context of materiality, actors, organization, and political and socio-technical interaction.

The overall aim of this chapter is to discuss to which degree this contribution of a new understanding of idea work is constructive and sustainable, and thereby a valid contribution to research. This is done in three steps. First, I discuss the organizational dimensions of idea work in more detail, since these dimensions have not been explained to the same extent as both the socio-technical and political dimensions are discussed here. Second, I discuss various alternative focuses there could be on idea work that might be expected to be touched upon in a study of idea work. Finally, I discuss the challenges Grundfos currently faces in relation to the new understanding of idea work that I propose.

10.1 Organizational dimensions of the new idea work understanding

In the following, I elaborate on the organizational dimensions of idea work as these have not been explained to the same extent as both the socio-technical and political dimensions, either in research papers or in this dissertation. Organizational dimensions are the third dimension highlighted in the title of this dissertation and therefore equally important.

In this PhD, I study the mobilization and combination of knowledge processes in an organizational context, and how these processes challenge and change an organization and the interaction between its organizational members. But in this context, it is important to emphasize that organization is not only viewed as a web of organizational structures. There is more to it. The organization also comprises practices, norms and rules – what Edquist and Johnson (1997) would term institutions: "*sets of common habits, routines, established practices, rules or laws that regulate the relations and interactions between individuals and groups*". Innovation entails that different social groups in an organization acknowledge that innovation or idea work changes status quo, but this change is not necessarily confined to a structural change in the organization or on the market; it can also involve a fundamentally new way to understand and interpret situations, circumstances and relations. Moreover, it entails new ways of interaction and the development of new practices.

The Alpha Pro case shows how different ideas, past development projects and knowledge fragments are combined over time and finally aggregated into a product. This is a finding other studies (Van de Ven et al. 2000) have also pointed to. However, the contribution of this finding should lie in the detailed account of how these ideas or knowledge processes are mobilized and organized over time. Although some events in the case seem coincidental or contingent on certain encounters, these events or ideas do not just aggregate randomly. The key to the understanding of idea work I offer is that the involved actors recognize and enact relevant discourses in society, in Grundfos' visions, and in governmental institutions. Moreover, the actors know how to mobilize these elements in combination with their socio-material knowledge, although trial-and-error is an integral part of this endeavor. In addition to the technological accomplishment, the success of the Alpha Pro circulator can thus be attributed to the success of the mobilization strategies. Mobilization, however, is not restricted to human actors alone. In accordance with actor-network theory, ideas, visions, arguments, and other non-human actors such as prototypes and drawings can also be mobilizers and mobilize others. For example, the LCA project in the Alpha Pro case

mobilized a new understanding of sustainability among the engineering designers in the research department and was later used to change technological frames that were present in Grundfos.

In my examination of Grundfos' idea work practices, I have not gone into the details regarding the role ideas or boundary objects play as mediators, translators or representatives in idea work practices, since many other studies have already looked into this (Henderson 1999; Carlile 2002). But I wish to emphasize the importance of such elements in idea work, as they not only contribute to developing new products but also influence the development of idea work practices.

With respect to the organizational dimensions of idea work, I argue that idea work is carried out and addressed in the field between organizational structures and the common habits, routines, and established practices that regulate the relations and interactions between individuals and groups. When the designers act, they bring events and structures into existence and set them in motion, a process Weick (1988) terms enactment, and the outcome is an enacted environment.

10.2 Alternative focuses on idea work

In the following, I briefly discuss alternative avenues I might have taken in developing an understanding of idea work, but for various reasons have not done so.

10.2.1 Idea work versus idea management

The focus in this study on ideas is on the *work* with ideas and everyday idea work practices, particularly on engineering designers' work with ideas. Other organizational members, such as managers, sales representatives, marketing and business developers were however interviewed as well. We might call this perspective an *actor-centered* perspective. An alternative focus could have been on the *management* or *instrumentation* of ideas, with emphasis on how managers provide the necessary organizational structures, incentives and instrumentation of the work with ideas. We might call this a *systemic* perspective. It is of course a bit forced to make a clear-cut distinction between these two perspectives, since they interact and overlap to some degree. The difference would be found, however, in who or what is in focus in the interviews. I focused mainly on the actors and their interactions with their 'surroundings', which includes other actors as well as the 'system'. If a systemic perspective were chosen, I would primarily focus on the 'system' and how management makes use of it. The difference would also be found in the understanding of ideas. In my approach, I assign significance to how ideas are created and constituted over time; in the systemic perspective, ideas are assumed to already exist, and the great challenge is to manage them.

By focusing on the actor-centered processes instead of the 'system', I have been able to create a richer picture of idea work in an organizational setting and portray the many different inputs that are fed into and drive such processes. If I had pursued the systemic perspective, I might have risked not discovering or understanding all these different processes, and would instead have perceived designers' work around the 'system' as illegitimate or counter-productive activities. In this regard, it could be argued that traditional idea management expects actors to adjust their work practices to the formal designed systems, instead of adjusting the formal designed systems to actual idea work practices. If the latter were pursued, idea management literature might possibly provide more examples of how organizational structures supporting specific patterns of interaction can be redesigned or how new incentives can be constructed to support idea work, instead of just proposing even more complex IT-based systems to standardize work practices. The risk involved in standardizing idea work practices is that some of the productive sources might be killed. As a quote in Chapter 3 of this dissertation also indicates: *"…we need [to look at] the indefinable, because that's where the cash cow just might appear some day"* (John's boss). This

is not an argument for not having formal designed systems. They can be helpful, but they cannot stand alone, and they need to take into consideration all the other idea work processes and practices in an organization.

10.2.2 Differentiation of ideas

In this dissertation's analysis of idea work, I have not explicitly made a distinction between different types of ideas or different types of idea work. In extant literature, however, differentiation between ideas is made both explicitly and implicitly. This differentiation concerns at least four characteristics of ideas: 1) impact, 2) purpose/content, 3) novelty and 4) maturity. In the following, I briefly describe each of these characteristics and finally discuss the implication of categorizing ideas.

In the innovation management literature, ideas are recognized as being a very essential element in the innovation endeavor. In this literature, the impact of ideas is discussed and divided into two overall categories: incremental ideas and radical ideas. The former only cause small changes in, for example, product designs, technologies or markets, whereas the latter can help change the innovation game radically. Incremental innovation is also referred to as continuous innovation or exploitation, and radical innovation is also referred to as break-through and discontinuous innovation, as well as exploration. Leifer et al. (2000) define an innovation to be radical if one or more of the following criteria are fulfilled: 1) an entirely new set of performance features, 2) improvements in known performance features of five times or greater, or 3) a significant (30 percent or greater) reduction in cost.

The second differentiation of ideas regards their purpose or content. Examples of this differentiation are that ideas are categorized depending on their potential implication for ideas for new products, services, technology, markets, customers, distribution channels, business models and internal processes (Hill and Birkinshaw 2010). At Grundfos, the innovation piano is an example of such differentiation.

The third differentiation concerns the novelty of ideas. Ideas can be old and ordinary (Vandenbosch et al. 2006) or substantially new. With respect to novelty, Hill and Birkinshaw (2010) further differentiate between the novelty of the outcome and the novelty of the ideation process. With respect to outcome, they also relate novelty to the impact of ideas, e.g. incremental and radical innovation.

The fourth differentiation concerns the maturity of the idea. Ideas can be referred to as embryonic, raw or mature. This differentiation indicates how advanced an idea is and how far it has reached in the development process.

Riedl et al. (2009) argue that in order to exchange and analyze ideas across different platforms a shared definition of ideas must exist. They therefore aim at developing an idea ontology for innovation management. They motivate development with the following argument: "*Several benefits can be expected from the use of an ontology, including a shared and common understanding providing structure to poorly structured or unstructured information, realizing management support and interdisciplinary communication as a result of structuring information, and allowing the analysis and comparison of the information represented beyond operational data*".

Dividing ideas into different categories or developing an idea ontology clearly has a set of implications for the understanding of idea work. First of all, classifying ideas potentially black boxes idea work, because it does not examine the nature of the idea work processes but only its outcome. Nor does it indicate how idea work should be approached. The categorization of ideas

may be relevant in relation to the formal selection processes, but it does not capture the informal processes and shifting character of ideas. Furthermore, categorizing ideas is often a retrospective activity. It can be very difficult upfront to determine the output of an idea, because it often changes throughout its development. Given these implications, it is important to discuss what effect categorization or an ontology for ideas will actually have other than providing an analytical framework, which can be applied retrospectively or used to sort ideas in a database.

With respect to incremental and radical innovation, a much debated challenge concerns how both incremental and radical innovation can be integrated in the same organization, and how a sustainable capability for radical innovation can be achieved. According to O'Connor et al. (2008), the challenge is that radical innovation calls for a different management system than the traditional one, in that it allows and encourages mistakes and failures in order to promote learning. My purpose here is not to discuss how radical innovation is best catered for with respect to management systems or organizational designs; rather, it is to discuss whether there is any difference between the idea work or processes leading to incremental and radical innovation, respectively. As stated above, the labels, incremental and radical, address the outcome and not the process through which the idea or innovation is conceived, and often such labels are attached retrospectively. But is there a difference between how incremental and radical ideas are conceived, a difference in the creative process, a difference in the political process, a difference in the socio-technical interaction? This may be the case, but I have only studied the entire progress of one marketed product, namely the Alpha Pro. The Space project never launched any products. And the other small narratives in the interviews cannot be used to categorize the idea work as incremental or radical. But if today we ask whether the Alpha Pro case was a radical innovation or not, we can conclude that the Alpha Pro circulator, in combination with the energy label, was a radical innovation. It radically changed the game and forced other pump manufactures to produce energy efficient circulators, and thereby also adopt or develop new technologies. But this was not at all apparent in 2005, when it was launched. And in 2007, when I was presented with the case, Grundfos was still not even sure whether it would be a profitable business. But was the idea work process radical? This is also difficult to determine, but as accounted for in research paper 2, a very important aspect of the development of the Alpha Pro circulator was the LCA project, which helped change the perspective from cost reductions to energy efficiency. So a cautious conclusion could be that entirely new perspectives that challenge existing understandings can cause radical innovation.

With respect to categorizing ideas with regard to their purpose or content, it is of course important for companies to recognize that innovation can be more than product innovation, as was the case for Grundfos with introduction of the innovation piano. But I would argue that whether developing ideas for new products or new services, ideas still have to be conceived, evaluated, supported etc. These elements do not change. A categorization of this kind, therefore, only plays a role with respect to opening the horizon to different kinds of innovations or to labeling them in an idea management system.

Categorizing ideas with regard to novelty relates to how new an idea is, and to some degree also to the idea's radicalism. It is somehow implied that novel ideas are the best; the same is true of radical innovation. Especially when evaluating ideas, novelty is often a criteria or parameter for measurement, which also indicates the quality of the idea (Kudrowitz and Wallace 2010). However, often ideas are not very novel, because they have been suggested before. But this does not necessarily make them less valuable, because often ideas, or rather the technologies, methods or materials to materialize ideas, need to mature over time or become cheaper in order to be relevant and realistic to work on.

Categorizing ideas with respect to their maturity relates to how developed an idea is. In research paper 3, I do address the maturity of ideas in the initial stage when the idea is very fragile. However, the problem with talking about maturity, or using the metaphor of an embryo for immature ideas, is that this implies that the initial idea is still the same when it constitutes the end product, i.e. that the embryo contains a specific DNA code for the end product. The Alpha Pro case shows us that many ideas can be combined into a product over time. And the idea work understanding developed throughout this dissertation emphasizes that ideas are constituted in and through the processes of their articulation and representation, and are therefore plastic and moldable.

To sum up: In this dissertation, I might have focused more on the categorization of idea work; however, categorization is often carried out retrospectively and therefore does not refer to the work processes in which ideas are constituted. A categorization of ideas would thus not have been helpful in opening the black box of idea work, which has been an important pursuit in this dissertation. The discussion about incremental and radical ideas is not uninteresting, but the current literature focuses more on providing normative models and guidance for how to organize radical innovation and seems to lack real case studies that examine and distinguish between the creative, political and socio-technical processes of idea work.

10.2.3 Construction of the user in idea work

Today, many innovation studies concern the user perspective and how users are involved in the development process. In the literature, users are recognized as an important source of ideas (von Hippel 2005), but also as an important resource in testing concepts and prototypes early in the development process. This is a perspective I could have pursued more explicitly in this dissertation. However, when reading the interview transcripts, it becomes apparent that Grundfos designers rarely mentioned users. And when they do mention them, the picture is a conservative one, and does not include their involvement in idea work or product development explicitly. Therefore, I have not followed this aspect in the dissertation. User involvement has not been depicted as a dominant idea work practice at Grundfos, or at least not in the very early development and idea work. Although users are not directly involved in the early development process, however, designers do construct some kind of user when they work with their ideas and develop products. The construction of the user is most distinct in the Alpha Pro case, where three types of users at stake. First, there is the retailer who sells the circulator to an installer who installs the circulator in the end user's home. It is the end user who benefits from the reduced electricity consumption at the cost price of a more expansive investment. Different understandings and constructions of the end user are apparent in Grundfos' R&D and marketing departments, respectively. In R&D, the idea about banning low efficient circulators constructs a user whose behavior can be regulated through a ban (and later, through an energy label). In the marketing department, on the other hand, the understanding of the installer as a conservative customer is reproduced, and the end user is constructed as someone who can make the right decision if provided with the right information through information campaigns such as TV commercials. If I were to pursue the user perspective further, Akrich's (1992) script analysis would be relevant to apply in order to understand what consequences a certain construction of the user has for actual use practice.

10.3 Grundfos' challenges

In the introduction to this dissertation, four challenges that Grundfos is currently facing were highlighted: 1) being a family-owned company, 2) globalization, 3) the transition from research and technology development to product development, and 4) moving from being much focused

on technology development to being more oriented towards business development and obtaining a better understanding of markets and how to involve users. In the following, I relate these challenges with the findings of this dissertation and the understanding of idea work it proposes. This discussion also raises new questions.

Challenge number one – being a family-owned company – relates to the charismatic leadership that both Poul Due Jensen and recently Niels Due Jensen demonstrated with respect to R&D activities over the years. In my interview with Niels Due Jensen, he emphasized the necessity of visions in relation to innovation activities: *"Someone needs to develop and think in visions. That's people like me [...], but others also need to work with visions. [...] The vision is the most important thing. If you don't have a vision of where you want to go, that is a dream of where you want to go, good heavens then I believe [...] you will only be developing insignificant things. So you need to think big thoughts. And we cannot expect all employees to think big thoughts, but some have to do it. And it shouldn't just be me, right? It should be a strong collection of resourceful persons and leaders at Grundfos who have to be thinking about visions"*. He continued by explaining that these visions concern not only new products but also marketing strategies, branding and other types of innovation. He concluded that it is visions that have made Grundfos the champion and market leader it is today, and that everything starts with people who think visionary.

The challenge related to Grundfos being a family-owned company is more specifically connected to the visions Niels Due Jensen has created over the years. It is remarkable to observe how engaged the designers at Grundfos already are in the daily idea work, but who or what is going to take over the visionary talent of Niels Due Jensen and create Grundfos' future in the longer run? In this regard, Collins and Porras (1991) argue: "*Organizational vision is not about predicting but rather constructing the future*". But is it possible to hand over the responsibility for being visionary to other managers in Grundfos, or distribute it to the designers themselves? What made the existing visions work was partly their soaring quality, and they were also put forward by an actor who had a significant status and enough resources to pursue them. Innovation Intent is an attempt by Grundfos' new management to meet this challenge. Current CEO Carsten Bjerg, therefore, also went on a world tour to visit the different Grundfos sites in order to promote the vision of Innovation Intent, which runs until 2025. It is important to remember, however, that writing a white paper or launching a campaign is not enough. In order for Innovation Intent to work, it has to be implemented in daily idea work practices. Moreover, it has to be renewed and reinvented concurrently with changes in the discourses in society and in how new opportunities emerge in the company and the competencies Grundfos has and acquires. In short, although the vision is a long-tem vision, Grundfos cannot rest on its laurels. With respect to the findings of the present study, one way to distribute visionary activity could be to let the designers experiment with new perspectives and to make room for reflections.

The second challenge concerned globalization has especially two important aspects: Grundfos' own ambitions to operate as a truly global company, and the increased competition from especially Asian countries. With respect to becoming a globally operating company, my examination of idea work in Grundfos indicates that the strategic or focal idea work is still reserved for the designers in Bjerringbro. Thus, the designers in China and USA are left with more delimited development tasks. The true challenge Grundfos faces, if it wants to become the global organization it strives for, concerns how to organize and cater for idea work in the future. This is especially important to consider if development activities are to be distributed to more sites all over the world. In this connection, there are a couple issues of concern. First, will designers abroad continue to accept that some development activities are reserved for specific R&D centers, or should activities be equally distributed between R&D centers? Second, how

many of the Danish idea work practices apply at all to other sites and cultures? Although some of the experiences regarding the formal instrumentation of idea work can be communicated to other development sites, the question is how local the daily idea work practices are, since they rely on certain management structures, habits, norms and rules that apply in Grundfos and in Denmark. How well do they apply in other cultures?

With respect to the increasing competition, especially from Asia, Grundfos has tried to focus their innovation activities more through Innovation Intent and the three innovation platforms defined. But they also pursue differentiation through corporate social responsibility. For example, Grundfos has recently launched a new initiative called life-link, which is a system that ensures access for rural communities to safe water from a safe and reliable water supply. A unique business model adds financial sustainability to the life-link solution. Another avenue Grundfos pursues to differentiate and keep Asian competitors away is continual refinement of their green profile. Emphasis is on green and energy efficient products. Moreover, Grundfos continues to lobby in the EU to make legislators continue to tighten the standards and requirements for energy-consuming products. With respect to idea work, it is important to continually cater for the socio-technical skills of the engineering designers, because it is these competencies that will help secure solutions such as Alpha Pro and Life-link in the future.

The third challenge regards the transition from research and technology development to product development, but it is very interrelated with the fourth challenge regarding the move from a strong focus on technology development to also being more oriented towards business development, obtaining a better understanding of markets, and involving users; therefore, these challenges are discussed together. My study of idea work shows that room must be made for experimenting with new technologies in an organization, even though the level of uncertainty is high and no immediate application of the technologies is possible. It can be difficult, not to say impossible, to rationalize solutions up front; therefore, an important part of finding new solutions is to experiment and cultivate trial-and-error processes, especially because such processes can also produce opportunities not anticipated beforehand. On the other hand, my study also shows that it is important for engineering designers to have an understanding of business, markets and users, as these are also essential elements in the work with ideas. As the analysis of the Alpha Pro case also indicate, the engineering designers need to learn how to activate and employ different perspectives in their work with ideas, and they must also have an eye for the application of their inventions and their business potential. Through Innovation Intent, Grundfos has become much more aware of this paradox, but it is still necessary to focus on how to address the paradox in daily practices and consider how to develop and nurture the socio-technical skills of the engineering designers.

11 Conclusion

In this chapter, I draw conclusions regarding the main findings of the study, reflect upon the applicability of the study, and finally suggest ideas for future research.

The aim of the present PhD study is to examine the nature of idea work in a mature industrial R&D setting. Initially, I formulated the following research questions to guide the study:

- How do designers work with ideas in a mature industrial R&D setting?
- How can work with ideas in a mature industrial R&D setting be stimulated and supported?

Idea work is a complex matter and takes many forms; thus, no simple answer can be given as to how designers work with ideas in a mature industrial R&D setting. But a set of characteristics can be derived from my study of idea work in Grundfos.

Before I answer the first of the research questions, I wish to recapitulate my definition of idea work in order to make clear what has been studied and what has not been studied. Idea work refers to the interactions and processes in which ideas are constituted over time and includes generation, recognition, development, negotiation, gaining support, materialization, and implementation of ideas. Focus in this dissertation is not on the distinct activities, but on the interrelation between them and the interaction of the involved actors as well as the individual and collective strategies they employ to advance ideas in an organization.

The individual/collective and the informal/formal aspects are especially emphasized in order to establish a frame for the research papers. Idea work is both carried out at an individual and a collective level in the organization. The individual level is closely related to the initial stages, when the idea is conceived, but also refers to the individual designer's efforts in building support and expanding the actor-network. Here, the idea and its relations in the organization are viewed as an actor-network. The collective level of idea work is associated with the more mature stages of the idea's dissemination in the organization, when the actor-network starts expanding but is still not stabilized. Although individual actions are a profound part of idea work, my study indicates, especially through the Alpha Pro case, that idea work is predominantly a collective endeavor. This is due to the fact that every individual action is taken in consideration to how the collective will react or interact. And the advancement of an idea is dependent on the support it can win and thereby on the collective. When promoting ideas and building support, negotiations are inevitable, since the involved actors have inclusions in different technological frames and thus view the world differently. Idea work is therefore to some extent also political.

Idea work is also carried out with more or less formality and deployment of the formal systems. Many different channels, means and strategies can be employed by engineering designers to advance their ideas in Grundfos. The present study shows that it is often a selective combination of more or less formal and informal means that are employed, since how an idea is best promoted is context dependent. What works for one designer or social group, does not necessarily work for others, due to their different backgrounds, competencies, seniority, reputation, track records and inclusion in technological frames.

To sum up, idea work is characterized by being interactive, collective and relational. It is most important when designers want to advance their ideas in the organization for them to mobilize support among co-workers, other professional domains in the company, and managers. Designers work with ideas can thus be viewed as the expansion and stabilization of an actor-network.

However, ideas and social relations are dynamic, and mobilizing and enrolling actors can thus be challenging. Furthermore, since the involved actors have inclusion in different technological frames and thereby have different understandings of what constitutes good ideas, political disputes also become an integral part of the designers work with ideas.

The second research question is: How can work with ideas in a mature industrial R&D setting be stimulated and supported? My study shows that two important characteristics are present when the designers and social groups succeed in advancing their ideas in Grundfos. First, the designers are committed to their idea – they believe in it. It is not necessarily the designer who conceived the idea, but there must be at least one person in the organization that believes in the idea and will fight for it. Another characteristic is the availability of resources. A full budget is not necessary from the beginning, but the designers need to have the time to develop the idea and, to some degree, also resources in the form of materials or workshop hours. If the designers are capable of explaining their idea and making it relevant, it is almost always possible to receive some initial funding to develop the idea in the initial phases from a department manager, for example. The present study also shows that visions are an important element in idea work, as they provide long-term goals and a direction. Moreover, the socio-technical competencies of the designers are important in finding solutions that go beyond technology and also encompass market relevance, use practices and business potential.

Given these characteristics, idea work can be stimulated and supported through the following five proposals. *First*, it is important to make it legitimate to work with ideas other than those requested by management or by formal roadmaps. Legitimacy is not only ensured through formal initiatives such as idea management systems or occasional competitions, but to a larger degree by accepting and acknowledging the common and maybe more informal idea work processes practiced in the organization. This can be done both very explicitly by discussing and encouraging such activities at department meeting, and it can also be done more implicitly through managers' silent acceptance when designers explore their own ideas, as is also the case for some managers today.

Second, it is important to make room for experimenting with new technologies, especially on a more formal level, as this kind of activity requires a certain amount of resources. It is important to emphasize that a specific purpose should not necessarily be set to start with, so that options can be kept open for experimenting with the technology in different contexts.

However, not all idea work activities should be without an end goal; therefore, the *third* proposal is to provide for and cultivate the designers' socio-technical competencies, since these shall help secure the broader application and market relevance of the ideas the designers are working with.

Fourth, it is important to stimulate idea work with the organization's different perspectives – preferable totally new perspectives – which can help provoke and challenge old assumptions and practices (Hansen and Andreasen 2006) and thereby hopefully provide new opportunities.

The *fifth* and final proposal concerns continuing work with visions. It is important not to rest on the laurels of Innovation Intent, but continue to work with visions and ways to distribute them in the organization.

For practitioners, managers and academics alike, the results from this study offer a different way of thinking about idea work, and thus idea management. Since it is established that ideas are constituted in and through the processes of their articulation and representation, it is this practice that should be catered for in the management of ideas.

11.1 Applicability of the study

Since the case study examined in this dissertation is limited to one company, no comparisons are made with other companies. The case material cannot support universal conclusions – such as idea work needs formal management – because different idea work practices exist in different companies, and this study examines only one. Having said this, however, the present case study does have a theoretical relevance that reaches further than the local setting of Grundfos, since it is not only grounded in the empirical data but also theories within the STS field. Thus, the understanding of idea work developed through this dissertation with basis in the STS field can be perceived as a theoretical contribution.

11.2 Future research

Even though a PhD project is of considerably comprehensive, it still leaves room for further research. It also arouses curiosity about what could also have been studied. In the following, I therefore make a couple of proposal for future research within idea work.

Only one company is examined in this study; therefore, it could be interesting to conduct a similar study in other companies and compare idea work practices in order to understand to what extent idea work practices are shared between different organizational settings or how different they are. For such a comparative study, the companies could have either similar or dissimilar characteristics with respect to size, industry and nationality. This would depend on the traits to be studied.

With respect to my proposals regarding how idea work can be better stimulated and supported, it could be interesting to study how this is done in practice. Such a study would have the character of an intervention. In the preparation phase, a model of how to equip designers with socio-technical skills or how to distribute visions could be developed, or alternatively a design game. This should then be implemented and the effects observed in order to learn more about how idea work is best stimulated. This research would be conducted using an action research method.

In the present study, I discuss to some extent how idea work is instrumented. Further research could be useful regarding how formal instrumentation of idea work is best facilitated. For example, how can the designers who design the tools and systems be more aware of the derived idea work practices? And how can they take into account the implications of the tools and systems while designing them? In continuation of this, another concept could also be studied, namely the staging of idea work and how this can complement its instrumentation.

Finally, it could be very interesting to study whether the idea work practices leading to incremental innovation differ from those leading to radical innovation. In this connection, it is also highly relevant to research whether such practices can be catered for in the same organization, since at preent there is much discussion concerning this matter, both in literature and in practice.

12 Epilogue - to become a researcher

This chapter presents my reflections on the personal and professional aspects of becoming a researcher and therefore has a very personal touch.

At one of the first meetings with my supervisors, Christian Clausen and Claus Thorp Hansen, Christian told me: "*This process will develop you and change you*". At that point in time, I did not really understand what he meant – but now I do. In my view, conducting a PhD project involves so much more than the formal tasks of planning the study, collecting data, reviewing literature, analyzing transcriptions, and writing and presenting papers. A wide range of additional activities and learning potential are also present in this process. As I have described throughout this dissertation, idea work is a political process in which organizational members need to gain support for their ideas; therefore, they need technical skills, but also a wide range of additional skills. In the same way, the research process calls for more than just plain analytical skills. As a PhD student, you need:

- to manage a project, make realistic project plans and continuously adjust your own expectations and ambitions. The latter is the most difficult.
- to learn how to present your project, also in the initial phases when you only have a short description and some initial ideas from your supervisors.
- to learn how to defend your point of view when people with different worldviews challenge your research.
- to develop excellent English skills, both written and oral, or else the reviewers will come after you.
- to develop teaching skills and be comfortable with the fact that you do not have all the answers.
- to develop writing skills and understand how to make an argument.
- to understand the research community of which you are a part and learn what discussions are relevant – or how you can make your subject relevant in this context.
- to know the strategies for publishing your papers and how to pick the right journal.
- to know and understand the academic play at the university.
- to know your project's role, both at the university and in the company you are examining.
- And maybe most important of all, you have to learn how to motivate yourself so you are sure you can reach the end goal: to write the dissertation and hopefully be rewarded with the fine PhD title.

These challenges can of course seem trivial and less surprising for the experienced researcher. I do not mean to complain, but when entering the field, these challenges can at first seem overwhelming. However, I can now acknowledge the learning potential each of these challenges has offered, and whenever my frustration over writing papers was about to overwhelm me, I thought of what the Danish film producer, Peter Aalbæk Jensen, once said: "*It takes at least five attempts for a film director to make a successful movie*". If this can be applied to my writing process, there is hope that I am on my way.

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Appendices

Appendix A

Transcribed interviews

In the Space and Alpha Pro cases, the interviewed persons are first presented by their original role in the case, followed by the title they had at the time of the interview (it may have changed since then). Most of the interviewees are men. Women are noted by a (♀) sign.

Nr.	Year	Date	Length	Interviewed persons	Case
1	2007	03-sep	50 min. 39 sec.	Project manager (Senior project manager)	Space
2	2007	13-sep	44 min. 52 sec.	Project team member (Innovation and concept manager)	Space
3	2007	20-sep	22 min 28 sec.	Project team member (Business development manager)	Space
4	2007	20-sep	39 min. 45 sec.	Project team member (Product engineer)	Space
5	2007	09-okt	46 min 03 sec.	Project team member (Chief engineer)	Space
6	2007	31-aug	57 min. 25 sec.	Senior engineer 1 (Chief technical adviser)	Alpha Pro
7	2007	14-sep	40 min. 32 sec.	Project manager (Innovation manager 1)	Alpha Pro
8	2007	14-sep	36 min. 37 sec.	Senior specialist 1 (Chief engineer)	Alpha Pro
9	2007	25-sep	54 min. 03 sec.	Research manager (Group senior vice-president, R&T)	Alpha Pro
10	2007	23-okt	50 min. 55 sec.	Senior engineer 1 (Chief technical adviser)	Alpha Pro
11	2007	12-nov	51 min. 52 sec.	Head of motor department (Chief engineer)	Alpha Pro
12	2007	12-nov	40 min. 00 sec.	Technical director, Engineering	Alpha Pro
13	2007	12-nov	57 min. 59 sec.	Sales Director	Alpha Pro
14	2007	19-dec	36 min. 58 sec.	Market Segment Director	Alpha Pro
15	2008	16-jan	34 min. 09 sec.	Senior specialist 1 (Chief engineer)	Alpha Pro
16	2008	05-feb	48 min. 06 sec.	Politician 1	Alpha Pro
17	2008	11-feb	16 min. 18 sec.	Politician 2	Alpha Pro
18	2008	26-mar	59 min. 21 sec.	CEO (Chairman of the PDJ foundation)	Alpha Pro
19	2009	04-feb	29 min. 29 sec.	Electronic engineer (Senior science advisor)	Alpha Pro
20	2009	25-feb	36 min. 25 sec.	Senior specialist 1 (Chief engineer)	Alpha Pro
21	2009	02-feb	46 min. 57 sec.	Department manager, Hardware	Innovation Intent
22	2009	03-feb	44 min. 26 sec.	Managing director, NoNox	Innovation Intent
23	2009	04-feb	64 min. 22 sec.	Director PDJ Academy (♀)	Innovation Intent
24	2009	16-feb	41 min. 22 sec.	Innovation manager 1	Innovation Intent
25	2009	19-mar	47 min. 0 sec.	Innovation manager 1	Innovation Intent
26	2009	23-mar	53 min. 15 sec.	Segment director, Building Service	Innovation Intent
27	2009	27-mar	69 min. 04 sec.	Group senior vice-president, Water Utility	Innovation Intent
28	2009	15-apr	47 min. 03 sec.	Group senior vice-president, People and Strategy (♀)	Innovation Intent
29	2009	16-apr	52 min. 03 sec.	Group senior vice-president, Industry	Innovation Intent
30	2009	21-apr	55 min. 25 sec.	Innovation agent, Design and Discovery	Innovation Intent
31	2009	23-apr	66 min. 37 sec.	Group senior vice-president, Building Service	Innovation Intent
32	2009	28-jan	69 min 52 sec.	Product engineer, Circulation and single stage	Idea work
33	2009	16-feb	50 min. 46 sec.	Product manager, Circulators	Idea work

34	2009	17-feb	64 min. 06 sec.	Senior product engineer, Hardware	Idea work
35	2009	18-feb	65 min. 24 sec.	Chief engineer, Product development	Idea work
36	2009	18-feb	56 min. 13 sec.	Technology director, R&T	Idea work
37	2009	20-feb	46 min. 22 sec.	Chief design engineer, Fluid mechanics	Idea work
38	2009	25-feb	57 min. 04 sec.	Senior project manager, New concepts	Idea work
39	2009	10-mar	52 min. 43 sec.	Application manager, Water Utility	Idea work
40	2009	10-mar	54 min. 02 sec.	Market segment director, Water Utility	Idea work
41	2009	11-mar	62 min. 03 sec.	Senior development engineer, Fluid mechanics	Idea work
42	2009	12-mar	48 min. 54 sec.	Senior signal processing specialist, Motor	Idea work
43	2009	12-mar	64 min. 14 sec.	Business development manager, Building Service	Idea work
44	2009	13-mar	48 min. 46 sec.	Program manager, Submersibles (♀)	Idea work
45	2009	16-mar	47 min. 25 sec.	Senior product engineer, Circulation	Idea work
46	2009	16-mar	50 min. 58 sec.	Senior product engineer, PD multistage	Idea work
47	2009	16-mar	59 min. 05 sec.	Senior engineer, Fluid mechanics	Idea work
48	2009	17-mar	48 min. 25 sec.	Senior science adviser, Research	Idea work
49	2009	18-mar	52 min. 22 sec.	Research manager, Research	Idea work
50	2009	24-mar	51 min. 01 sec.	Chief engineer, R&T Technology	Idea work
51	2009	31-mar	71 min. 15 sec.	Department manager, Hardware	Idea work
52	2009	01-apr	52 min. 24 sec.	Chief engineer, Fluid mechanics	Idea work
53	2009	02-apr	67 min. 32 sec.	Innovation and concept manager, Water Utility	Idea work
54	2009	15-apr	60 min. 12 sec.	Group senior vice-president, R&T	Idea work
55	2009	15-apr	59 min. 16 sec.	Market segment director, Industry	Idea work
56	2009	17-apr	52 min. 11 sec.	Design and engineering director, Product development	Idea work
57	2009	17-apr	55 min. 14 sec.	Global D&E planning and strategy manager	Idea work
58	2009	17-apr	42 min. 47 sec.	Senior Vice President, New Business	Idea work
59	2009	17-apr	48 min. 28 sec.	Director, Marketing	Idea work
60	2010	21-sep	49 min. 13 sec.	Project employee, Discovery and Design (♀)	Idea work

Appendix B

Research paper 1

The paper has been submitted to the journal *Research in Engineering Design*. The paper is currently in a review process which the authors at the present moment do not know the outcome of. However, acknowledgement is given to the original source of publication. If *Research in Engineering Design* decides to publish the paper the final publication will be available at www.springerlink.com in a rewritten edition.

The nature of idea work in a large industrial company – a case study

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The nature of idea work in a large industrial company – a case study

Abstract

The work with ideas is perceived by both academics and industry to be an important element in new product development and has thus been the subject of investigation in many different research fields. Creativity research has especially focused on the creation of ideas; innovation management literature has focused on the sources of ideas and their relation to front-end innovation activities; and design methodology literature reports studies of what kind of stimuli can affect idea generation in the concept phase. However, although these contributions are important in developing an understanding of idea work, we also need to consider the socio-technical and organizational dimensions of idea work, since these dimensions can not only help us illuminate the moment of idea creation, but also the subsequent activities involved in how ideas are recognized, supported, developed and implemented. In this paper, we investigate how ideas emerge and gain momentum in a large industrial company. We do this through an in-depth case study of the development of the energy-labeled circulation pump Alpha Pro, developed by one of the world's leading pump manufacturers Grundfos. In our study, we observe that: 1) ideas are pieced together from previous ideas and results; 2) ideas are carried through by continuous mobilization of support and development of legitimate arguments; and 3) idea work is more than an engineering task. Furthermore, we observe that idea work is an ongoing process undertaken across different projects, actors, departments, strategies and visions within the company, and sometimes also involves external actors across companies and organizations.

Keywords: New product development, early phases, idea work, case study

1. Introduction

Today, many large and medium-sized industrial companies in Denmark use product development models to organize and monitor their new product development (NPD) projects. The use of systematic approaches has among other things led to improvements in lead time, increased product quality, more efficient use of resources, and strengthened communications in projects. However, in communication with representatives from a range of Danish industrial companies, the authors have experienced an emerging shift from a predominant focus on the later operational phases to the earlier phases taking place before the NPD activities are officially initiated. This has been observed in a number of student and PhD projects, networking groups, and workshops with participants from Danish industry. In particular, work with ideas has received attention, because ideas are recognized as critical for a company's success, while they are also perceived to be difficult to manage. What we have seen in Danish industry is in line with Rothberg's (2004) argument: "Ideas are critical for the ultimate success of organizations; they are an essential management resource. Those managers who understand what is happening to ideas in their workplace, and their organization's environment, will be placed to benefit from them". But how is work with ideas actually carried out in an industrial product development company?

One of the world's leading pump manufacturers, Grundfos, founded in Denmark, initiated the research work documented in this paper with a PhD project aimed at gaining greater insight into to how work with ideas goes on in the early phases of new product development, since they found that their management and execution of the operational phases of NPD were effective and efficient. Therefore, Grundfos sees a potential in improving product development by focusing on the early phases. In academia, the interest in the early phases is also growing, as these phases are

recognized to have a great influence on end results. It is therefore promising to address the early phases in order to achieve improvement of the overall development process (Koen et al. 2002).

Ideation capabilities have been a central subject in creativity literature for a long time, and in the field of engineering design, studies have been made of how idea and concept generation is best stimulated. These contributions give valuable insights into how ideas are generated and best stimulated on the level of the individual designer; however, since we are also interested in understanding the broader organizational and socio-technical processes associated with idea work in a large industrial company, we set out to examine an in-depth case study about the development of the energy-labeled circulation pump, Alpha Pro, by Grundfos. It is expected that the insights gained will help support the authors' long-term research goal of reaching an understanding of how idea work is best facilitated and supported in a large industrial company. The paper is structured as follows: In section 2, we provide the theoretical background for this paper and look at current understandings of idea work in order to identify our research challenge in extant research. In section 3, we present our research questions and method, and then in section 4, introduce our case as a narrative. In section 5, we present our analysis and main findings; and in section 6, we discuss and propose a new understanding of idea work and its implications. Finally, we conclude in section 7.

2. Theoretical background: Current understandings of idea work

Ideas and the work with them have previously been investigated from various perspectives and in many different fields of research. We have identified five relevant fields, which we present in the following in order to qualify our research challenge. These are: 1) idea generation, 2) stimulation of idea generation, 3) sources of ideas, 4) early phases of new product development, and 5) informal processes: roles and networks.

2.1 Idea generation

A considerable part of the literature is concerned with the generation of ideas. Madanshetty (1995) has tried to understand how ideas emerge when design problems have to be solved in conceptual design. He proposes the C/D model of design breakthroughs, arguing that the mind can see aspects of the pursued problem manifested in many things in the surrounding world, and that a breakthrough happens when the mind sees a context where the essential problem-solution is re-enacted. Problem-solving methods and creative idea generation techniques (Altshuller and Shulyak 1998; Geschka 1983; Osborn 1965; Zwicky 1969) have also been widely proposed. Here, the focal point is that a person's ability to generate ideas and problem-solving powers can be influenced (Ryhammar and Brolin 1999). Although problem-solving methods and idea generation techniques are frequently used in companies, and are highly valued by project managers and others i similar positions, the techniques only concern the moment of creation and do not reflect on the subsequent and equally important activities, such as further development, support and implementation. Furthermore, in idea generation, focus is on the individual's ability to create, but we are also interested in insights into the more complex organizational aspects of idea work.

2.2 Stimulation of idea generation

In the field of engineering, design studies have been made of how different kinds of stimuli can affect the generation of ideas (Howard et al. 2010; Howard et al. 2011; Liikkanen and Perttula 2010; Mak and Shu 2008; Perttula and Sipila 2007). In a study of mechanical engineering students, Liikkanen and Perttula (2010) found that verbal stimuli had an evident impact when

initial ideas for a concept were generated. Howard et al. (2010) studied designers in industry and found that by introducing different forms of stimuli the frequency of idea generation was in many cases increased. Moreover, the ideas generated were also more appropriate with respect to concepts proposed at the stage-gate. Thus, these studies have provided valuable insights on how ideas are generated and best stimulated on the individual designer level.

2.3 Sources of ideas

A third line of research looks into the sources of ideas. Here, both internal company sources, such as company departments and work methods, and external sources, such as magazines, industrial fairs, and patent search, have been identified (Koen and Kohli 1998; Stasch et al. 1992). With respect to internal sources, suggestion systems have been studied especially as an instrument to utilize employee creativity (Detterfelt and Lovén, E. and Lakemond, N. 2009; van Dijk and van den Ende 2002). However, companies vary greatly with regard to how successful they are in implementing these systems. Van Dijk and van den Ende (2002) argue that some of the critical success factors in establishing suggestion systems are employee motivation, organizational support and resource commitment. Concerning external sources, the role of users as sources or drivers of innovation has recently received a lot of attention (von Hippel 2005), as well as the paradigm of open innovation, which not only recognizes users as sources of ideas but also suppliers, competitors, other companies, universities etc. (Chesbrough 2007). However, incorporating end users in the new product development process raises some interesting challenges. To mention just a few: It is first of all questionable whether users are at all capable of providing companies with ideas that can make a radical difference. Often ideas from users are very incremental in nature (Drejer 2005). Second, issues concerning intellectual property are often raised, especially with respect to open innovation. Third, companies must be able to articulate their needs precisely and quickly come to a consensus (Di Gangi and Wasko 2009). In a study of sources of ideas in engineering design, Salter and Gann (2003) found that engineering designers involved in complex, non-routine design processes rely greatly on face-to-face communication with other engineering designers for solving problems and developing new ideas, even though IT tools are widely provided for communication.

Research on sources of ideas helps us understand where ideas come from. However, we are interested in covering the more socio-technical complexities and processes of how ideas configure and gain momentum in large organizational settings; thus, we now turn our attention to how idea work is related to front-end innovation and new product development in extant literature.

2.4 Early phases of new product development

In the early 1990s, researchers began to focus more on the early phases of the product development process, realizing an unexploited potential for reducing cycle time (Smith and Reinertsen 1998) as well as the front end's critical character for the rest of the process (Rubenstein 1994). Smith and Reinertsen (1998) introduced the term "Fuzzy Front End" about the early phases, and define it as: "the fuzzy zone between when the opportunity is known and when we mount a serious effort on the development project". Idea generation is associated with the front end of innovation and is often illustrated by a light bulb (Cooper 2001) or a funnel (Tidd and Bessant 2009; Ulrich and Eppinger 2003; Wheelwright and Clark 1992). Wheelwright and Clark (1992) argue that it is important to enlarge the mouth of the funnel and gather ideas from a wide range of sources. The narrowing shape of the funnel implies that in the beginning of the idea generation phase, the pool of ideas is large, but with time, clarification is gained and the number of ideas decreases as the least promising ideas are weeded out. Khurana and Rosenthal (1998)

also associate idea generation with the front end and argue: “New product ideas need to generate support before they become formal development projects. Such support comes from establishment and testing of the idea, formulation of plans for its development and justification of its business prospect”. Despite acknowledging that idea generation is not enough but that support of ideas has to be carried out as well, Khurana and Rosenthal tend to black box the actor-centered and organizational processes of idea work. Koen et al. (2002) have tried to open up the black box of idea work and propose a non-sequential relationship between the front-end activities, and argue that ideas are expected to flow, circulate, and iterate between and among all the different activities in their model. An idea can go through much iteration – i.e. be built up, torn down, combined, and reshaped. Koen et al. (2002) argue that often it is not the generation of ideas that is a problem, but rather the selection of them. They further argue that no single selection process can guarantee success, but that many different activities are needed. Although Koen et al. (2002) provide us with more detailed insights on the activities related to idea work that are carried out in the front end than previous scholars, they still retain a normative view and prescribe how things ought to be instead of how things really happen in a large organizational context.

2.5 Informal processes: roles and networks

In the last stream of literature that we review in this paper, focus is on the more informal processes taking place with respect to idea work in organizations, as well as the actors involved. Markham et al. (2010) argue that informal role-taking – such as champion, sponsor and gatekeeper – is critical for innovation, especially to get ideas across ‘The Valley of Death’, which is the ‘space’ between research and new product development. Generally, the champion literature acknowledges that champions are needed to negotiate resources and support as a supplement to the formal systems. Kijkuit and van den Ende (2007) have studied the importance of actors and networks in idea work and elaborate on the champion literature. They propose that an idea is surrounded by a network of employees who discuss it and thereby affect both the quality of the idea and its chances of adoption. Once an opportunity or idea is identified, they argue, it is the social interaction carried out with respect to the idea that determines the idea’s further development and its evaluation. In the initial phase, it would be the idea generator’s personal network that affects the creation of the idea, but with time, the networks can expand to also include other actors in the organization. Both during idea generation and idea development activity, mutual understanding among the network actors is required in order to recognize the value of diverse and complex knowledge, and also in order to actively transfer this complex knowledge. Finally, mutual understanding is mainly important to obtain support from decision makers. Whereas Markham et al. (2010) and Kijkuuit and van den Ende (2007) focus on internal company actors, Legardeur et al. (2010) also consider the role of external actors. Through a case study of a failed innovation, Legardeur et al. (2010) studied the complex dimensions of the collective and social interactions when new concepts and ideas are proposed in the early phases of product development. They found that the innovation process must cross the company’s boundary in order to involve suppliers and partners in the process. Furthermore, they found that a lot of work has to be put into convincing participants and management that a new idea is worth exploring further.

2.6 Identifying our research challenge

Our literature study shows that idea work has been investigated from different perspectives and levels. Our aim in this paper is to reach insights into the socio-technical and organizational aspects of idea work, which means not only addressing the generation of ideas but also subsequent activities, such as the recognition of ideas and their support, development and

maturation. Moreover, we want to understand how ideas are put forward in a large organizational setting and finally turned into a successful product. Thus, building upon the existing literature, we focus on the content and dynamics of ideas and the work with them in a broader organizational product development setting. Based on our case study's socio-technical and organizational perspective, we intend to bring both academics and practitioners an enhanced understanding of how ideas emerge and gain momentum.

3. Research questions and methodology

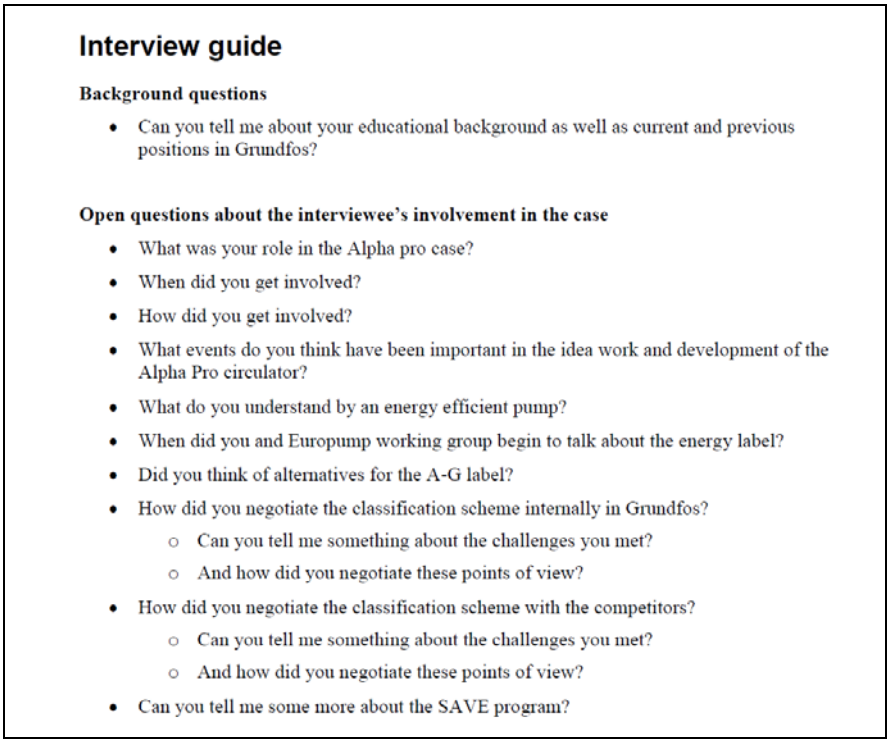
Taking point of departure in the research challenge we identified through the literature study, as well as Grundfos' wish to focus more on the early phases with respect to idea work, we can address our research questions: How do ideas emerge and gain momentum in a large industrial company? And how does idea work relate to front-end innovation activities? We answer these questions through a case study conducted at Grundfos. The findings documented in this paper, and the answers to our research questions, contribute to the literature on idea work in the field of engineering design.

The empirical findings presented in this paper were obtained by using case study methodology (Eisenhardt 1989; Flyvbjerg 2011; Yin 2009). Yin (2009) argues that the case study methodology has a distinct advantage when the research questions posed contain 'how' or 'why' questions. Furthermore, he argues that the case study methodology allows researchers to retain the holistic and meaningful characteristics of real-life events. The present case study is based on a single case with a single unit of investigation: the development of the Alpha Pro circulation pump, also called a circulator. The case study was conducted in Grundfos, a global enterprise that develops and manufactures a wide range of pumps for domestic and industrial uses. With an annual production of more than 16 million pump units, Grundfos is one of the world's leading pump manufacturers. In 2010, the Grundfos group employed more than 16,500 employees, had a net turnover of €2633m, and a profit before taxes of €322m. Grundfos was founded in 1945 and is owned today by a family foundation, which was established as a self-governing institution in 1975.

For the case study, a completed product development project was chosen for investigation with help from Grundfos. The development project and its result, the Alpha Pro circulator, are viewed by Grundfos to be one of the biggest successes in recent years. This case was chosen due to Grundfos' interest in gaining insights for use in future engineering and innovation practices. The case can, according to Yin's (2009) terminology, be characterized as a unique case, because it does not represent a typical development project at Grundfos. It was executed in half the average product development time and incorporated a whole new way of addressing the market.

The empirical data for the case study has primarily been collected through interviews conducted by the first author. Given our limited knowledge about the development of the Alpha Pro circulator prior to the case study, our research was intentionally exploratory. The interview format was semi-structured, allowing the interviewees to describe what they felt was important. Focus was on tracing the history of the work with ideas and the development of the Alpha Pro circulator. A preliminary interview guide was developed. Along the way this interview guide was further developed and refined (Kvale 2009). The questions posed can be divided into three overall categories. The first category consisted of questions concerning the interviewee's educational background, work experience, and current position in Grundfos. The second category consisted of open-ended questions regarding the idea work of Alpha Pro. These questions were continuously adjusted to suit the person being interviewed. New questions were also added if previous interviewees had addressed on their own initiative a relevant subject that needed further

investigation. The last category of questions was intended to clarify organizational facts, such as organizational structures, size of departments, years and sales figures. These questions were not explicitly written down, but asked whenever it was relevant. Fig. 1 shows the interview guide used in the first interview with electronic engineer 2.



Interview guide

Background questions

- Can you tell me about your educational background as well as current and previous positions in Grundfos?

Open questions about the interviewee's involvement in the case

- What was your role in the Alpha pro case?
- When did you get involved?
- How did you get involved?
- What events do you think have been important in the idea work and development of the Alpha Pro circulator?
- What do you understand by an energy efficient pump?
- When did you and Europump working group begin to talk about the energy label?
- Did you think of alternatives for the A-G label?
- How did you negotiate the classification scheme internally in Grundfos?
  - Can you tell me something about the challenges you met?
  - And how did you negotiate these points of view?
- How did you negotiate the classification scheme with the competitors?
  - Can you tell me something about the challenges you met?
  - And how did you negotiate these points of view?
- Can you tell me some more about the SAVE program?

Fig. 1 The interview guide used for the first interview with electronic engineer 2

Our contact person at Grundfos initially helped us identify two key informants, who were interviewed. After these interviews, the remaining interviewees were selected by snowball sampling (Bryman 2001), which means that interviewees were asked to recommend new, relevant interviewees. When the interviewees began to recommend persons who had already been interviewed, we knew we had identified the most central persons. Ten organizational members and two politicians were interviewed. The organizational members were involved in different aspects of the development of the Alpha Pro circulator, or had special knowledge about it and the organization's history. They represented organizational positions in top management, R&D and marketing, and included development engineers, project managers, heads of departments, sales representatives and the CEO. One interviewee was interviewed twice, and another interviewee was interviewed three times, so that the total number of interviews was fifteen. Each interview lasted from 17 minutes to 60 minutes, was audio recorded and then transcribed. The interviews with the organizational members were conducted at Grundfos, either in a meeting room or an office, if the interviewee had his own office. The interviews with the two politicians were carried out over the telephone and in one of the politician's home, respectively. Prior to conducting the interviews an email was sent to the interviewees explaining the aim of the interview.

3.1 Initial analysis and construction of a case narrative

All the interviews were transcribed successively. The transcriptions of the interviews were read several times and coded manually. The aim was to construct a narrative with focus on a

chronological time line identifying the different events and actions carried out by the involved actors. This narrative is presented in section 4 and forms the basis for our analysis and subsequent findings. The construction of the time line was already initiated during the interview process. After the first couple of interviews, a time line was constructed and showed to the interviewees. In this way, the time line became a tool that could be used to organize the interviewees' statements. Overall, seven themes/events were identified in the transcribed interviews.

Table 1 shows the different themes and which interviewees had addressed them. It is striking that many of the interviewees commented on the challenges of the energy label; however, this may indicate the intriguing character of this 'event', since at that time, it was a very different approach in Grundfos.

	Integration of frequency converter	Life Cycle Analysis project	Development of permanent magnet motor	CEO's vision about banning low-efficiency circulators	Challenges concerning energy label	Europump working group	Alpha Pro development project
Interviewees							
R&D							
Head of Motor Department	x		X				
Research Manager	x	x	X	X	x	x	x
Technical Segment Manager		x			x	x	
Senior Engineer							
First interview		x	X	X	x	x	
Second interview		x			x	x	
Electronic Engineer 1		x	X		x		x
Electronic engineer 2							
First interview					x	x	
Second interview					x	x	
Third interview						x	
Project Manager					x	x	x
Marketing							
Segment Director	x		X		x	x	
Sales representative	x		X		x		
Top Management							
CEO				X	x		
Politicians							
Politician A				X	x		
Politician B					x		

Table 1 Interviewees addressing different themes in the interviews

From the many interviews, we were able to create a rich picture of the development process of the Alpha Pro circulator. It was never the intention to use statistical testing to analyze statements from the interviewees, since it is not the sum of the single statements which are of interest but the richness of the picture (Gable 1994) that can be drawn from the many different statements. As Flyvbjerg (2011) argues, in order to understand a phenomenon to any degree of thoroughness, it is necessary to do case studies. To understand the prevalence of a phenomenon, it is necessary to do statistical studies. In addition to the interviews, internal written documentation (only very little still exists), EU and industry reports, popular articles, research articles and several websites were used to gather information about the case. Furthermore, two workshops were held at Grundfos after gathering the case information. This gave the interviewees, as well as other Grundfos staff,

the opportunity to comment and elaborate on the case facts and findings, as well as on the constructed time line of actions and events. In the following, these workshops are referred to as the validation workshops. By applying three different methods to obtain our data – namely interviews, documents and validation workshops – we have sought to validate our data by triangulation.

4. Case: The development of the Alpha Pro circulator

The Alpha Pro circulator is a small circulation pump, installed to circulate hot or cold water in heating systems, utility water systems and cooling and air condition systems in one-family and two- family houses. In the following, we present the case study of the development of the Alpha Pro circulator. Fig. 2 shows the Alpha Pro circulator and the energy label.

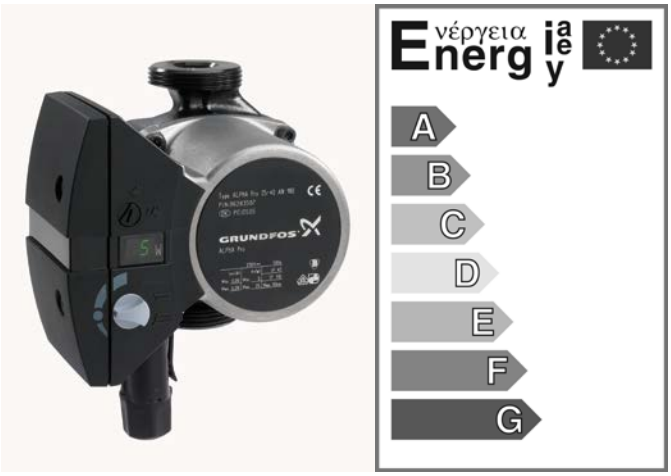


Fig. 2 The "A"-labeled Alpha Pro Circulator and the energy label

4.1 Improving pump efficiency

Improving pump efficiency and quality as well as reducing costs have been on Grundfos' agenda for a long time. A breakthrough that really made a difference came in 1985. An article in Fortune International (Bylinsky 1985) was passed around in the R&D department. *"We were hungry to do something that could, you can say, make the products of Grundfos trendsetting as you call it today. You didn't say that then, but anyway to do something special"* (Head of Motor Department). The article dealt with smart power chips and stated that a new kind of semiconductor chip might be able to reduce energy consumption dramatically by making AC motors 40 percent more efficient. The smart-power chip would allow AC motors to adjust the speed of the motor electronically and hence the amount of electricity consumed. The article evoked excitement. *"We went crazy. It was exactly what we had been waiting for"* (Head of Motor Department). The smart power chip would allow a frequency converter to be integrated into the motor and the pump, making the pump run twice as fast and reducing material costs.

In 1985, CO_2 emission and energy consumption were not an issue that was discussed in international society as it is today. The prevailing argument for investing in this new technology was primarily cost and size reduction, together with the promise of a faster pump. In 1991, the first circulator with an integrated frequency converter was launched by Grundfos.

4.2 Reaching a sustainability mindset

High energy consumption as an environmental issue was not really recognized at Grundfos until they entered a Life Cycle Assessment (LCA) project called UMIP (Development of environmentally friendly industrial products) in 1990-1994. In this context they co-developed a LCA tool with four other Danish companies, the Technical University of Denmark and the Danish Governmental Environment Agency. With the LCA tool, Grundfos was suddenly capable of assessing a pump's environmental impacts throughout its lifetime, and they now realized that disposal was not the only issue to be concerned about. Using the LCA tool showed that a circulator's greatest impact on environment (98 percent of the lifetime energy consumption) was due to its operating phase. This finding gave birth to a new argument for improving pump efficiency: to save energy.

Towards the end of the LCA project in 1993, the Grundfos' Motor Department, inspired by the mindset that grew out of the LCA project, started exploring how to achieve more energy efficient motors. They wanted to create the "*future motor of Grundfos*" (Head of Motor Department). At one point, it appeared that a permanent magnet (PM) motor could be a promising choice for a new motor technology to reduce energy consumption, but due to the technology level of the control algorithms in the middle of the 1990s, there were problems with noise. "*[The CEO] he took a screwdriver and placed it between his skull and the pump [to sense vibrations and noise]. That was what we had to honor"* (electronic engineer). In the Energy Project, as the motor project was called, they did not succeed integrating the PM motor in circulators due to the noise, but the Motor Department realized it could be used in submersible pumps instead, where noise is not an issue since these pumps are placed underground.

Even though Grundfos did not succeed in integrating the PM motor in circulators, they did improve energy efficiency due to other technological optimization efforts, and towards the end of the 1990s Grundfos started to advertise for their low energy consumption circulators; however, despite a marketing campaign on national television, the products did not sell as expected.

4.3 Recognizing new opportunities

On one occasion in 1998, Grundfos' CEO met a Danish EU parliamentarian who told the CEO about the recently implemented Ballast Directive in the EU. This directive banned low efficient starting switches in strip lights, and starting switch manufacturers were required to out-phase the poorest performing switches over a period of time. This conversation inspired the Grundfos CEO to envision an opportunity to ban low efficiency circulators as well, which could lead to a promising market for high efficiency circulators.

At Grundfos, different managers and employees became involved in realizing the vision. But a challenge appeared; this was a political issue rather than a technical problem that had to be solved. A former Danish politician was contacted to act as political consultant. *"It was very much about thinking politics and formulating the goal in a way a politician could understand it"* (Research Manager). At the same time one of the senior engineers was assigned to contact relevant politicians and run lobbyism in Denmark and the EU in order to gain support for the idea to ban low efficiency circulators.

In 1998, many different activities were initiated to mobilize support for the idea of banning low efficiency circulators. Danish politicians were predominately positive toward Grundfos' message, but legislation could not be only a Danish matter, as it involved other EU countries as well.

This effort faced various difficulties, such as different requirements for heating in northern and southern Europe, and varying levels of technological development between the east and the west.

One issue at the time was that circulators were considered components in heating systems and not products on their own, and since heating systems were subject to national legislation, it was not possible to legislate on the EU level. Therefore, the next challenge was to change the status of circulators from components in heating systems to stand-alone products. This challenge was met successfully.

Along the way, Grundfos' political message changed. Instead of aiming to ban low efficiency circulators, they worked to establish an energy-labeling scheme. This reformulation of the vision would also be more attractive for politicians and Grundfos' competitors.

In order to convince politicians, it was important to be able to present facts showing the energy saving potential due to better controlled circulators. During 2000 and 2001, Grundfos conducted a study (SAVE II) showing that circulators are responsible for as much as 15 percent of the electricity consumption in European households. At that time, the average energy efficiency of installed circulators corresponded to energy category "D" or "E". If all circulators were changed to "A"-labeled circulators, the electrical energy saving potential in EU's 25 countries would be 44 TWh per year, with a reduction of 17.6 million tons CO_2 per year.

At this point, it was time for Grundfos to involve their industry association Europump, as this was an issue of interest to the whole industry. In 2001, a working group under Europump was established with representatives from Grundfos and four other European pump manufacturers. The purpose was to develop a classification scheme for circulators with respect to energy consumption. An energy efficiency index was calculated according to an annual energy profile, and a proposal for an EU energy label was designed. The "A" to "G" label for household lamps formed the basis for the design. The index for the label was calibrated so that most of the "non-controlled" circulators on the market at that time would receive a "D" or "E" label. The most energy efficient circulators on the market would receive an "A" label, and the rest of the circulators would fall into the categories in between. The classification project ended in February 2003.

4.4 Product development

Parallel with the energy label work, Grundfos had started a project aimed at refining some of the technologies to be used in an energy efficient circulator, such as the PM motor. In 2004, it was decided to develop a new energy efficient circulator that could be labeled in energy category "A". The development project only took 15 months instead of the normal 30 months or so. Grundfos was aiming to have the product ready for the ISH fair (Internationale Fachmesse für Sanitär und Heizung) in the spring of 2005. The scheme for a voluntary label agreement had been formulated, but no official approval had taken place. Since the end of the classification project, there had not been much activity in the Europump working group. However, when Grundfos realized that it was possible to get a high efficiency circulator ready for the ISH fair, they started to push for the energy label agreement to become official. The Europump working group agreed that the energy label should be presented at the ISH fair in Frankfurt in 2005. The agreement was officially signed the day before the fair started. Grundfos was the only pump manufacturer that had an "A"-labeled circulator ready for the fair.

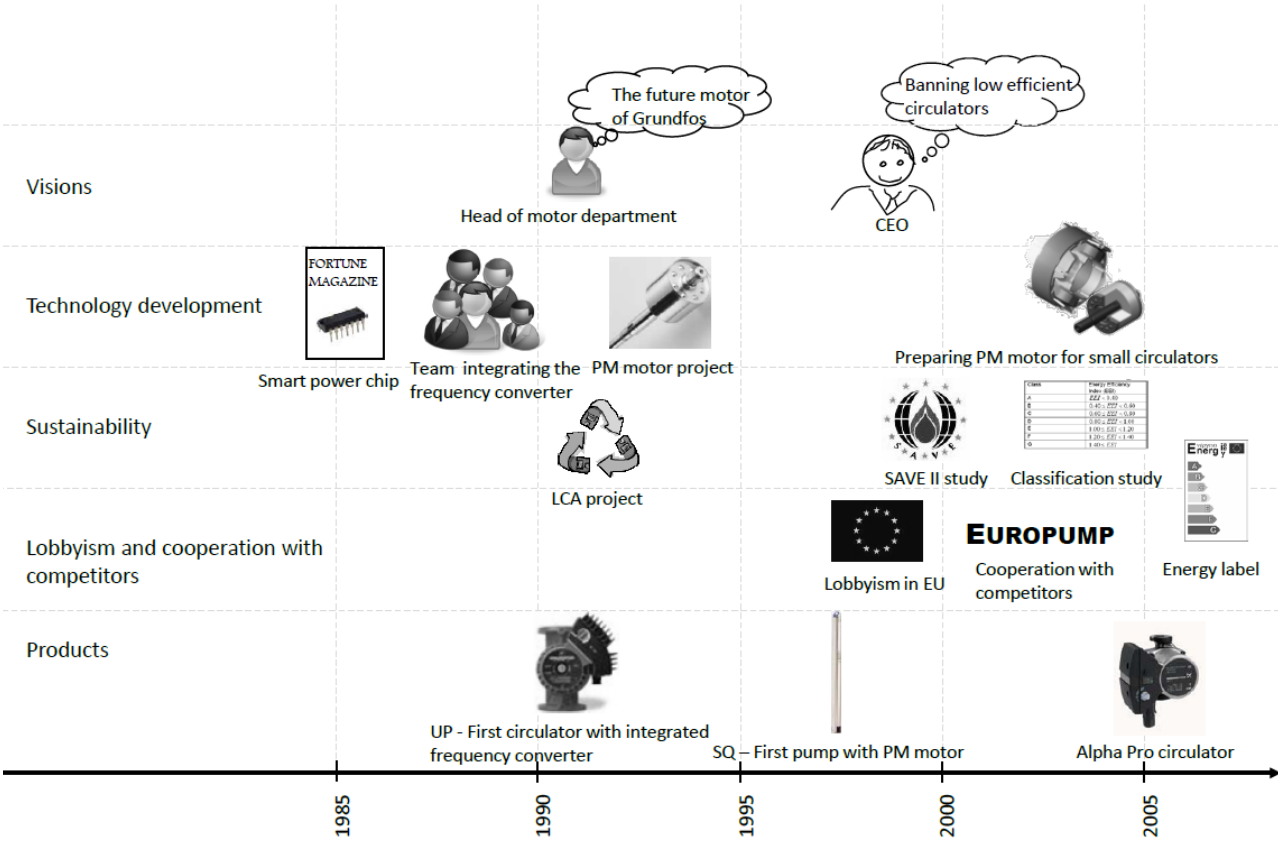


Fig. 3 Timeline of different activities in the idea work for Alpha Pro

The Alpha Pro uses as little as five watts. The good energy performance is achieved through a combination of the technological solutions mentioned previously. First, a permanent magnet motor was chosen to drive the pump. A permanent magnet motor has an inherently higher efficiency than a traditional induction motor, and this effect is stronger the lower the power level. However, the permanent magnet motor requires the use of a frequency converter, i.e. an electronic device to control the motor current. Once the frequency converter is in place, the speed of the motor can be continuously controlled in accordance with the current use profile of the pump. This enables an additional large jump in efficiency. Fig. shows a timeline of many of the different activities in the idea work for Alpha Pro.

5. Descriptive analysis and findings: case-specific characteristics

The point of departure for our case study was to study the content of the idea work that resulted in the Alpha Pro circulator in order to understand the progress and nature of idea work. This soon proved to be a longer journey than expected. If we look at the circulator today, we would probably identify the idea of Alpha Pro as ‘a high energy efficient circulation pump achieving a category “A” energy label’, but none of the twelve interviewees ever identified the idea as such. Every interviewee pointed to a new aspect of the story as important for understanding what kind of knowledge, visions, strategies, values and, not least, ideas lie behind the Alpha Pro. We were brought twenty years back in time from the day it was introduced on the ISH fair. In the following, we present the findings based on our case regarding idea work and its relation to front-

end innovation. We have divided our findings into the following three case observations: 1) ideas are pieced together from previous ideas and results; 2) ideas are carried through by continuous mobilization of support and development of legitimate arguments; and 3) idea work is more than an engineering task.

5.1 Ideas are pieced together from previous ideas and results

Koen et al. (2002) define an idea as: "The most embryonic form of a new product or service. It often consists of a high-level view of the solution envisioned for the problem identified". This analogy of an idea as an embryo is widely used (Boeddrich 2004; Montoya-Weiss and O'Driscoll 2000), and it gives rise to the association that the idea from the beginning contains a plan for its own future, like a DNA code. According to this line of thought, it would be possible to recognize the initial idea – the embryo – in the final product.

Our case shows that an idea does not just have one point of origin, but that it develops from many different pieces of knowledge, ideas, values, strategies and visions, combined over time by actors placed across as well as outside the industrial company. Thus, the Alpha Pro circulator roughly builds on both previous ideas and existing results, such as frequency converter technology; awareness gained through the LCA project of a circulator's energy consumption during its running phase; permanent magnet motor technology; the vision about banning low efficiency circulators, which developed over time into an energy labeling agreement; and a new concept study to refine and integrate existing technologies with new ones, which made it possible to develop the Alpha Pro circulator. So in the Alpha Pro case, it has not been possible for either the interviewees to identify or the researchers to analyze the transcribed interviews to find one embryonic idea that envisions the Alpha Pro circulator from the start.

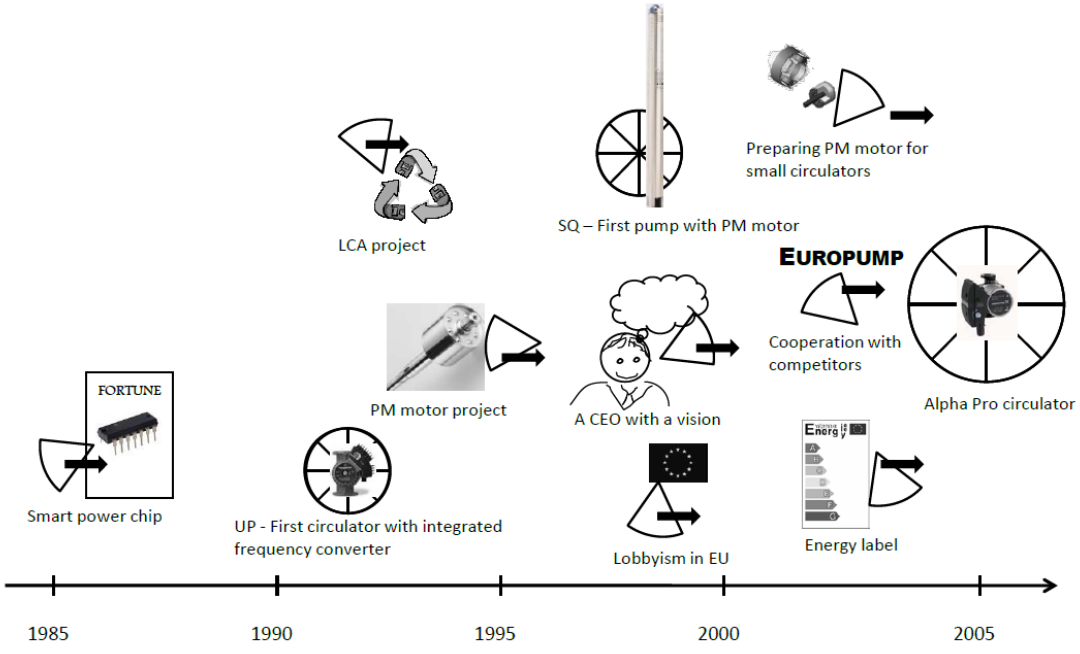


Fig. 4 How different 'idea fragments', existing results and technologies are combined or recombined to make the Alpha Pro circulator. According to this understanding, it is not possible to identify only one original idea

Björk and Magnusson (2009) state that: "Innovation ideas evolve and develop over time and can also be recombined with other ideas over time". Figure 4 illustrates the Alpha Pro circulator's

development from the recombination of previous ideas as well as new ones. The figure is inspired by Hansen and Andreasen (2005), where idea fragments are conceived into a composed whole. However, it is only retrospectively that we can identify the different idea fragments. At the time, when for example the LCA project or the permanent magnet motor project were executed in the beginning of the 1990s, no one could have known that some day the Alpha Pro circulator would benefit from it.

As this first observation shows, new ideas build on existing ideas in combination with the company's existing knowledge base, which is expanded for every new project executed, successful or not. The idea for the Alpha Pro circulator thus emerged as a result of the designers' and managers' awareness to integrate relevant results in a new context. Over the years, Grundfos adds new knowledge to their existing knowledge base through research, developing new technologies and products etc. But it is not only the successful projects that contribute with lessons learned. Failed projects and technologies can also be tapped for valuable insights. Therefore, relevant results do not only concern successful projects but also failed ones. The Alpha Pro case shows that by combining relevant results and envisioning a new context, it was possible to evolve a 'new to the world' product. But this was only possible because different actors at different levels of the organization were aware of the relevance of previous projects and results, and were capable of combining them. Thus, it can be difficult to distinguish idea work from the regular development work that goes on in the company, as the activities can be perceived as both front-end activities and as projects or processes in themselves, depending on when it is you look at them. As one of the participants in the case validation workshop formulated it: *"I have never had an early idea"*. As an example, the permanent magnet motor project was a project in itself in the early 1990s, but later on it became an idea fragment or front-end activity for the Alpha Pro circulator. Therefore, we argue that it is important to acknowledge that Grundfos never starts with a clean slate when developing new products or conceiving new ideas – the past will influence the present and future in one way or another. On the basis of our case and the first observation of how ideas are formed from previous ones and the existing knowledge base, we claim that idea work is not necessarily a one-off activity executed at the beginning of a product development project, as many models propose. In the Alpha Pro case, idea work was an ongoing process due to the continuous awareness and attention managers and engineering designers gave to previous results gained in the organization. Idea work therefore becomes a continuous process, undertaken across different projects, actors, departments, strategies and visions within the company, and sometimes also involving external actors from other companies and organizations.

5.2 Ideas are carried through by continuous mobilization of support and development of legitimate arguments

Our literature study showed that in order for an idea to become an organizational priority, it needs support from a range of actors building both a formal and informal network around the idea (Kijkuit and van den Ende 2007; Markham et al. 2010). Our case confirms that support among a wide range of actors is needed in order for ideas to gain momentum and be implemented; furthermore, we found that this support is gained through developing legitimate arguments. These arguments can change over time and be adjusted so the message corresponds with the world view of targeted persons or positions.

In line with this, the argument for starting the frequency converter project back in the 1980s was that the control unit could be made as small as a sugar cube. This was an intriguing argument for the CEO, who was keen on smart technical solutions. But the fact that pump efficiency could be increased and cause the speed of the pump to double while material costs could be decreased was

also an argument that convinced the CEO and the rest of the management team to invest in electronic control of pumps.

Besides improving quality and saving costs, improving pump efficiency has been one of the main development parameters in the last twenty to thirty years in Grundfos. However, the arguments for improving pump efficiency have changed over time. In the middle of 1980s, energy consumption was not on the agenda. Instead, developers were interested in how fast the pump could run, because when rotation speed is increased, the size of the pump can be decreased and materials saved. The LCA project (1990-1994) changed this attitude so that attention was given to improving efficiency with respect to energy consumption. In accordance with this line of thought, the argument for starting the permanent magnet motor project was to decrease energy consumption during the pump's running phase. The project was supported financially by the Danish Energy Agency, and one of the convincing arguments then was how many power plants could be saved. Later on, in the quest for banning low energy efficient circulators, the argument about saving energy was still valid, but as the world started talking about CO_2 emissions, the wording changed from saving power plants to saving CO_2. This was a frame of reference politicians understood. In the following, we take a closer look at how support was gained in the EU, and how legitimate arguments were developed and reinforced.

When Grundfos began lobbying the EU, it was important to identify central actors and make them interested in Grundfos' cause. This involved participating in conferences, not only concerning energy politics but just to create an opening for a talk. At some point, Grundfos concluded that one of the important actors was the Administrator at the European Commission DG Energy and Transport, in charge of EU regulatory and voluntary programs for the rational use of energy in consumer equipment, buildings and industry. One of Grundfos' main arguments was based on calculations of the potential energy savings in EU countries if all small domestic circulators were changed to circulators that are able to adapt speed automatically to the use profile. Grundfos estimated that there were about 80 million circulators in the EU. The Administrator did not believe this, and Grundfos left the meeting with him empty handed. But a few days later, the Administrator contacted Grundfos' Senior Engineer; he had just investigated his own house, found four circulators and became convinced.

At this point, Grundfos had mobilized so much support in the EU that EU initialized an official project, the SAVE-II study, for the purpose of calculating potential energy savings. Grundfos became project leader and conducted the project in collaboration with a university and a private consultancy firm. This study reinforced Grundfos' argument and made it even more legitimate, because it now had EU's seal of approval.

It was also important to mobilize support among competitors. Relatively early in the process Grundfos changed their vision from banning low efficiency circulators to making a labeling agreement, as this message was more engaging. At some point, they framed it as a voluntarily agreement, both because the process in the EU would then be faster and less bureaucratic, and also because it made it easier for some of the competitors to accept.

The activities reported above only represent a fraction of the many activities executed during the seven years (1998-2005) it took to establish the energy label, but they indicate how important it is to identify relevant actors (e.g. actors who can spread the idea and help build momentum, or make decisions about implementation), create contact with them and gain their support. Support is mobilized by using legitimate arguments – and in this sense, legitimate means that the arguments are rooted in rational explanations (like calculation of potential CO_2 reductions in Europe), and also that the arguments point to or relate to the frame of reference of the identified relevant actor. For example, politicians would like to be associated with positive cases, and

framing the idea about banning low efficiency circulators as a sustainable solution to reducing CO_2 is much more positive and easy to support than if Grundfos had argued that they could increase their market share because they were able to produce high efficiency circulators.

5.3 Idea work is more than an engineering task

Hansen and Andreasen (2005) have examined the literature concerning the content of product ideas, and they argue that a product idea can be described according to eight different dimensions: strategy, technology, product, task, goal specification, user/customer, need, and business. These different dimensions not only tell us something about the content of ideas or where ideas can originate; they also indicate what kind of work should be done or what aspects should be considered in order to materialize ideas into successful products. Product success and performance have been investigated in many empirical studies. Montoya-Weiss and Calantone (1994) have gathered some of these studies and conclude that product performance involves some combination of strategic, development process, organizational, and/or market environment factors. Our case supports and exemplifies how these different factors and dimensions play a role in the constitution of a product.

Our first observation showed that ideas are pieced together from previous ideas and results and that these previous ideas and results had many different origins. In Grundfos, they have a strong technological basis. For years, they have searched for new technologies and continued refining their existing ones. They have been trendsetting in integrating technologies into products. Their former slogan: *'Leaders in pump technology'* also indicates this, but although many of the elements in the Alpha Pro circulator are technological – the frequency converter, the PM motor, the control algorithms – and thus came to life through engineering processes, many of the elements that the Alpha Pro builds on are non-technical. The LCA project in itself was of course technical, as it was about developing a computer program for assessing environmental impacts, but the thoughts behind the project were rooted in a wish to understand more about products' environmental impacts and had a broader potential than just optimizing products with respect to environmental issues. The project also sent a signal to Grundfos' surroundings and helped lay the ground for the green policy Grundfos pursues today.

Work with the labeling agreement also had some technical elements – e.g. the design and calculation of the energy index – but most of the work was non-technical in that it involved gaining people's support and changing EU legislation, a task requiring other skills than technical ones. As Grundfos' research manager pointed out in an interview: it was a political and not a technical task. Negotiation skills also had to be used inside Grundfos, because if the new motor technology were to be implemented, it would mean new investments in production equipment.

To spot the opportunity or come up with the vision to ban low efficiency circulators and thus create a whole new market for high efficiency circulators is not something that can be engineered. So all in all, many of the processes going on in idea work and product development exceed the task of engineering, even though it plays an important part.

6. Discussion: Towards a new understanding of idea work

Based on the observations outlined in section 5, we now elaborate on how idea work can be understood and addressed.

Idea work has traditionally been associated with front-end innovation, as our literature study shows. Current front-end literature (Khurana and Rosenthal 1998; Koen et al. 2002; Smith and Reinertsen 1998) does not explicitly consider how earlier projects and ideas relate to a current

front-end process; instead, they focus on the front-end process as a pre-project activity, and ideas are addressed for specific projects.

Based on our first observation – that ideas are pieced together from previous ideas and results – we suggest that idea work cannot only be associated with front-end activities or activities carried out prior to the NPD process. Idea work should be perceived as an ongoing process that is independent of any specific development project being carried out. Idea work cannot only be confined to ideas directed toward a specific goal. Goals shift as ideas develop and contexts change. When we examine the different idea fragments or projects that led to the Alpha Pro circulator, we can see that these idea fragments were not only directed toward one goal, or at least that goals and arguments changed. Take for example the integration of the frequency converter. This was not only used in circulators but also in pumps and motors for industrial use, and it created a trend in the whole pump industry. The insights gained from the LCA project were not intentionally developed for the Alpha Pro circulator either, but were important stepping stones on the way. Thus, the ideas for the Alpha Pro circulator did not point directly at that specific product, but in many directions for many different products and technologies. In this way, options were kept open and could be used in other contexts later on.

The implication of our first observation is that idea work should be addressed and catered for independently of its potential front-end relevance. In this respect, the front end is potentially a misleading notion in relation to idea work, because if companies only focus on front-end activities or ideation sessions, they can miss other promising opportunities – for example, the organization's members working in different contexts and trying to apply failed technologies, previously rejected or forgotten ideas and other results to new problems, or recombining them in new contexts. In other words, it is important that engineering designers are aware that existing 'elements' in the organization can potentially be recombined or used in new contexts, and it is important that management is willing to risk work with ideas even though it is not confined to a specific goal. Furthermore, both designers and management have to be alert to the fact that promising ideas can come from many different directions and layers in the organization and from unexpected actors.

Existing literature shows that creativity and creative methods are a central element in developing new ideas, but idea work requires more than a creative act. In order for ideas to gain momentum in an organizational setting, support is needed from a wide range of actors, and legitimate arguments have to be constructed in order to convince relevant idea carriers and decision makers, as our second observation shows. Whether development activities are run formally on management's initiative or more informally, driven by employees, it is important for companies to recognize that a central aspect of idea work is that ideas have to be 'sold' to many different actors in order to gain momentum, and that these actors apply different frames of reference, depending on their educational background, organizational affiliation and general beliefs. The implication of this observation is that idea champions have to be aware of how they persuade relevant actors and develop their argumentation. They need to make the idea relevant for those whose support they seek, and this can be done by appealing to their frame of reference with legitimate arguments.

Our third observation highlights the fact that idea work comprises more than the task of engineering. Being visionary, possessing negotiation skills, spotting opportunities, making risky investments etc. are also elements in idea work. Or as formulated in the final report for the strategic plan for engineering design in 2030 (Shah et al. 2004): "Understanding the social aspects of engineering design, which underline these socio-technical interactions is, therefore, critical in future design research". Here, it is important to note that these different elements are

not catered for by one person alone, but are distributed among several actors in the organization, idea work is cross-functional, cross-organizational and sometimes also inter-organizational. The implication of our third observation is thus that it is important for management to recognize the breadth of idea work, and that many diverse elements have to be managed in order to gain success. Furthermore, managers should also be aware of how to utilize employees' various skills and backgrounds, since such diversity is needed in idea work.

In the design methodology literature, we find several authors proposing structured approaches and inventing tools and methods for organizing and supporting various engineering design activities, although with varied success (Killander 2001; Lopez-Mesa and Bylund 2011). In relation to idea work, especially idea and concept generation has been addressed (Howard et al. 2010; Mak and Shu 2008; Mulet and Vidal 2008). And more integrative idea lifecycle management tools have also been proposed (Legardeur et al. 2010). However, our case study of the development of the Alpha Pro circulator seems to suggest that implementing a computer-based knowledge or idea management system is not a proper solution for Grundfos. The idea work and its elements (technical solutions, visions, and legitimate arguments) are too complex and seem to develop in a much more interactive process of meetings and dialogue, both internally in the company and also with external actors and in external settings. Instead, we argue that the implications listed above indicate that managers and engineering designers should be trained in and stimulated by a mindset of idea work.

6.1 Limitations

Although our qualitative research method has helped to reveal some interesting findings, the case study method also has its limitations. First of all, we only examined one case in one company, which makes it difficult to generalize the results. It could therefore be relevant to perform more case studies, both inside Grundfos as well as in other companies. Grundfos has found the study very interesting, however, and relevant for their internal learning process. A second limitation of the study is that information and interviews were conducted after the Alpha Pro circulator was developed. The drawback associated with this approach is that potentially relevant actors had left the organization, and those remaining may have forgotten certain details or remembered some aspects or years incorrectly. The fact that fifteen interviews were conducted with thirteen different interview persons, however, lowers the risk of misinformation, since information has been cross-checked between the different interviewees and through two validation workshops. Furthermore, the first author has conducted several other interviews in the company for other purposes, in which details about the Alpha Pro circulator were mentioned and thereby further confirmed the case story.

7. Conclusion

Initially, we asked ourselves how work with ideas is actually carried out in an industrial product development setting. Through our case study about the Alpha Pro circulator developed by Grundfos, we studied how ideas emerge and gain momentum, as well as how idea work relates to front-end innovation activities.

Our first observation showed that it can be hard to identify a specific idea for a new product, since ideas are pieced together from previous ideas and results in the organization and thereby have several different origins. Thus, ideas emerge as a result of the continuous work an organization's staff carries out, recombining existing and new elements in new contexts.

Our second observation showed that in order for ideas to gain momentum both inside as well as outside the organization, ideas need support from many different actors. This support is gained by using legitimate arguments that refer to the frame of reference of the implicated actors.

Our third observation showed that even though engineering processes are an important part of idea work, social dimensions such as spotting opportunities, developing non-technical issues and negotiating and formulating visions are equally important.

The point of departure for our case study was Grundfos' interest in knowing more about how idea work is carried out in the early phases of the innovation process, because they found it hard to further improve their NPD process. The assumption that lies in this wish is that idea work is associated with front-end innovation activities, as the innovation management literature also suggests. Therefore, this was also our point of departure as researchers, before conducting the case study. However, we found that work with ideas cannot be confined to the front-end activities in the case of Alpha Pro, since idea work is more than a one-off activity executed in the beginning phase of the NPD project. It is an ongoing process, due to the continuous awareness and attention managers and designers give to previous results gained in the organization.

In this paper, we have presented some of the implications of our study, but to further support idea work in large industrial company more research is needed. Accordingly, it would be relevant to examine further the strategies an organization's members use to gain support for their ideas, and why some ideas are perceived as good while others are initially rejected.

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Research paper 2

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Framing ideas in the making

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Framing ideas in the making

ABSTRACT:

Research and recommendations regarding work with innovative ideas in industrial settings have predominantly treated ideas as rather stable 'black boxes' amenable to being harvested and selected for industrial implementation. This paper contributes a new understanding of work with ideas in innovative processes, and seeks to expand our understanding of how a product concept is constituted and synthesised through organisational members' socio-material interaction and engagement in idea work. The paper engages the notion of technological frames in a political process perspective, and contributes an in-depth longitudinal case study of the industrial development process behind the energy saving Alpha Pro circulator launched by the Danish pump manufacturer Grundfos. Based on an analysis of how organisational players engage in the controversial and shifting understandings of what seems to constitute a successful product, the paper offers a new perspective on navigating the players' ideas in the political processes of innovation. It suggests that navigation of technological frames may be offered as a new perspective to make explicit the implicated actors' belief systems and world views, including what they perceive as relevant problems and related strategies for solving them.

Keywords: idea work, framing, technological frames, political process

Introduction

Ideas are the malleable 'stuff' which designers, engineers and business developers mould in order to create new products, services and business for their organisations. In the innovation and product development literature, the general perception is that ideas are the starting point of innovation activities (Wheelwright and Clark 1992; Cooper 2001; Tidd and Bessant 2009). Although there are various philosophies about how to manage work with ideas, both the existing definitions of ideas in the literature and many of the innovation and product development models prescribing the evolvement of ideas have a tendency to 'black box' the content as well as the contextual aspects of ideas, and thereby, the processes in which they are actually created and moulded over time. This way of thinking is illustrated by Stevens and Burley (1997) with their claim that 3,000 raw ideas are needed for one commercial success. This is a common philosophy embedded in many researchers' and companies' approaches to idea management. According to this philosophy, quantity is the key success criteria for an idea management system – "quantity yields quality" (Yang 2009). Moreover, the philosophy underpins the understanding of ideas as fixed entities with intrinsic qualities that are just waiting to be harvested. Consequently, several attempts can be found in literature to define what an idea is. A typical definition is found in Riedl et al. (2009), where an idea is defined as "…an explicit description of an invention or problem solution with the intention of implementation as a new or improved product, service or process within an organisation". This definition underlines the fixation and objectification of an idea and downplays the more visionary and evolutionary aspects. The risk associated with black-boxing ideas and its associated processes is that we lack the necessary insight to understand how content and outcome are constituted and what actions and interactions are required. This has implications for both the managers who organise and manage these processes and the designers who engage in the specific idea work, and indeed for the interaction between them.

Scholars who have produced the front-end innovation literature have tried to anticipate the problem of black boxing the early phases of the innovation process by focusing their attention on

how to approach these ‘fuzzy’ activities. Accordingly, Koen et al. (2002), with their New Concept Development model, give an account of what kind of analyses and activities have to be taken into consideration when maturing ideas into concepts. This is a normative model, however, which prescribes what to do and not how things actually develop in an organisational context. This critique is not new, and scholars within the Minnesota Innovation Research Program (MIRP) have previously pointed out that existing innovation process models are too normative and lack empirical evidence (Schroeder et al. 2000; Van de Ven et al. 2008). Based on an impressive body of longitudinal studies, both Schroeder et al. (2000) and Van de Ven et al. (2008) have tried to reach a new understanding of how innovation processes really take place. Among other things, they observed that an initial idea tends to proliferate into several ideas during the innovation process: that in managing an innovation effort, unpredictable setbacks and surprises are inevitable; and as an innovation develops, the old and new exist concurrently and over time they are linked together. However, although valuable insights have been gained about idea work, we lack insights into how the organisational micro-processes of idea work take place in a complex web of interactions while ideas are being created and moulded over time.

In order to capture, unfold and understand these processes of idea work, I have sought inspiration in the field of Science and Technology Studies (STS). Latour (1987) argues that in order to understand technology, we have to open up the ‘black box’ and get inside in order to follow actors as they engage in the making of technology. Scholars within the STS-field, such as Latour (1987), Callon (1986), Grint and Woolgar (1997) and Pinch and Bijker (1987), are known for seeking to open up the black box of technology. Woolgar (2004) even proposes an understanding of ideas through his constitutive perspective: “ideas are constituted in and through the processes of their articulation and representation”. Pinch and Bijker (1987) and Bijker (1995) propose the theory of Social Construction of Technology (SCOT), which is concerned with the constitutive interpretative processes and consensus building among social groups when new technologies are developed. In the context of the present article, especially their concept of technological frames offers a framework for understanding how various actors and groups interact and attribute meaning to a technology throughout a socio-material process of flexible interpretation and negotiation. This framework thus has the potential to open up the processes of idea work.

The research question sought to be answered in this article is: How can we open up the black box of idea work in order to better understand the interactions between diverse actors and perspectives that lead to a viable product concept? To answer this question, I analyse the development of the Alpha Pro circulation pump as a case study of idea work in an organisational setting. In 2005, Grundfos launched the energy labelled circulation pump, Alpha Pro. The actual development project (from concept to product) took only about fifteen months, but the idea work that finally led to the “A” labelled Alpha Pro pump took almost twenty years. The Alpha Pro circulator is the outcome of several years of work involving technological trial-and-error attempts with varying success to understand and involve users; experiments in order to understand how sustainability could be incorporated in product development; negotiations between knowledge domains and power positions; and competing framing of ideas. And these efforts were all combined under the influence of a visionary CEO.

Besides offering insights into how the organisational micro-processes of idea work take place in a complex web of interactions while ideas are being created and moulded over time, the present study brings insight from technology studies into the field of idea work. Typically, idea work has been addressed by scholars within engineering design and innovation management, but it has failed to open up the content of work with ideas while engaging a socio-material and political process approach.

The article is structured as follows: First, I present a body of literature that draws on framing theories. Then, the research method for conducting the case study is presented. Hereafter, the

empirical findings are presented and analyzed, and then I discuss my findings and propose implications. Finally, I present my conclusions.

Frames and framing – theories to open up idea work

In the following, I present a body of theories within the field of frames and framing in order to analyse the micro-processes of idea work in an organisational setting. The concepts of frames and framing have been applied in a wide range of theoretical disciplines. Here, I draw on research traditions in Science and Technology Studies (Pinch and Bijker 1987; Bijker 1995), organisation studies (Orlikowski and Gash 1994), the political process perspective (Mcloughlin, Badham and Couchman 2000; Buchanan 2008) and sociology (Snow et al. 1986; Benford and Snow 2000).

Frames

The term frame is applied to understand how actors attribute and negotiate meaning in relation to objects and events, as well as how they act and interact with other actors: "By rendering events or occurrences meaningful, frames function to organise and guide action, whether individual or collective" (Snow et al. 1986). Pinch and Bijker (1987), Bijker (1995), Orlikowski and Gash (1994) and Mcloughlin et al. (2000) use the term technological frames to denote collective frames that concern the interpretation, development and use of technologies.

Pinch and Bijker (1987) were the first to suggest the concept of technological frames. They apply the term to understand and analyse how a dominant design within technologies or artefacts occurs. According to Pinch and Bijker (1987) and Bijker (1995), a technological frame is not only applied by engineers but also by users and non-users of a technology. They emphasise that technological frames are not an individual characteristic but rather something located between actors that structures their interaction and also the outcomes of the interaction. Technological frames thus emerge when interaction related to an artefact begins. A technological frame comprises the concepts and techniques a community employs in its problem-solving – e.g. goals, key problems, problem-solving strategies, tacit knowledge, testing procedures, engineering or use practices etc. Pinch and Bijker (1987) and Bijker (1995) focus especially on socio-materiality and interaction among actors, aspects that are both important when we want to understand how designers interact in relation to ideas and product concepts.

The concept of technological frames is also taken up in a political process perspective. Orlikowski and Gash's (1994) conception of technological frames is in many ways consistent with Pinch and Bijker's (1987) and Bijker's (1995) conception, although they employ technological frames to understand how technological development, use and change happening in organisations. Orlikowski and Gash (1994) suggest that different groups within an organisation may have different technological frames. Buchanan and Badham (2008) are inspired by Orlikowski and Gash (1994), but they use the term innovation frames. They argue that these frames include ideas of best practice, efficient production methods, and paths of innovation that are perceived to be novel, feasible and valuable. The latter aspects are especially concerned with idea work. McLoughlin et al. (2000) use the term technological frames to gain a better understanding of the relationship between technology and organisation, as the political process perspective has previously focused more on the human and organisational dimensions of technological change than on the technology, thus often black boxing, technology.

Pinch and Bijker (1987) and Bijker (1995) argue that actors can have different degrees of inclusion in a technological frame. And actors are often included in more than one frame at the time. When it comes to understanding how actors come to agree on key issues or how new actors can be included in existing frames, Pinch and Bijker (1987) and Bijker (1995) are not very explicit. However, Snow et al.'s (1986) four strategies for alignment can be helpful here. Benford

and Snow (2000) also discuss alignment processes, i.e. aligning collective frames with individual's interest and belief systems in connection with key elements. They suggest that the success of the alignment process depends on how well a collective frame resonates with the targeted actors' own beliefs. Snow et al.'s (1986) strategies for alignment are: frame bridging, frame amplification, frame extension and frame transformation. Frame bridging refers to the linking of two or more ideologically congruent but structurally unconnected frames regarding a particular issue or problem. Frame amplification involves the clarification of a frame concerning a particular issue, problem or set of events. Frame extension involves the collective having to extend the boundaries of its primary framework so as to encompass interests that are incidental to its primary objectives but of considerable importance to potential adherents. And frame transformation refers to changing old understandings and meanings and generating new ones, a process that can also be labelled reframing. Whereas Pinch and Bijker (1987) and Bijker (1995) examine the interactions and negotiation processes between two or more social groups, Snow et al. (1986) and Benford and Snow (2000) examine the negotiation processes between a collective and individuals. Snow et al. and Benford and Snow help us understand the operational processes of aligning technological frames.

Orlikowski and Gash (1994) also examine how alignment between technological frames is achieved, although they denote it as congruence. They suggest that where incongruent technological frames exist, organisations are likely to experience difficulties and conflicts in connection with developing, implementing and using technologies. McLoughlin et al. (2000) use the term 'dominant' technological frames to refer to a relative degree of congruence within a frame.

To summarise, I use the term technological frame to denote how different collectives within the Grundfos organisation, as well as outside it, attribute and negotiate meaning in connection with problems, solutions, ideas, technologies and events, as well as how they act and interact with each other.

Framing

The term framing is applied to denote the activity of framing a subject such as a problem, an idea or a technological artefact. When a subject is framed, certain aspects of that subject are highlighted in a compelling way, which is associated with the framer's own technological frame. Although they do not use the term framing explicitly, Pinch and Bijker (1987) and Bijker (1995) propose a model for understanding how technological artefacts are developed. A relevant social group is a notion they use to denote a collective that is concerned with a specific technological artefact. Since more social groups can be engaged with the concerned technological artefact, Pinch and Bijker (1987) are especially interested in the problems each group has with respect to the artefact. For each problem, several solutions can be proposed. The different problems and the appertaining solutions can be framed in a certain way. Bijker (1995) calls this interpretive flexibility and uses the example of the bicycle to support his point. Before a dominant bicycle design was reached, different designs were offered but framed in different ways, such as 'the *macho* machine', 'the *safe* machine' and 'the *unsafe* machine'. These solutions were appealing to different social groups. Framing can accordingly be consciously applied in order to negotiate support for a particular idea. However, Pinch and Bijker are not explicit about how framing can be used as navigation, or as a deliberate political process, which is relevant when discussing organisational contexts.

Benford and Snow (2000) propose three core framing tasks: diagnostic framing, prognostic framing and motivational framing. Diagnostic framing refers to the identification of a problem as collective experience. Prognostic framing involves the articulation of a proposed solution to the identified problem, which could be a plan for how to deal with the problem and strategies for

carrying out the plan. And motivational framing provides a rationale for engaging outsiders in collective action. This category of framing tasks helps nuance the repertoire that actors can draw on when they frame subjects.
To summarise, I apply framing to identify how different social groups render significance to problems and present solutions in compelling ways in order to gain support. The term re-framing is applied when a collective changes the framing of a subject, e.g. changes old understandings and meanings attributed to the subject by generating new ones.

Methodology

Yin (2009) argues that case study methodology is especially suited when posing 'how' and 'why' research questions. Moreover, he argues that case study methodology allows us to retain the holistic and meaningful characteristics of real-life events. The present case study is conducted at Grundfos, a global enterprise that develops and manufactures a wide range of pumps for domestic and industrial uses. Grundfos is today one of the world's leading pump manufacturers, with an annual production of more than 16 million pump units. In 2010, the Grundfos group employed more than 16,500 employees, had a net turnover of €2633m, and profit before taxes of €322m.
The case study is based on a single case with a single unit of investigation: the development of the Alpha Pro circulator. For the case study, interviews have primarily been conducted. Initially, two interviewees were pointed out by a representative from Grundfos. Hereafter, the other interviewees were selected by snowball sampling (Bryman 2001), which means that interviewees were asked to recommend new, relevant persons to interview. When the interviewees began to recommend persons who had already been interviewed, it was apparent that we had identified the most central persons in the case. For the case study, fifteen qualitative and semi-structured interviews (Kvale 2009) were conducted. Each interview lasted from 17 to 60 minutes, giving an average of 40 minutes. All the interviews were audio recorded and subsequently transcribed. Ten organisational members and two politicians were interviewed. Two of the organisational members were interviewed two and three times respectively.
Focus in the interviews was on tracing the history of the work with ideas and the development of the Alpha Pro circulator. For the interview situation, an interview guide was developed with two explicit categories of questions: 1) questions concerning the interviewee's educational background, work experience and current position; 2) questions concerning the interviewee's role in and view of the case. These questions were primarily open-ended questions. When needed, clarifying questions were posed. In the process, the interview guide was further developed and adapted to the individual interview situation (Kvale 2009). Due to the semi-structured interview format and open-ended questions, emphasis in the interview situation was on letting the interviewees describe what they felt was important with respect to the case in question.
For the analysis of the case, the interview transcriptions have been studied closely. The first readings helped construct a timeline of the events and development of the Alpha Pro circulator and from this a case narrative. The next readings were done with a frame perspective in mind. The interviews were coded manually in accordance with the frame perspective introduced previously. In addition to the interviews, internal written documentation, observation and access to relevant databases were used to gather information about the case. Furthermore, two workshops in relation to the Alpha Pro case were held at Grundfos after gathering the case information. These workshops were used to validate the interviewee's statements and my representation and linking of events. The workshop participants included the interviewees as well as other members of the organisation interested in the case.
Kaplan and Tripsas (2008) argue that "the most problematic aspect of studying technological frames is the risk of retrospective reconstruction". In this regard, a limitation of this study is that

information and interviews were conducted after the Alpha Pro circulator was developed. The drawback associated with this approach is that potentially relevant actors had left the organisation, and those remaining may have forgotten certain details or remembered some aspects or years incorrectly, or more calculatingly chosen to create narratives that portray certain actions in a certain light. This risk was reduced, however, by the fact that two validation workshops were held where facts and findings were presented and the participants had the chance to freely comment on the case.

The case

The Alpha Pro circulator is a small circulation pump, installed to circulate hot or cold water in heating systems, utility water systems and cooling and air condition systems in one-family and two-family houses. The particular feature of the Alpha Pro circulator is that it uses as little as five watts, which is a large jump in efficiency performance compared to previous pumps as well as competitors' products at that time. Furthermore, it was the first circulator ever on the market to achieve an energy label in category "A" – the best category. Similar energy labels are known from the white goods industry. The circulator was launched in 2005. From the time the concept was clarified, it only took about fifteen months to develop the circulator; however, the idea work leading to the concept took almost twenty years. Improving pump efficiency has been on the Grundfos agenda for a long time. Introducing the smart power chip made a significant difference for Grundfos, as at the end of the 1980s it allowed integration of a frequency converter into the motor and pump. The integrated frequency converter made it possible to continuously control the speed of the motor in accordance with the pump's current use profile. The development of a permanent magnet motor during the mid-1990s seemed to be a promising choice to increase pump efficiency even further. It was difficult, however, to convince the users to pay more for the increased efficiency of the pump; so several marketing campaigns were launched, but unfortunately without result. It was therefore a turning point, at the end of the 1990s, when the CEO at the time envisioned making more eco-friendly products. He therefore wanted a ban on low- efficiency circulators. This initiated years of lobbying at the EU, which in the mid-2000s resulted in the establishment of a voluntary European energy label agreement in the pump industry. Integration of the permanent magnet motor was a precondition for developing a circulator that could accommodate the energy efficiency requirements of an "A"-label in the energy label agreement, but this had not been possible in the mid-1990s. Therefore, a concept study was initiated at the beginning of 2000 in order to develop and integrate the various technologies needed in a circulator. Finally, the Alpha Pro circulator was developed and launched in 2005, together with the energy label agreement.

Analysis: Unfolding idea work

In the following, I illustrate with case examples how idea work involves negotiations, developing support, definition and redefinition of problems, and sometimes even political controversies. Furthermore, I illustrate how the concept of technological frames can help open up idea work, and illustrate its importance and content. The analysis is divided into two main sections: Framing technology, and framing market and users.

Framing technology

Integration of the frequency converter

In 1985, the Motor Department recognised the opportunity to improve pump efficiency by integrating a frequency converter into the motor and the pump by using smart power chips. The argument that prevailed and convinced management was that the pump could be made to run twice as fast and the pump size and material costs could be reduced: *"That was the argument we offered management; all the steel you could save by building the frequency converter into the pump and motor. And then run twice as fast as normally when using the electricity network" (Head of Motor Department).* This argument appealed especially to a management team with high inclusion in a technological frame where saving costs by optimising manufacturing processes was viewed as the main challenge. *"At that time, stainless steel would cost as much as a working hour. Today, it is much cheaper" (Engineer 1).* During the 1960s, 1970s and 1980s, Grundfos had developed a capability for high-quality mass production. An undertaking to which the founder of Grundfos was strongly dedicated (Christensen 2002). This undertaking had therefore also had a strong impact on what was viewed as proper problems and proper solutions in the technological frame of the management team. This frame can be labelled the cost frame. *"We tried to explain to the management what it was all about, if it worked. And they gave us their support" (Head of Motor Department).* The Motor Department succeeded in gaining support from management, because they understood how to frame their idea in such a way that the management team found it compelling. The reason for this was that the Motor Department also had some degree of inclusion in the cost frame: *"At that time, when we developed motors, it just had to be as inexpensive as possible. […] The price, the cost – the production costs – was one of the main drivers" (Engineer 4).* This case example shows that an important part of idea work is for actors to gain support for their ideas. Framing ideas in a way the receiver finds compelling increases the chances of support. When actors have high inclusion in the same frame, it is more likely that agreement can be achieved.

Developing the permanent magnet motor

In 1992, when the Motor Department wanted to find *"the future Grundfos motor" (Head of Motor Department),* a permanent magnet motor emerged as a promising choice. Improving pump efficiency was still viewed as one of the main technological challenges that had to be solved in pump development, and a permanent magnet motor had an inherently higher efficiency than a traditional induction motor. *"At the outset, we knew exactly what we had to achieve on the technological front in order to deliver a more energy efficient circulator. We had to develop an electronic motor control and a new motor based on permanent magnetisation" (Electronic engineer).* Previously, the argumentation had been informed by the cost frame and thus evolved around cost reductions from improving energy efficiency through integrating the frequency converter into the pump, but then a new argument came on the agenda with introduction of the idea about a permanent magnet motor – namely, that energy or electricity could be saved. The project was called the 'Energy Project', which rhetorically underpins the framing even further. The project was partly funded by the Danish Energy Agency: *"We went to the Danish Energy Agency and presented our case. We said 'so' and 'so' and we can save 'so' many power plants. We sold the idea because it would provide energy savings, and it was incredible what energy we calculated could be saved with all the pumps running" (Head of Motor Department).* The Danish Energy Agency was convinced, as they were also included in the same 'saving energy' frame; however, other challenges emerged internally at Grundfos.

In order to develop a functional permanent magnet motor, a range of different technologies had to be developed and integrated, such as effect electronics, NdFeB magnets and adaptive control.

These activities were carried out in a collaboration between the Motor Department, the Electronics Department and the Electronics Factory. However, it was not possible to develop the motor without interfering with other technological domains, such as mechanical engineering and hydraulics. *"We had to mess with the hydraulics and the rotor diameter. But we quickly learned that Grundfos was standing there with a new top-tuned manufacturing assembly representing an investment of around one billion DKR (present value)" (Electronic engineer).* The manufacturing assembly produced circulators, a core business at Grundfos also at that time. Messing with the hydraulic system meant that both the rotor diameter and rotation speed had to be altered in order to fit the adaptive control. These changes would also mean changes in the manufacturing process and thus the manufacturing equipment. *"So there was not a strong interest in messing with the hydraulics" (Electronic engineer).* The Electronics domain[1] never succeeded in convincing the technological domains of hydraulics and mechanical engineering or the production site to alter the rotor diameter. *"It ended in power struggles" (Electronic engineer).* Framing the idea of introducing a permanent magnet motor as a question of saving energy was not congruent with the dominant technological frame of the persons who had to be convinced. *"That was the attitude: are you raving mad? Are you out of your mind? It won't work, there is not money for it, and nobody wants to pay for it" (Senior engineer).* The main concern for the production site was still optimisation of manufacturing processes and cost reductions. And altering a rotor diameter and hence a highly efficient manufacturing line was neither in their interest nor the solution to what they perceived as their main challenge.

To sum up, the Electronics domain's idea about developing a high-efficiency motor technology informed by the 'saving energy' frame clashed with the established understandings of the production site's cost frame. In this sense, the Electronic domain never succeeded in framing their idea in a compelling way. And because the 'saving energy' frame and the cost frame were as diverse and incongruent as they were, interactions among the actors seemed to be in conflict (Orlikowski and Gash 1994). This case example shows that an essential part of idea work is tough negotiations and political disputes when the involved actors cannot come to agreement on what are the central problems and how they should be solved.

Changing technological frames

To understand how the dominance of the technological frame evolving around energy savings emerged within the Electronics domain, we have to examine another project, namely the Life Cycle Assessment (LCA) project. Before this project was launched in 1990, the Motor Department and the Electronics Department, which initiated the frequency converter project, had high inclusion in the cost frame; but after the introduction of the LCA project, they seemed to become more included in a 'saving energy' or LCA frame. When the Research Department became involved in the LCA project, which was partly funded by the Danish Ministry of the Environment, a new technological frame started to take form. *"I argued with people in these circles at that time, because some wanted to make informative environmental labelling, and some wanted to use it as sales promotion etc. […] When we started to work with LCA, we had not envisioned what we wanted to use it for. But we chose to use the LCA in product development. We wanted to use it as a tool to improve our products" (Senior engineer).* Previously, environmental considerations had mostly concerned manufacturing processes. *"It was not until we started to make life cycle assessments that we began making links between the environment and our products, besides when we talked about waste" (Senior engineer).* The LCA project led to the

[1] The Electronics domain refers here to the Motor Department, the Electronics Department and the Electronics Factory. The Electronics domain was not established as a separate domain until the establishment of the Electronics Factory and the Electronics Department in 1987.

realisation that a pump's greatest impact on the environment is caused when it is installed and running in the user's house. Ninety-eight per-cent of the electricity consumption is due to the pump's running phase. This created awareness about energy consumption and the potential for reducing it. *"The products have an indirect affect on the environment, which is caused by our electricity consumption. That was not at all something we had thought about at that point in time. But we began to do it" (Senior engineer).* A new technological frame was slowly developing around the LCA findings while negotiations were going on regarding the results of the LCA project and what meaning to attribute to them. The engineers of the Motor Department and the Electronics Department were gradually being included in this new technological frame. At one point, this "LCA" frame became more dominant for the engineers than the previous "reducing costs" frame. In Snow et al.'s (1986) terminology, a frame transformation was happening in the Motor Department and the Electronics Department, which explains their new focus on developing an energy efficient motor technology. This case example gives insights into how a new technological frame develops and how actors change their degree of inclusion in different frames.

Framing market and users

Breaking away from competing solely on price and quality

It was not only on the technological frontier that the 'saving energy' frame influenced interaction among organisational members and their negotiations about the introduction of new technology. Market issues were also addressed: *"Previously you would sell pumps on price and quality, but then a new set of parameters were introduced, such as energy consumption, environment etc. and that led to a lot of challenges" (Sales director).* However, it was neither the Circulator Market Segment nor the Marketing Department that introduced the new set of parameters. It was actors within the R&D department, actors with inclusion in the 'saving energy' frame. Actually, the Market Segment was not convinced about the matter until late in the process: *"I think that many of us didn't quite understand it" (Market Segment Director).* It was the Circulator Market Segment that had responsibility for developing the circulator business as well as running marketing campaigns, but as the Senior engineer pinpoints: *"If you had made a market analysis at that time, then anyone would have turned his thumb down. If you had gone out and asked the customers whether they were interested in a pump that didn't use very much electricity, they would have laughed out loud. […] So they [the Market Segment] focused on what was most important on the market, and that is also what sales people have to do"*. The actors within the Market Segment had inclusion in another technological frame, a frame where the customers were perceived as conservative in their choice of products, and their needs were taken at face value. Thus, competing on other parameters than price and quality was out of the question. We can label this frame the 'price and quality' frame. This technological frame was also shared by some of the competitors: "*What are you up to? Are we going to compete on other parameters than price and quality?" (Senior engineer).* This quote indicates that this technological frame is shared by a whole industry, and there is thus an established way to address customers. In this sense, the 'price and quality' paradigm has been institutionalised. The case example is interesting because it is unexpectedly actors within R&D who offer a new way to frame the market, and not those who traditionally work with marketing. The example thus shows that addressing the market is a key aspect of idea work.

Slowly accepting energy savings as a sales argument

Although the Motor Department and the Electronics Department did not succeed in developing a permanent magnet motor for use in circulators in the mid-1990s, pump efficiency was generally

improved due to other technological optimisation efforts. Slowly, some actors on the marketing side were convinced that a new competitive parameter and thus a new way to differentiate circulators could be energy savings. Grundfos made different attempts to address the customers and inform them about the benefits of buying an energy- optimised circulator and the consequent reduction in electricity costs they could gain. Among other initiatives, a TV commercial was launched in 1998. *"It was on and it gave a boost, but not as much as we could have hoped for. The problem was that it was only on for a relatively short period of time, maybe half a year or so. And then attention dropped again" (Sales director).* When developing the TV commercial, there were discussions about the argumentation or framing of the message: "*That was the first time I used the environment argumentation: Honestly, if I were to brag to my neighbours, then I would rather say that I did something good for the environment and then, by the way, save money. Instead of just saying that I saved money" (Senior engineer).* The Senior engineer had a strong inclusion in the 'saving energy' frame, since he had been one of the main drivers of the LCA project. On the other hand, although the actors representing the marketing side had understood the objectives and argumentation of the 'saving energy' frame, they still had a higher inclusion in the 'price and quality' frame. However, the TV commercials did not help. *"If you look at such a thing as sales, that went really slowly, the growth rate was not very high […]. One thing is that you have an idea, but the market, the receivers, they were just really lagging behind" (Sales director).* Many of the interviewees pointed out that the explanation for this could be found in the distribution chain. Between Grundfos and the end user are both a wholesaler and an installer. *"A wholesaler just wants to be competitive, […] because when you enter a wholesaler, you will typically meet a business-educated sales person, and he does not enter a sale's situation in which he cannot explain what the product is all about. Then, he would rather make the safe choice" (Sales director).* The wholesalers also have inclusion in a technological frame. Their aim is to run a business and sell reliable products so their customers (the installers) will continue to come back. The wholesalers do not have the same technical knowledge as the engineers who develop the products, so the products have to be straightforward and understandable. Hence, price and quality are the key parameters. *"Take an installer, how should he convince Mrs. Petersen that she should pay as much as twice or three times as much for a pump that looks like the one she already has, if he is not capable of explaining why she should spend all that money?" (Sales director).* Furthermore, *"the majority of the customers didn't even know that they were customers" (Electrical engineer 2),* because in most cases it is the installer or another professional who chooses the pump as well as installs it. And even if the installer is at all aware of energy savings, it is still a challenge: *"We would preferably have [the installer] call the phone number that [the house owner] maybe left for him and say: 'You know what, you have another good option. The extra purchase cost can be saved in one and a half to two years on the electrical bill'. But to get him to do that is a huge challenge" (Market segment director).* The installers have inclusion in a technological frame where focus is on the product's functionality. Their main concern is that the pump works so the house owner can get his heat back on. Whether the house owner saves energy or not is thus not perceived as a relevant problem for carrying out the installer's work. Therefore, in order to convince the customers (wholesalers, installers and end users), saving energy has to be made relevant. The case example shows that at one point the actors from the marketing side also gained inclusion in the 'energy saving' frame. The example also shows, however, that when working with ideas, it is equally important to address outside customers as internal organisational actors. It also shows that traditional tools, such as TV commercials, are not always enough when addressing customers who have inclusion in a substantially different technological frame – in this case, the 'price and quality frame'. Thus, other means are needed.

Developing an energy label as a sales tool

An energy labelling agreement proved to be the solution, since it provided the installers with a tool that they could use to explain the benefits to the end users. The end users were acquainted with the energy label from other consumer products, such as refrigerators and light bulbs. However, the energy labelling agreement was not invented overnight. Initially, the process started with the CEO's idea of banning low-efficiency circulators. But it proved difficult to convince the EU politicians to legislate about energy consumption on the circulator market. Instead, by going the long way around, it ended in a voluntarily energy labelling agreement among European pump manufactures. On the way, Grundfos had to get the status of circulators changed from components in heating systems to products on their own. They engaged in the EU SAVE II study to calculate CO2 saving potential. They gained a 'Blaue Engell', a German environmental label. And they established a working group in Europump[2]. These were all small steps on the way to constituting an energy label agreement: *"In 1991, and back then we would have ruled out that it was at all possible. If you had told people: 'Now we're going to make an energy labelling agreement on pumps, and we have this pump that does not use as much energy' – then people would have said: 'Bruuh, you are crazy; come back when you can behave" (Sales director).* This case example shows how the energy label becomes a socio-technical device (Clausen and Yoshinaka 2009) that advances Grundfos' new framing of the market, and a tool with which Grundfos can articulate the advantages of buying high-efficiency circulators. Furthermore, the energy label strengthens the 'energy saving' frame internally in Grundfos. The case example also shows that idea work not only concerns internal processes in an organisation but also processes outside. Furthermore, the case shows that it is not only technological frames that are negotiated during idea work; established institutional practices are also negotiated, such as circulators' status as components and cooperation among competitors.

Discussion and implications

In the previous sections, I have unravelled a historical case and identified how different social groups within and outside a company attribute meaning and render significance to what they perceive as relevant ideas (problems and solutions). This is what I term idea work: all the negotiations, problem definitions and redefinitions, search for new solutions, and the political struggles that are inevitable when actors act and interact with outset in different technological frames. By applying the concept of technological frames, inspired mainly from a STS perspective but also partly from an organisational and political perspective, I have tried to open up the black box of idea work and examine how the organisational micro-processes of idea work take place in a complex web of interactions. The use of technological frames has illuminated how organisational actors assess problems and solutions differently and how this can lead to agreement as well as political disputes; but it also shows how actors can change their perception (inclusion in a technological frame) of what constitutes a good idea by being introduced to new projects (such as the LCA project) or new tools (such as the labelling agreement). This study of idea work thus differs from the existing findings in the engineering design and innovation management literature, because it opens up a phenomenon which previously has been black-boxed.

The study shows that by identifying and labelling the technological frames of the implicated actors engaged in idea work and product development, it becomes clear how different groups'

[2] A working group was established in the European pump industry's interest organisation, Europump. Grundfos held the chairmanship, but five other European pump manufactures also participated in the group. The group worked on calculating an energy index, which was finally used in the labelling agreement to set the different energy categories: A to G, where A is the best.

perspectives on problems and solutions either conflict or inform each other, and thereby influence the development of ideas and products over time. Accordingly, the concept of technological frames can help us identify and understand the underlying political processes present in idea work and product development. By using technological frames in an organisational context, we find that ideas are not neutral. They can indeed disturb the existing order, not only in the marketplace but also internally in the organisation where they initially emerge. This is in many cases also the intention, although it can subject them to rough treatment, especially when established competencies, responsibilities, relationships, hierarchies, knowledge domains and power positions in the organisation are threatened and contested, which was the case both when the Electronics domain wanted to introduce the energy efficient motor technology and when R&D introduced energy efficiency as a sales argument. In this sense, ideas have a political content. And the established distribution of power interacts with the meaning attributed to the idea or technology in question. Or in other words, a way to gain a powerful say is closely related to actors' inclusion in the most dominant technological frames.

The case findings indicate that the dominance of technological frames and the inclusion of social groups are dynamic and can change over time. However, actors do not only act in accordance with particular technological frames; they also act as organisational members who are part of established institutional settings. This means that actors' inclusion in technological frames is influenced, among other things, by organisational structures and routines. Accordingly, certain organisational processes will retain existing technological frames, whereas others will contribute to changing them. Pinch and Bijker (1987) do not address the changeability of technological frames very explicitly; however, Bijker (1995) does give some hints: *"The closure that was reached resulted in important revisions of the frame"* (p. 236). And: *"During the subsequent stabilisation of the artefact, however, the technological frame is reshaped as well"* (p. 241). And: *"The technological frame was adapted"* (p. 241). It can be discussed, though, whether it is the technological frame that changes or the actors' inclusion in the frame. Of course, a technological frame is not static, so it will somehow change concurrently with the actors' changing degree of inclusion. However, I would label this kind of change incremental. Accordingly, I argue that when radical changes occur within a social group, such as when a social group changes its perception of what is the relevant problem, it is not the technological frame that changes but the social group's inclusion in that particular frame that diminishes while it extends into another technological frame. This argument is exemplified by the Alpha Pro case, where it was the LCA project which inspired actors within the departments of Motor and Electronics to change their perception of what constituted relevant problems and solutions in idea work. Thereby, they commenced inclusion in a new technological frame – the 'saving energy' frame.

The intriguing observation that actors' inclusion in technological frames can be changed indicates that new R&D projects, such as the LCA project, can help question existing assumptions and established practices in an organisation, and thus be used strategically to challenge existing dominant technological frames and provide new perspectives in idea work. However, this renewal would be expected to come from those with least inclusion in the challenged frame. And this presents a challenge, since the implicated actors have to be aware of how to navigate the situation. Among other things, they have to be aware of the dominant technological frames in the organisation and what would happen if they were challenged. Moreover, what new perspectives would be able to challenge these established understandings in a productive way? The dilemma here is that in most companies, it is management that is in a position to initiate R&D projects; but if they themselves have inclusion in the dominant technological frame, it can be difficult for them to suggest projects that would challenge this inclusion. One way to work strategically and pro-actively with technological frames in a company could be to openly recognise and label various frames in the company, so they become transparent to all. This could be done through workshops

or design games. One of the implications of challenging existing frames could be to break away from the existing technological path the company is pursuing and instead create a new one (Garud and Karnoe 2001).
While technological frames concern the implicated actors' belief systems and world views, the activity of framing ideas concerns how to present an idea in a certain way, preferably in a compelling way. The case shows that ideas are framed in accordance with the technological frame of the presenter, e.g. *"all the steel you could save" was an argument in the cost frame. Moreover, the case also shows that if the presenter of an idea and the receiver of the same idea share a technological frame, it is more likely that the idea is accepted by the receiver. On the other hand, if there is no congruence between the technological frames of the presenter and receiver, the idea is rejected and conflicts seem to arise, as Orlikowski and Gash (1994) also found in their study. This indicates that when technological frames differ too much from each other, regular framing strategies – such as diagnostic and prognostic framing (Benford and Snow 2000) or chunking (Garud and Karnoe 2001) – do not work. For these strategies to work, some congruence between technological frames has to be present. The implications of this observation reflects back to the implications presented in the previous section, namely that making existing frames transparent in the company by o*penly recognising and labelling them, chances are that the organisational members become aware of different worldviews and thus become more open to them as well.
For designers, the present study can help them discuss and challenge their own ideas, because they are provided with a concept (technological frames) that labels different perspectives in an organisation openly; thus, the difference between hidden agendas and constructive contributions becomes more transparent when dealing with critique of ideas. For managers, the study indicates that by introducing new strategic R&D projects, they can help set a new direction for the company; However, this demands that they are not too immersed in existing technological frames and established organisational practices, but can take a step aside and take a look from outside in.

Conclusion

In this article, I show how the concept of technological frames, inspired mainly from the STS-field, can be applied to open up the organisational micro processes of idea work in a large organizational setting. Idea work is hence very much about framing and reframing what constitutes a good product concept in an organisational context of established practices. Through analysing the Alpha Pro case, I have found that interaction is an essential part of idea work, especially the negotiation of support. The interaction around idea work can be better understood by viewing the evolving idea work as competing attempts to frame problems and solutions. Problems and solutions are framed in accordance with the framer's technological frame. However, technological frames can clash, especially when congruence between them is lacking. This can result in political disputes and failed attempts to gain support for the idea in question. Accordingly, technological frames can be linked to and reproduced by organisational politics and established institutionalised practices. However, new perspectives, introduced for example by R&D projects, can enable repositioning of actors and help create new technological frames.

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Research paper 3

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Navigating organizational challenges in idea work: How actors promote their ideas by relating them to or challenging current practices, values and visions in the organization

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ABSTRACT: In this paper we offer an understanding of how idea work is undertaken in an industrial product development setting by focusing on the organizational micro processes of idea work. In particular, we focus on how engineering designers navigate organizational challenges when they want to promote new ideas in the organization. Our aim is: on one hand to unravel what kind of obstacles these designers are confronted with when they want to provide the organization with new ideas; and on the other hand, what kind of strategies they apply to overcome these obstacles. Our findings are based on an in-depth case study at one of the world's leading pump manufacturers, Grundfos A/S. Our data has been obtained using a qualitative research design based primarily on interviews with organizational members. We have found that it can be problematic to separate the idea and the idea navigator in the early stages. The idea is fragile, since it is based on the idea navigator's technical competences and knowledge domain, as well as his mindset and visions. Conveying these rather immaterial aspects is not easy. However, to realize the idea, the idea and the engineering designer who is viewed as the idea navigator have to expand the network in the organization. But it is also here the challenges and dilemmas begin to emerge. The paper presents these difficulties through seven vignettes: 1) navigating time, 2) timing with formal planning processes, 3) constituting the 'good' Grundfos idea, 4) circumventing the formal decision-making process, 5) navigating arguments that count, 6) navigating and negotiating evaluation criteria, and finally, 7) navigating organizational limitations. We end the paper with a set of managerial implications.

Introduction

Work with ideas is an important activity in the innovation process. Van de Ven (1986) characterizes the process of innovation as: "The development and implementation of new ideas by people who over time engage in transactions with others within an institutional context". Van de Ven (1986) claims furthermore that one of the key problems in the management of innovation is how ideas are managed to be good currency, in order to be implemented and institutionalized. Along these lines, Kanter (1985) argues that in order for an idea to be worked into good currency, at least one organizational member needs to assume ownership of that specific idea and guide it through the organizational landscape until the organization as a whole, opinion formers or distinctive decision makers have taken over its ownership.

In most large product development organizations, a wide range of formal structures, processes and instruments are articulated and put into practice in order to manage ideas into becoming new

products. Examples of such are strategy formulation, technology and product road mapping, and development models. However, although such formal systems have been refined and become more sophisticated over time, and despite the fact that companies have begun investing in idea management systems, informal processes and personal networks still play an important role in helping organizational members promote and advance their ideas (Kijkuit and van den Ende, 2007). Tuominen and Toivonen (2011) argue that innovative behavior is important for organizations, although it is not formally required. Innovation literature has studied how innovation activities are best managed, and many normative approaches and models have been proposed. More recently, however, academia has also begun to examine what is really going on with respect to the organizational micro processes that take place in companies, such as negotiating decisions, support, and power positions outside the formal forums. Along this line, Christiansen and Varnes (2007) found that few decisions were left to the official gate and portfolio meetings, since decisions were already negotiated beforehand. Thus, the official meetings functioned more as a forum for approval than for actually making decisions.

A vast amount of literature has examined innovative behavior in order to understand what role individual organizational members play in change and innovation processes. This literature can be divided into a least three different categories: 1) Intrapreneurship and corporate entrepreneurship, 2) Champions, and 3) Issue selling. Especially the champion and issue selling literature are interesting, as it acknowledges organizational members' use of informal processes when engaging in innovative activities. Champion behavior has especially been examined in the innovation and product development literature – e.g. how organizational members take ownership of ideas, provide support, build coalitions and affect decision makers (Schon, 1963; Howell and Higgins, 1990; Markham et al., 2010). And here it has been found that it is characteristic for champions to apply certain influence tactics and informal processes in order to gain support. The organization and strategic change management literature examines the concept of 'issue selling', which is "…the process by which individuals affect others' attention to an understanding of the events, developments, and trends that have implications for organizational performance" (Dutton et al., 2001). In this literature, emphasis is on describing influence tactics, but also on the importance of the issue seller's understanding of the context within which he operates.

In both fields, important insights have been gained regarding how individuals take ownership of ideas or change proposals, and what they do in order to convince managers and co-workers to provide their support. However, some essential aspects, which are required in order to gain a more detailed understanding of the content and organizational dynamics of idea work, have not been addressed. This gap concerns the relation between the idea promoter and the idea he is putting forward, as well as how and what idea promoters perceive to be the organizational challenges in their quest to gain support for their ideas. In an attempt to fill this gap, this paper's focus is on the socio-technical, political and organizational aspects of idea work as part of the designers' idea promotion. It is thus the aim of the present study, on the one hand, to unravel the challenges confronting idea promoters when they want to provide their organization with new ideas; and on the other hand, what kind of strategies they apply to overcome these challenges. Or briefly, how do designers navigate ideas through the organizational landscape?

In order to answer our research question, we have conducted a case study based on interviews with R&D professionals (primarily engineers) at one of the world's leading pump manufacturers, Grundfos. In this study, we focus especially on the engineering designer's work with ideas in a large product development setting. However, instead of viewing him just as a designer, we view him as an idea navigator (Dawson, 2000), in order to stress the political and socio-technical aspects of the undertaking of navigating his idea through the organizational landscape and the emergent challenges that turn up. To interpret the empirical findings, we find support in Actor-

Network Theory (Callon, 1986) and political process theory (Dawson et al., 2000; Dawson, 2000). We see the present study contributing to the product innovation literature in an important way, by offering a comprehensive understanding through real case examples of how idea work is undertaken in an industrial product development setting by stressing the socio-technical, political and organizational aspects.

Theoretical background

The conception that ideas need internal marketing is widely acknowledged in the 'champion' literature (Schon, 1963; Howell and Higgins, 1990; Chakrabarti, 1974; Shane et al., 1994; Howell and Boies, 2004). Schon (1963) examined how technical innovations were disseminated in the US military; he argues: "In spite of the myth that valid technical ideas do not need internal sales, it is characteristic of successful technical innovation within the military that the new idea requires and receives active promotion". The champion literature examines different aspects of the champion role, and we have identified two aspects that are relevant to mention here. The first aspect concerns influence tactics. It is found that champions are more inclined to use influence tactics than non-champions (Howell and Higgins, 1990; Shane, 1994). Markham (1998) found that champions use cooperative tactics more often than confrontive tactics. And Howell and Shea (2001) found that framing an innovation as an opportunity was positively related to an internal locus of control. Howell and Boies (2004) found that champions tie their innovations to a great variety of positive organizational outcomes, such as profitability, market share, organizational image and reputation, vision or strategy, or to other ideas or innovations. The second aspect of the champion role is the utilization of formal and informal processes. Howell and Boies (2004) suggest that champions' "unique contribution to promotional efforts stems from their use of informal selling processes". Shane (1994) found a positive relation between champions and the acceptance of bypassing the organizational hierarchy as well as circumventing organizational rules and procedures. From the champion literature, we now know what kinds of influence tactics champions apply to affect decision makers, and that employing informal processes and circumventing the formal system is an integral part of champion behavior. In other parts of literature, the perception that ideas need promotion also exists. Dutton et al. (2001) examined how managers at a hospital shaped change proposals through 'issue selling'. They describe issue sellers as "…'players' who use a repertoire of moves to sell issues and affect top-level decision makers' attention". These moves can be divided into three categories: 1) How the issue is presented, 2) which actors are involved and how, and 3) the formality of the process. Dutton et al. (2001) argue that effective involvement tactics depend on contextual knowledge, including the sellers' understanding of the important social relations, of what is perceived to be appropriate behavior in the organization, and of the organization's goals. Dutton et al.'s study confirms many of the findings from the champion literature and also provides us with a more detailed and structured description of influence tactics. Moreover, they put more emphasis on the issue of the seller's understanding of the context within which he operates.

In this paper, we are especially interested in understanding how the organizational context influences designers' work with ideas, since organizational members do not act in a vacuum but in an organizational environment where they build relations, interact with others, and relate to the organizational structures, rules and norms. However, since neither the champion nor the issue selling literature provides us with sufficient insight on this matter, we now turn our attention to another field of literature. Innovation management literature has traditionally viewed the structural conditions in terms of impediments or enablers of innovation. Both Tidd and Bessant (2009) and Menzel et al. (2007) identified factors that either impede or enable technological change to thrive, depending on their configuration. These factors are organizational structure,

physical work environment, management style, teamwork and communication, resource availability, and organizational culture and climate, and the culture and climate involve trust and openness, challenge and involvement, conflict and debate, freedom and risk taking. In the change management literature, Nguyen (1998) uses the term filter to denote "a set of interrelated conditions that a proposal for change must meet as a prerequisite for its adoption by an organization". He argues that a change proposal is more likely to become organizational routine if it can pass through all of the following three filters: emotion, cognition and action. For a change proposal to pass the emotion filter, it must be perceived by the targeted actors as being in congruence with the organization's core values. Furthermore, the change agents have to be trusted. To pass the cognition filter, sufficient knowledge development and sharing are necessary for the realization of the change proposal. And finally, for a change proposal to pass the action filter, sufficient lateral coordination as well as sufficient commitment to the execution efforts ares needed to carry through the change proposal. However, both the innovation management literature as well as the change management literature seems to draw on a rather simplified understanding of the relations between structure and change. The environment is not just something 'out there' with clear-cut boundaries; it is also something we may create ourselves through circuitous chains of activities and occurrences (Gioia, 2006). When people act, they bring events and structures into existence and set them in motion. This is a process that Weick (1988) terms enactment, the outcome of which is an enacted environment. About the enactment of limitations, Weick (1979) argues that limitations are deceptive, as they are based on presumptions rather than actions. By avoiding making tests, people can conclude that constraints exist in the environment and that limits exist in their repertoire of responses.

In the above sections, we have identified what kinds of tactics have already been acknowledged in the literature as relevant for champions and issue sellers, as well as what kind of organizational factors can impede or facilitate innovation activities. However, the tactics identified are generalizations and do not tell us about how the individual designer navigates in a distinct situation, e.g. how and what he understands as challenges, and what specific tactics he would apply in this situation. Furthermore, while the organizational factors identified in the existing literature are important, although very broad in nature, they do not relate to a specific product development context with the specific planning, procedures and norms that it involves. These are the circumstances we intend to examine in more detail in this paper.

Research Methodology

The present study is part of the first author's PhD project, which is conducted in collaboration with the Danish company, Grundfos. Grundfos develops and manufactures pumps for a wide range of commercial and industrial purposes and is a world leader in the production of small circulation pumps. In 2009, its workforce comprised around 16,000 employees worldwide, and annual production was more than 16 million pump units. Net turnover was €2275m, and profit before taxes was €116m. Grundfos comprises 82 companies in 45 countries.

The first author was given unrestricted access to the company, including intranet and relevant databases as well as events and meetings relevant to the subject. The data used as the empirical foundation for this study were obtained through a qualitative research design and derived primarily from interviews, but observation and document analysis were also applied. Forty interviews were conducted with organizational members engaged in research, technology, and product and business development, as well as marketing and human resources, although the majority of the interviewees were engineering designers. The interviewees were found partly by snowball sampling (Bryman, 2001), i.e. interviewees were asked to recommend new, relevant

interviewees, and partly by examining the organizational chart to ensure that a representative cross section of the R&D organization was included. Interviews were only conducted in the Danish R&D organization. The interviews, which ranged in duration from 42 to 71 minutes, were audio recorded and then transcribed. The nature of the interviews was intentionally explorative and the format was semi-structured, in order to allow the interviewees the possibility to describe what they felt was important with respect to the case in question. The interviews evolved around the individual designer's work with ideas and with developing relations to the rest of the organization. The findings in the present research paper were realized in several steps. First, all the interviews were read and different themes were identified, using a grounded method (Bryant and Charmaz 2010; 2007). The first readings gave us an indication of two overall themes: 'impediments to idea work' and 'strategies to overcome impediments to idea work'. This also gave us an indication of what to look for in the extant literature. The next readings helped us find small cases in the interview material that could be used for further analysis to illustrate the many challenges idea navigators meet and how they meet them.

It should be noted that a large share of the interviews were conducted during the winter and spring of 2009, a period that was strongly affected by global economic crises. This meant that layoffs had already been made and more were planned, not only in the production, distribution and sales force but also among R&D personnel. This changed the atmosphere in the organization; for a while, the general level of energy dropped and ongoing projects were reconsidered and reprioritized with the result that some were closed and others sat on standby. R&D personnel reconsidered what their key assignments were, and resources were generally economized. This situation should be seen in contrast to the energetic R&D milieu observed by the first author in 2007, and which during 2010 began to be re-established. In the methodological context, this situation has been taken into consideration when analyzing data.

Grundfos – the organizational context

Many members of the organization, with different backgrounds and experience, are involved in innovation activities at Grundfos. In the Danish headquarters, around 600 employees are engaged in research, technology and product and business development. Although it is an approximation, due to the complexity of the organization, the following description should serve to give a better understanding of the contextual elements in the subsequent case stories. Innovation activities at Grundfos are carried out within three overall organizational units: Research and Technology (R&T), Development and Engineering (D&E), and a set of different Business Areas. The activities carried out in R&T include research into new knowledge domains, technology scouting, maturing technologies, and developing new concepts for future products. The activities in D&E include developing new products by following stage gate plans, and ensuring effective response to necessary product maintenance and modifications. In the Business Areas, innovation activities comprise identifying business opportunities, developing product portfolios, and marketing campaigns.

Empirical findings and analysis

In the following, we examine the micro-processes of idea work in two steps. First, we examine how Grundfos designers constitute idea work, and on this basis, draw the contours of an idea navigator. Next, we examine how idea navigators navigate in the organizational landscape – how resources and politics are negotiated. This is done through seven small examples of idea navigation at Grundfos.

Constituting idea work and the contours of the idea navigator

Breeding ground for idea work

A shared understanding that idea work is hard work was clearly articulated by the designers, without any particular encouragement on the part of the interviewer:*"Most ideas come because you work with them" (D&E designer 1).* At a workshop held at Grundfos, one participant compared idea work with rubbing two pieces of wood together to start a fire. This metaphor emphasizes that idea work is hard work in contrast to the commonly used metaphor of the light bulb. Besides being hard work, idea work is perceived as grounded in the knowledge domain of the designer. *"If you get the great idea in the shower, then it is because you are in a process where you are already trying to solve these things: 'Oh, why don't we do that?' It is not like you stand in the shower and then suddenly, 'God, why don't we make a circulator that can do this or that?' if it weren't because you had been working with the problem" (D&E designer 2).* Interviewees describe how ideas emerge because they are already working with a certain set of problems or are engaged in a particular assignment, or because they are exposed to other actors' knowledge domain or questions and interest. Therefore, the interviewees view dedicating time, working carefully with problems, interacting with others and tapping into knowledge domains as being very important aspects of idea work. And the 'work' in 'idea work' is emphasized. This general characterization of idea work very much resembles other anthropological accounts of the work of designing engineers (Bucciarelli, 1994). But then again, a differentiation is made between the very open-ended and uncertain work carried out by designers in the R&T department compared to the work in the D&E department. Some designers like to work with a high degree of uncertainty and risk: *"It is something where you are totally high and dry. Well, you start from scratch; you don't have to fit it into something. In reality, the outcome could just as well be that there isn't anything in it for Grundfos" (R&T designer 1).* Most of the work in R&T is characterized by a high degree of uncertainty and risk, whereas many of the tasks in D&E are characterized by a lower degree of uncertainty and risk. *"Well, I think at some level that those who work in R&T are better at getting their ideas through than those who sit in the development function, because R&T is a more natural breeding ground for ideas than Development [D&E]"(D&E designer 3).* This quotation points to who in particular is expected to work with new ideas in the organization, and where in the organization the best conditions for idea work are provided. It is the aim within R&T to address: "*this about the early phases, this about idea generation, this about being at the forefront of things" (R&T designer 1).* This can be the reason why R&T is perceived as a more *natural breeding ground* for idea work. Here, it should be noted that they of course also work creatively with ideas in both D&E, while the risk profile is lower, and in the Business Areas. However, the lack of sufficient technical background knowledge can be a challenge for organizational members in the Business Areas. As one business developer explains with regard to making his idea valid for the rest of the organization: *"But I do not have the technical competencies required to express what it takes" (Business Area developer 1).*

We identify above a key assumption and experience concerning idea work in the Grundfos organization: Despite uncertainties, technical and material elements are important in constituting ideas that are considered relevant, and a technical background is seen as a key criteria and competence when working with ideas.

The idea and the idea navigator are inseparable

A widespread conception among the interviewees is that the initiator is the best 'champion' of an idea: *"It is very much about how you can never get an idea through if you don't carry it yourself. You cannot give an idea to somebody else and say: 'I have an idea. You must work with it'. I*

simply do not believe that it is possible, because when you get an idea, then you are dedicated to it. It is not guaranteed that the guy the idea is given to is dedicated. It could be that he thought it was crap. And you would not get the support from him or get him to work on it either. So you have to be a part of it yourself to get it through" (D&E designer 3). According to this line of thought you cannot trust your ideas to just anyone, and ideas are therefore very fragile, because they indeed depend on the idea navigator in order to be disseminated in the organization. Many of the ideas referred to by the interviewees are technical ideas, which have a materiality as opposed to more abstract business ideas. This means that the ideas are grounded in a technical domain or discipline, such as topology, fluid mechanics, or power electronics. The designers are not only dedicated to their idea; their ideas are so much a part of their individual technical competencies, visions, and the technical domains they draw on, that leaving a pre-mature idea to the will of others is felt as a threat to the idea. In this sense, the idea and the idea navigator constitute an actor-network (Callon, 1986), where the idea and the idea navigator are inseparable from each other. This also explains why the internal idea suggestion system is viewed by many of the interviewees as a *'parking lot'*, a *'graveyard'* or a *'garbage bin'*. As one designer explains: *"When you send your idea to somebody else, also the [idea suggestion system], then it loses life. […] An idea has to be given away; you cannot just send it. It has to be received by somebody. You cannot just expect that others will treat it as you would yourself. Because you are dedicated to it, and you bring along more with your mindset than the one who receives it" (D&E designer 4).* This quotation reinforces the conception that the idea and idea navigator belong to each other. The idea stems from and is grounded in the idea navigator's *mindset* and knowledge domain. In order to keep the idea *alive*, the person with the idea has to make sure that whoever receives it receives it properly. Thus, a 'relation creating' act is required, not a 'passive' action such as *sending* the idea to an idea suggestion system. Another designer puts it in this way: *"Where I see a major strength is when you talk with others about your ideas and don't take ownership but give ownership instead" (R&T designer 2).* This quotation indicates that an idea cannot be held onto forever. But when ideas are transferred to others, it is not just the fundamental idea that is transferred. It is the whole actor-network, which comprises both the social and the material: the designer's mindset, beliefs, visions and technical expertise, as well as the materialized idea that has to be translated. In this sense, ownership of ideas is given through the sharing of a clear vision of the end goal, and an understanding of the difference the idea makes.

In the preceding section, we identified ideas as a socio-material phenomenon. In the very early stages, it can be very difficult and risky to separate the idea from the designer. This is because the idea is based in the technological knowledge domain of the designer, and because it can be complex to transfer the more immaterial elements, such as the designer's mindset and visions, which also constitute parts of the idea.

Navigating organizational resources and politics

Through interviewing the designers at Grundfos, the contours of the designers' view of what idea work is and what it demands emerged, as outlined in the previous section. Although it is the designer who is viewed as being the most important carrier of the idea, he cannot stand alone. In order for his idea to be realized in the organization, the actor-network has to expand. An important element in getting an idea through the organizational system is thus internal marketing: *"There are many good ideas which do not get realized as a tangible product or service, because they do not get marketed in the right way in the right places" (D&E designer 5).* It is believed that ideas have to be promoted in the organization in order to gain support. This includes both how the idea is presented (*in the right way*) and to whom (*in the right places*). These are both important aspects that the idea navigator has to take into account, but as one designer puts it, this

is also the difficult part: *"I would say that compared to the amount of work, and compared to the effort, then this about getting the idea and formulating it are just one part. That is basically the easy part. The difficult part is afterwards to connect to the company's course, where it is heading and get [the idea] sold" (R&T designer 2).* When getting an idea sold, it is not only the closest co-workers or social networks that are significant – more is at stake. When organizational members navigate, they have to relate to the larger organizational context of which they are a part, as the quotation also indicates. By using the label 'navigating', we want to emphasize the selective engagement in relations-building and overcoming the technical and organizational impediments that designers encounter. The focus here is on the dilemmas involved in how to draw on organizational resources without losing control over the content of the idea, and also how to engage in mutual translations of the content of the idea and the engagement with wider organizational priorities. In the next section, we examine how idea navigators deal with such complexities and navigate through or around them. In the interviews, we have identified seven different themes related to idea navigation. The following list of themes is not exhaustive, but it does indicate central challenges and examples of how to come around them.

1) Navigating time – a basic theme

One resource needed for idea work is time. All designers at Grundfos shall use 80 percent of their time on ongoing projects, regardless of the department to which they belong. The rest of their time can be dedicated to department meetings, organizational events, continuing education or their own projects. However, idea work is in hard competition with the designers' daily job: *"But what is difficult about this is to keep it alive while knowing you also have other projects to work on" (D&E designer 3).* In most cases, organizational members are primarily measured by the results they produce within the '80-percent' project time; therefore, they have an incentive to prioritize this work. *"We were six [persons] in this group [an idea-generating group that met every Friday], but as soon as we came closer to our project deadlines, it became difficult to get people to participate because then it was the projects that counted, because of the deadlines. Then, you de-select the other stuff" (D&E designer 3).* Many of the interviewees stated that finding and prioritizing time is an important aspect of idea work. However, dedicated idea navigators often find a way to work with their ideas in one way or another: *"Well, then I sit at home and fiddle with it in the evening, because it has my interest. So I get it through in that way. […] Now I sound like the world's biggest over-achiever, but I do that. It is also a private interest. You cannot keep yourself away from it, when you have been at a place as long as I have. It takes up so much of your life" (D&E designer 6).* Utilizing spare time is not the only strategy used to gain more time for own ideas. Accounts were also given of how ideas are fitted in as parts of existing projects, or how official project time can be used on own ideas. The task of navigating time is basically about finding it and prioritizing it. But in doing so, a prevailing dilemma is: how to find the time? Should the idea navigator respect the organization's above-mentioned 80/20 rule, and if he needs more than the 20 percent then use his own spare time? Or is it justifiable to work against the organizational priorities and fit the idea work into the 80-percent scheduled project time? These are considerations the individual idea navigator has to wrestle with and reconcile.

2) Timing in relation to formal planning processes – the 'right' idea at the 'right' time

Whereas time is a very important resource in the early stages of initiating the actor-network, organizational resources are important when the actor-network is to be expanded; however: *"…a very limiting factor for the ideas that are implemented is economy. You have x number of billions you invest in research and development each year. And here, the challenge is to get your product [idea] to be considered and financially supported. That is tough. So you need to look at the whole*

wheel, you might say, and be sure that it is the right ideas that get through and are financially supported by R&T and D&E" (D&E developer 5). The final show-stopper for idea work is often economy. If resources are not granted, this means the end of the idea. Resources are often negotiable, however, as long as they are within the scope of the company. But before even getting into a position to negotiate resources, another challenge presents itself. The above quotation also refers to the annual strategic planning process (*the whole wheel*), where roadmaps are updated and new ideas are taken into consideration – but this only happens once a year. The challenge that some interviewees commented on in this respect is that ideas do not usually emerge only once a year or synchronous with pre-scheduled processes. Ideas emerge all year round. And the risk is that ideas will be forgotten if the designer is not able to time them in relation to the organizational planning processes. If and when ideas are timed correctly, the idea has to be the '*right*' idea in order to gain financial support in the formal planning system. *"Well, the formal systems – regardless of how kind-hearted you think they are in the beginning – they almost always end up being the constraining factor as well. So it is necessary with a devil-may-care attitude, if you want to get your ideas through" (D&E designer 5).* The dedicated and politically astute idea navigator cannot wait for the organization to be ready to consider ideas once a year; therefore, other means must be used. The dilemma the idea navigator faces here, and which has to balance is: when to comply with formal organizational conventions and when to circumvent the system. Some of the following vignettes elaborate on different facets of this dilemma.

3) Constituting the 'good' Grundfos idea

Most of the designers interviewed had a very clear perception of what constituted a good Grundfos idea. They are thus aware of what technical and organizational values they need to inscribe in their ideas: *"It has to have some quality […]… Grundfos' image is something with quality; it is something with robustness; it is something about good service and so on. If we come up with a product that is only a functional product, with some nice shiny shields, figuratively speaking, […] it wouldn't match Grundfos' image, you might say. It doesn't support Grundfos' image as environmentally conscious and quality leader in the field we operate in" (R&T designer 3).* In addition to quality and environmental consciousness, which are mentioned here as important elements that constitute a good Grundfos idea, technology is also a very essential element: *"At Grundfos, we very much like to work with something that is technologically sexy or high tech. If it has that in it, then it has good chances – or its opportunities are improved" (Business Area developer 2).* These elements are of course very Grundfos-specific. It could be argued that they constitute Grundfos' DNA. Although the designers seem to agree on at least these three values, they are not static in nature but change over time. Earlier, neither quality nor environmental consciousness were accepted to the degree they are today. *"In the Energy project, [they] discover that by introducing permanent magnet motors, a lot of electricity can be saved. But at that time, the attitude was: Are you guys totally crazy? It's not reasonable, there is no money in it, and nobody wants to pay for it" (R&T designer 4).* Today, the permanent magnet motor is an integrated part of Grundfos' best selling product, the domestic circulator Alpha 2. In developing ideas, the idea navigator has to be receptive to what constitutes a 'good' Grundfos idea; the idea has to meet certain criteria in order to be accepted. But this also constitutes a dilemma; if existing criteria are reproduced over and over again, the company risks being locked into a specific technological path (Garud and Karnoe, 2001) that will be difficult to break away from. Therefore, existing values have to be challenged in order to renew the product line. And it is up to the idea navigator to decide whether is it more feasible to satisfy the existing criteria or to break away in order to expand the actor-network in a different direction.

4) Circumventing the formal decision-making processes

Gaining support is an essential part of realizing ideas. In order to gain support, the first step is to gain attention and interest – interessement is Callon's term (Callon, 1986). This can be done in many ways. Usually, effective means for accomplishing this can be to make business plans and prototypes. However, more unconventional means may also work. *"I could have written it down like project plans and those kinds of things, send it, and then relax… But instead, I wrote a mail to those who were in charge of Grundfos Challenge – well, the steering committee – and then sent it to [the CEO] as CC. Then, I wrote: see [the CEO] on television tonight with Denmark's-best-idea" (D&E designer 7).* The designer also attached a description of his idea in the mail. Shortly after, one of the members called him: *"I can't find it in the television guide!"* The designer explained the joke, and then some time went by without further interest in the idea. But eventually the CEO wrote back to the designer and asked what was happening with the idea. This email was then forwarded to the steering committee, and suddenly the designer was invited to a meeting in order to present the idea. *"It died then because they still didn't believe in it […]. But the point is sort of to do things differently,… try to sell it in another way. That can sometimes help create a bit of attention" (D&E designer 7).* In telling his story, the designer emphasized the untraditional way to create attention, by making up a television show and referring to it as real. But there is more to his navigation attempt than just the content of the email. By associating the CEO (a person not usually involved in idea work at this early stage) with the idea by putting him on a television program and having him as carbon copy on the email, the designer benefits from the inscribed power relation existing between the CEO and the steering committee. By getting the CEO interested, he has someone on a higher organizational level than the steering committee to influence and put pressure on the decision-making process. Similar examples of by-passing or interrupting formal decision-making processes are to be found in the interview material, especially accounts of how the Chairman of the Board (son of Grundfos' founder) has been made an important ally at the 'right' time. But the risk here can be that when involving top management, their excitement and involvement can reach a point where the idea navigator is left without control over the idea's further course, and the original actor-network may be translated in a less desireable direction. Here, it should also be noted that the designers are very much aware that it is not always appropriate to apply these kinds of strategies. There are certain considerations to take into account, especially not to ruin a relationship with existing decision makers. Interviewees report that although it is accepted to a certain extent to by-pass the formal organizational processes, unwritten rules exist of who can do this and how and when to do it. In circumventing the formal organizational decision processes in order to expand the actor-network, the idea navigator faces a dilemma: Should he risk losing control over the idea as well as his relationship with co-workers and decisions makers?

5) Navigating what arguments count

Developing good arguments is an important part of convincing decision makers and enrolling support. The interviewees widely referred to certain key elements that can help the designers win the necessary support. In the Business Areas, particularly Business Plans, a key element is to present valid arguments for further investment in an idea. In the more technical departments, especially drawings, prototypes and calculations are the prevailing currency. These rather physical elements act as boundary objects (Henderson, 1999) when negotiating support. However, more immaterial means are also used: "*Some preparatory work had already been done [by Grundfos]; clean water to the world. […]. Then I wrote [in the presentation] 'Okay – we have a lot of nice headings, but how should we do it? I have an idea as to how exactly we do it and make a difference'" (R&T designer 2).* This quotation shows how the designer makes his idea indispensable – his idea can solve the organization's problem with *clean water to the world*.

But *clean water to the world* is not only a literal problem Grundfos wants to solve; it also points to articulated visions and discourses in the company, with which the designer associates his idea. This resembles the initial step in Callon's (1986) process of translation – the problematization. By problematizing the credibility of the intent, the designer makes his own interpretation of the company's visions and builds a bridge that can connect his vision for the idea with the company's vision. Thus, the designer's *mindset* can be conveyed to and envisioned by the decision makers. The challenge when developing arguments is to find what counts in any given situation. Business-oriented persons will value different arguments than more technically founded persons, because they emphasize different aspects of an idea. The problem then is to balance the features or visions to be emphasized.

6) Navigating and negotiating evaluation criteria

Both before entering formal stage gate processes and between gates, idea navigators have to relate to continuous evaluations, which are made by co-workers as well as decision makers. The nature of the evaluation can be both unpredictable and unconventional, in contrast to the formal evaluation criteria, which are more clearly defined at the outset. *"[The former CEO] took a screwdriver and placed it between his skull and the pump [to sense vibrations and noise]. That was what we had to honor" (R&T designer 5).* This is an example of an unpredictable evaluation criterion. It does not follow any pre-described instructions or any objective scoring-matrices. It is based on years of experience with technology, embodied knowledge, and maybe even a gut feeling. The concept being tested is the permanent magnet motor intended for a high energy-efficient circulator. The concept did not pass the test; instead, it was found applicable in another product where noise was not such a problem. Years later, the designers solved the noise problem, and today the motor is used in circulators. The challenge in navigating especially informal evaluation criteria is, first of all, that it can be difficult for idea navigators to predict when their ideas are up for evaluation – it can happen any time. Secondly, it can be very difficult to predict the criteria in advance. But even though an idea or concept is turned down, this does not mean that the designer will let go of it: *"We still have three [pumps] running down in the basement […]. We've let them run. They have reached around two to two-and-one-half running years. Well, we might as well do it. It is such a good advertisement, if they keep going, right? And they are running well down there. Usually, we say they have to endure around 20,000 running hours. And we have passed that" (D&E designer 8).* The concept referred to in this quotation had been rejected, but the test set-up keeps running in case somebody should show interest in the future. In this case, the evaluation criterion is not taken for granted. The designer and his team keep the possibility open that the evaluation criterion can be renegotiated later on. Meanwhile, they are developing new arguments by letting the pumps run – the more running hours, the better the argument. In navigating evaluation criteria, the challenge is both to deal with very unpredictable criteria but also to be aware of the possibilities for renegotiation.

7) Navigating organizational limitations – challenged by the organizational set-up

Although both support for and excitement about an idea have been established, challenges can still emerge: "*So you could say that the organizational set-up that was required to market such an idea didn't exist. Even though there was a lot of excitement, it was simply not possible to deliver the idea anywhere" (R&T designer 6).* Grundfos had for many years been good at making physical products "*delivered in a box*". But during the 1990s, the internet exhibited new opportunities for offering services as well. *"We could easily do it, also within reason with regard to price, but yet there didn't seem to come any wave. And I think that what we realized along the way was where should a product like that be sold? Because actually it was a service."* The organizational set-up was organized around developing, manufacturing, distributing and selling

physical products. To sell a service did not fit into the organizational routines: *"You could say that there has to be something, an operating function of a kind, somebody to sell it. […] The sales companies, what interest did they have? They have to sell something that in principle doesn't exist. And who gets the profit, and who shall operate it?"* Today, Grundfos has implemented the idea: *"But it was an extremely long course of events. It took more than 10 years, right?"* Although, everybody in an organization agrees that something can be a good idea, there is no guarantee that it will be realized. If the organization cannot manage the idea, at whatever stage it is in, more than good arguments are necessary. The challenge here is that it is probably a new organizational set-up or new routines that are needed, which in many cases exceeds the scope of the idea navigator. Here, other actors are needed, maybe even new organizational capabilities. This is especially the case with many radical innovations, because they do not fit into the core business of the company, and in some cases, they even challenge existing business areas.

Discussion and Managerial implications

Ideas can very roughly be divided into two overall categories: directed ideas and non-directed ideas. The first category comprises ideas that fit easily into existing organizational plans, because they are requested by management, whereas in the second category, the ideas are met by a larger range of impediments. The subject of analysis in the present paper is primarily non-directed ideas. These are ideas that are not explicitly requested by management and therefore do not formally fit into existing projects or business areas. In other words: non-directed ideas are ideas, which to a higher degree than directed ideas, have to be 'worked' into good currency in order to be accepted in the organization. As our findings show, ideas can be worked into good currency by different means and by employing different strategies. However, these means and strategies are not fixed repertoires. Rather, the idea navigator has to take stock of each and every situation he finds himself in. In these situations, contextual knowledge is very important, as also argued by Dutton et al. (2001). An example of how important it is to understand the organization's goals can be found in vignette 5. The designer knows that sustainability and environmental issues have high priority at Grundfos and that they are announced to be among its core corporate values. Accordingly, he associates his own idea with this company agenda and declares that he knows how to solve the challenges associated with clean water to the world. Examples of appropriate behavior and the use of formal channels versus informal channels are also present in the empirical findings. In vignette 4, one designer circumvents the formal decision-making processes by involving the CEO. However, he and the other Grundfos designers are aware that this is not a strategy that works in all cases. In fact, unwritten rules exist regarding who can do what and when. To make such strategies work, some degree of respect and positive standing must have been earned among peers beforehand, or else they can actually rebound and work directly contrary to intentions. Among other things, respect can be earned through track records – e.g. the number of valuable ideas the designer has realized in the past, or other kinds of initiatives that have created value for the company in some way. Kanter (1985) argues that ownership of ideas must be taken in order to realize them. However, it has often been claimed that designers can be reluctant to share their ideas, since they are afraid that others will take credit for them. Another picture is presented at Grundfos. Here, it is not only about taking ownership but about giving ownership of ideas to colleagues. Ownership is especially given by exposing ideas in social networks, and by using the strategies outlined in the analysis and findings section, such as relating ideas to existing corporate visions and values, and showing that the ideas work by making prototypes and running test set-ups. In existing literature (Tidd and Bessant, 2009; Menzel et al., 2007), organization structures, culture and climate, as well as management style and resource availability, are among other factors identified that can either impede or facilitate

innovation, depending on how they are constituted. In the empirical findings, some of these factors have also been pointed out as challenges. Vignette 7 presents an example of how the organizational set-up came to be a limitation when a new service was introduced. In this case, support was generally given by a wide range of organizational members, but at that time, Grundfos had not developed the proper routines or structures to handle the idea. With respect to resources, time was especially pointed out as a critical factor. This was touched upon in vignette 1, where the dilemma of whether to work against or comply with organizational priorities was raised. Besides perceiving organizational structures and limited resources, such as time, as impediments for innovation activities, which earlier studies also indicate, our study shows that timing in relation to formal planning processes and negotiating evaluation criteria can also be challenging. Along these lines, vignette 2 shows an example of how ideas should be timed in relation to the annual planning process in order to be considered, but this is seldom possible in practice, since ideas emerge throughout the year. This vignette also contains a general statement about how the formal systems, despite their intention to assist innovation activities, can end up being a constraint instead. Evaluation criteria can also be challenging (vignette 6), especially when they are not predefined and are imposed unexpectedly. With respect to challenges, Weick (1979) raises the issue that limitations are not 'out there' in the environment but are very much realities actors impose on themselves. The challenges that the Grundfos designers have pointed out seem at first glance to be very much 'out there' in the environment. However, many of them also understand how to come around them by applying certain strategies to circumvent the formal systems and processes. With respect to what were perceived to be challenges, we noted that there were some differences between R&T, D&E and Business Area personnel's perception of difficulties when undertaking idea work. What they perceived as difficulties were very much related to their own backgrounds and competencies. For example, R&T professionals have an advantage over business professionals when promoting and advancing technical ideas, because they know how to sketch their ideas and make prototypes. Regardless of designers' place in the organizational structure, however, there seems to be consensus about what characterizes a 'good' Grundfos idea. Sustainability, quality and technical performance were referred to over and over again as characteristics or values that a good Grundfos product must live up to. And the designers were convinced that these traits would make an idea more easily accepted by others in the organization.

Our findings also give rise to a set of managerial implications, which are introduced in the following. With respect to time, our findings indicate the importance of having 'access' to free time in order to enable designers to work with their own ideas, but the question is: is more free time always better? Both 3M and Google practice the philosophy that a certain amount of time should be dedicated purely to designers' own projects. But it is also reported that not all designers use this opportunity, and some need far more than e.g. 15 percent (Brand, 1998). We thus propose that it is not the 15 percent in itself that makes the difference; rather, it is the signal the company sends – that it is acceptable to pursue one's own ideas. Our findings also indicate that the key factor in obtaining time as a resource depends very much on the designer's ability to focus and develop dedication to his own work. Many of our vignettes touched upon the dilemma of when to comply with formal organizational conventions and when to circumvent the system. In practice, such strategies as by-passing decision-making processes, re-negotiating criteria and involving unexpected allies should not be ruled out, since this would hamper the successful navigation of ideas. Therefore, we suggest that the key implication here is to focus on learning political navigational skills and openly supporting reflection with regard to experiences. This can be achieved through workshops and games designed for this purpose. When convincing decision makers, good arguments are important; however, the challenge is to find out what counts as a good argument in any given situation. The implication is thus that designers cannot choose from a

predefined repertoire of fixed strategies. Instead, they have to accept the rather emergent nature of the situation. Our findings indicate, however, that decision makers are more likely to listen when ideas are associated with company visions and values. Finally, our findings show that support for more radical ideas can be difficult to achieve, either because the existing organizational capabilities are not sufficient to realize them, or because of internal resistance. But on the other hand, it has also become clear that long-term changes in organizational visions and strategies are strongly inspired by and dependent on the intrepid work with new ideas – especially those that lead to radical innovations.

Conclusion

Initially, we problematized the fact that designers are confronted with difficulties when they want to provide an organization with new ideas, and we suggested that by applying certain strategies, they could overcome such challenges. Accordingly, we asked: how do designers navigate their ideas through the organizational landscape? We have answered this question in two steps in the section presenting our findings and analysis. First, we examined the relation between the idea navigator and the idea, as this relationship has not been investigated before in existing literature. Then, we examined the challenges confronting idea navigators.

With reference to actor-network theory (Callon, 1986), idea navigators can be viewed as network builders. The emerging actor-network comprises the idea as well as the idea navigator, with all his visions, particular mindset and commitment. It is problematic to separate the idea and the idea navigator in these early stages. The idea is fragile, since it is based on the idea navigator's technical competences and knowledge domain, as well as his mindset and visions. And conveying these rather untangible aspects is not easy. In this sense, the idea can be viewed as a socio-material phenomenon. In order for the idea to be realized, the actor-network has to expand. This is accomplished through translation of the relations in the network. Callon (1986) describes four moments of translation: problematization, interessement, enrollment, and mobilization of allies. But it is also here the challenges and dilemmas begin to emerge. In the second part of the findings and analysis section, we have tried to bring to light some of the difficulties idea navigators are confronted with when trying to expand the actor-network in an organizational context. These translation processes do not follow a simple pattern, as the presented moments of translation might suggest. Instead, they are processes characterized by uncertainties and locally adopted strategies that change over time. In this paper, we have chosen to view the designers who make every effort to work their ideas into good currency as idea navigators. This notion is not in opposition to the well-known 'champion' (Schon, 1963; Howell and Higgins 1990; Markham et al., 2010), since they have certain characteristics in common. However, the notion of navigator does emphasize the more political and emergent nature (Dawson et al., 2000) of the behavior a designer must have in order to overcome the challenges he is always confronted with when working with ideas. In this sense, the idea navigator is not a predefined role with a fixed repertoire of strategies. Instead, he is a human actor with heterogeneous competences, who has to consider each and every situation he encounters, reflect on how to act and react, and last but not least, try out strategies to find out what works in each different context.

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Research paper 4

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Experiences with Idea-promoting initiatives – why they don't always work

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Abstract

In new product development, a central activity is to provide new ideas. Over the last decades, industrial practice has provided experience with stimulating employee creativity and establishing idea-promoting initiatives. Such initiatives are often labeled Idea Management – a research field of growing interest. In this paper, I examine three different idea-promoting initiatives that were carried out in Grundfos, a leading pump manufacturer. In the analysis, I address the understandings of idea work that are inscribed in the initiatives, and the role these initiatives play in the organization with respect to idea work. Furthermore, I look into what makes these initiatives 'work' or 'not work'. The analysis is based on an in-depth case study made in Grundfos based on 40 interviews with R&D professionals and managers. The managerial implications of the study are that managers should be aware of the understandings of idea work that are inscribed in the idea-promoting initiatives, since, in order to work, they must fit to some extent with the understandings embedded in practice.

Keywords: idea work, idea management, change programs, case study, socio-technical

1 Introduction

In 1880, a wooden box was placed on a wall at the William Denny & Brothers shipyard in Scotland for collecting ideas from employees. It was the first of its kind, but ever since then, companies have implemented many similar concepts in order to tap great ideas from employees. Working with ideas, e.g. generating, developing and maturing them, is an essential undertaking and starting point for companies' innovation activities and is often approached in various ways in product development organizations. Some companies benefit from formal idea management systems, whereas others rely on more informal processes and networking among employees [1]. Although research and reports on best practice do exist, especially regarding IT-based idea-suggestion systems, making the concepts work in practice can still be a challenge. I have observed and discussed this with a number of Danish product development companies.

In this paper, I examine one company's experiences with a selection of such concepts. This is done in order to analyze why some concepts are immediately welcomed and implemented in daily practice, whereas others are rejected or only partly accepted.

The company under examination is Grundfos, a global enterprise that develops and manufactures a wide range of pumps for domestic and industrial uses. With increased attention from top management, Grundfos has over the last two decades carried out a series of initiatives aimed at stimulating and supporting idea work. The initiatives range from the global, in that they address the whole organization, to the local, which only affect a selected group of employees. The concepts examined here are: the Idea Bank – an IT-based suggestion system to which employees can submit their ideas; the Research & Technology Playground – a forum where resources and department time can be granted to employees who have a technical idea they would like to develop; and Innovation Intent – an innovation vision that should function as a guiding star for future idea work at Grundfos.

The paper is organized as follows: First, I introduce my research question and methodology. Then, I present two theories within change management and social construction of technology in order to characterize and analyze the three selected idea-promoting initiatives carried out at

Grundfos. This is followed by a description of Grundfos and its general history with idea-promoting initiatives and then by an analysis of the three selected initiatives. Finally, the discussion and managerial implications are presented.

2 Research question and Methodology

The research documented in this paper is conducted as a part of my PhD project, which is carried out in collaboration with Grundfos. The overall theme for the PhD project is socio-technical and organizational dimensions in the early phases of idea work in product development. The empirical data used in the project is mainly obtained through qualitative interviews with Grundfos' organizational members engaged in research and technology, product and business development, as well as marketing and human resources. Reading through the transcribed interviews made it apparent that an ongoing theme was what I have labeled 'idea-promoting initiatives', which are initiatives implemented at Grundfos in order to stimulate, support and steer ideas and the work with them. This observation has led me to pose the following research question to be examined in this paper: What makes an idea-promoting initiative 'work' or 'not work'? In order to elaborate on this main research question, two further questions are posed: What understanding of idea work is inscribed in the different idea-promoting initiatives? And what role do the different idea-promoting initiatives play with respect to idea work? I answer these questions partly through a literature study, which helps establish the analytical context and criteria for analyzing the understanding of idea work and the role and dissemination of the different idea-promoting initiatives; and partly through a case study [2] I have conducted on idea work at Grundfos, which provides the empirical data for the analysis.
The forty interviews used as empirical data in this paper lasted from 42-71 minutes, were audio recorded, and then transcribed. The interview format was semi-structured, leaving room for the interviewees to describe what they felt was important with respect to the case in question. Twenty-nine of the interviews addressed 'general thoughts on idea work', and the interview questions focused on finding specific examples of ideas and the work with them, identifying the 'channels' ideas can be 'worked' through in the organization, and identifying idea-promoting initiatives. Eleven interviews addressed 'Innovation Intent' – Grundfos' innovation vision. The interview questions in this case focused on how Innovation Intent was initiated and implemented, by whom, and what role it plays in the daily work with ideas. In both cases, interviewees were selected partly by snowball sampling [3] (i.e. interviewees were asked to recommend new, relevant interviewees), and partly by examining the organizational chart and ensuring that a representative cross-section of the R&D organization was included. Interviews were conducted only in the Danish R&D organization. Coding the interviews was done manually in three steps: first step was observing that idea-promoting initiatives are interrelated with idea work; second step was to mark every time such an initiative was mentioned in the interviews; and third step was to categorize the different statements about the different initiatives. The coding was based on the principles of grounded theory [4], but the interpretation of the data was also guided by the theories presented in the next section.

3 Theoretical framework

To examine Grundfos' idea-promoting initiatives, I have applied two theories within change management and social construction of technology. These theories establish the analytical context and criteria for analyzing the understanding of idea work and the role and dissemination of the three selected idea-promoting initiatives at Grundfos.

Influencing employee creativity and productivity by establishing organizational procedures and structures is widely known across a range of disciplines in organizations, e.g. in production, product development and finance. Besides restructuring the overall organizational set-up of a company, the use of management concepts can also stir up things. Lean, Business Excellence and TQM are well-known examples of such management concepts, which act as recipes for achieving success in business. Historically, these management concepts can be traced back to the beginning of the 20th century with Taylor's "The Principles of Scientific Management" [5], a change program addressing productivity and efficiency of manufacturing processes. Many new concepts have since sprung from manufacturing processes, and are now extended to also encompass many other processes such as product development and innovation processes. Examples of concepts in this field are Integrated Product Development [6], Concurrent Engineering, Lean Innovation and Idea Management.

In the context of this paper, I am especially interested in Idea Management. Idea Management aims at organizing and managing the generation, selection, and implementation of ideas for commercial use through a structured and controlled process. Many different tools exist to support this process, e.g. IT-based suggestion systems, idea competitions and creativity courses. No matter whether a management concept aims at improving manufacturing processes or product development activities, it is a program that facilitates change; and management concepts comprise more than neutral diagnosis and tools. Kamp et al. [7] operate with three different analytical perspectives on change processes: change as a political process, a symbolic process, and a learning process.

In the political perspective, the management concept is viewed as a political program that is biased with respect to preference structures, how the future of the company is viewed, and what actors are attributed privileged roles. Focus is on how this program is negotiated in an attempt to extend and maintain its legitimacy and create support in the organization.

In the symbolic perspective, management concepts are carriers of symbolic meanings and can act as branding both internally in the company and to the outside world. The 'symbolic' concepts offer a new language for the organizational actors and give them an opportunity to associate themselves with the change process by letting them use the new language.

In the learning perspective, the management concept is viewed as an opportunity to learn. Focus is on how the organization functions as a learning environment. In order for the company to learn, participation from a large group of actors is required. They need to take ownership of the process. These three perspectives represent different takes on change processes and illuminate their different aspects and natures.

In the analysis of Grundfos' idea-promoting initiatives, presented after the case study, Kamp et al.'s analytical perspectives are used to characterize the understanding of idea work, which is inscribed in the initiatives.

To better understand how the management concepts' practical functions, social meanings and cultural identity are constructed – or more briefly, what understanding of idea work is inscribed in the different initiatives – a script analysis can be helpful. A script is the materialization of the designer's more or less informed presumptions, visions and predictions about the relations between the artifact and the human actors surrounding it [8]. Akrich [9] argues that "…competencies are distributed in the script of the technical object". If we read 'management concept' instead of 'technical object', it would mean that some decisions and actions are fixed by the management concept, whereas others are left to the initiative of human actors. Continuing with Akrich: "Technical objects define actors, the space in which they move, and ways in which they interact". Thus, the present construction of a management concept has consequences for how the change process is understood in the organization, how it is planned for, what actors are expected to take part, and what actors are excluded. In this

line of socio-technical reasoning, it can be argued that whether a management concept is received and integrated successfully in an organization or not, and whether it 'works' as intended, depend on what constrains are inscribed into it – for example, does it appeal to those it is intended for? Does it let key players play their role? Or does it manage to configure a network that brings together relevant actors, whether human or non-human? De-scription is the analytical notion for how the users read or use the management concept in practice. To analyze what kind of understanding of idea work is inscribed in the different initiatives and what role the initiatives play, I use Akrich's script analysis.

4 Case study

Over the years Grundfos has carried out a wide range of different change programs to address either the whole organization or parts of it. In the following, I describe the initiatives carried out over the last two decades in Grundfos that are relevant to work with ideas in a technology and product development context. Before going into detail with these initiatives, I present a brief introduction to Grundfos and the broader organizational context within which these initiatives should be understood.

4.1 Grundfos and the organizational context

The starting point for Grundfos as a pump developing and manufacturing company was in 1945, when Poul Due Jensen, the founder, received a request from a local farmer to install an automatic water board. This demanded an efficient pump, which he could not find anywhere. So he began designing the pump himself, a characteristic that has followed the company ever since – *we'll do it ourselves*. Since then, Grundfos has developed and produced many different kinds of pumps for both commercial and industrial uses and has grown into a company with around 16,000 employees, an annual production of more than 16 million pump units, a net turnover of €2275m, and profit before taxes of €116m in 2009. Grundfos is represented by 82 companies in 45 countries. This makes it one of the world's leading pump manufactures in business today. Of the 16,000 people employed in Grundfos, around 500 are engaged in research and technology, product, and business development, in a so-called Business Development Center. Actually, this could be said to be a misleading label since technological development or technological 'push' has been by far the most dominant activity in most parts of Grundfos' innovation history. Grundfos' greatest example of technology push was integrating the frequency converter with the motor and pump in the 1980s by using smart power chips. This set a trend in the whole industry. However, Grundfos is currently facing a period of transition, moving from being a technology-centered company towards a better balance between technology and market/business development. This also means that many different initiatives have been taken during the last couple of years in order to accommodate future challenges, such as increased competition and globalization. Among other things, a large restructuring of the organization was implemented during 2008, and Innovation Intent was launched. Although for many years Grundfos has emphasized technological development and leadership, it has also been aware that collaboration across the organization involving the market-side was necessary. To really understand Grundfos and its context, it is important to understand the legacy of Poul Due Jensen and the current role of Niels Due Jensen, the founder's son, who took over management as Group President after his father's death in 1977. Niels Due Jensen worked as Group President for 25 years, and functions as Group Chairman today. The welcome brochure from Grundfos' internal museum states that "*[the first pump] became a norm for Poul Due Jensen's work and the requirements he gave himself and his employees: A new product can only be justified if it is different and better*". And the brochure

continues: "*Poul Due Jensen was however, not a man who was satisfied with a great result: The pump had to be improved further […]*". But Poul Due Jensen also encouraged collaboration among his employees. His motto was: "*There is not much a single person can accomplish alone; but there are no limits for what several people working together can accomplish*". And this still applies. Only a few people present in the Business Development organization today have experienced working with Poul Due Jensen, but many of today's employees have been in Grundfos for many years and have experienced Niels Due Jensen's engagement in development activities and his visionary mindset: "*If he had not done these things and said this is how it should be, then we would not have had the products we have today. We would not have had a three inch submersible pump. We would not have a sensor factory. Then we would have had the same products as everyone else. […] We should just be thankful that somebody has stepped forward and said; 'we shall have this', and then forced it through*" (Product developer 1). Many similar statements can be found in the interview material, and they bare witness that even though Niels Due Jensen is no longer formally engaged in the daily routines at Grundfos, he still plays an important role with respect to innovation activities and "*is contributing to keep a high level of ambition" (Product developer 2). Niels Due Jensen is not alone however in encouraging innovative activity. Top management is also engaged in selected activities in the R&D organization and does not focus only on economic concerns. "It is easier to get something off the ground here […] and it is very motivating that there is an interest in the things you work with"* (Product developer 3). In general, working with ideas and developing new technologies and trendsetting products are the life blood of Grundfos and a core activity for the R&D professionals.

4.2 Idea-promoting initiatives – an overview

Over the years, the quest for staying innovative has resulted in a series of different idea-promoting initiatives. The initiatives described in the following were brought to my attention in two ways; they were either carried out while I was in the organization, or the interviewees mentioned them in the interviews. Table presents an overview of the different idea-promoting initiatives. The initiatives in Table 1 differ in scope, but overall they aim either to gather and develop ideas, stimulate creativity or strategically steer innovation activities. They also differ in relation to who in the organization is expected to engage in the different initiatives, it varies from specific groups to the whole organization. Despite that Grundfos seems to be a large hierarchy, studying the organizational chart, distance from top to bottom in the R&D organization is not that big in practice. This means that there is room for employees to take initiatives on their own as one did when he established an Innovation Day. And in this line initiatives can originate from many different persons and departments. The last column of Table 1 shows whether the initiative is still running.

It is apparent that a lot of the initiatives were taken during 2006. The main reason for this is that 2006 was announced to be Innovation Year by Top Management. This included an enhanced focus on innovation and brought along a definition of innovation: innovation = creativity x successful implementation. "*It was a global initiative focusing on strengthening a common understanding of what innovation means at Grundfos and how we as an organization may work determinedly to become even more innovative*" (Annual Report 2006).

Table 1. Overview of idea promoting initiatives in Grundfos

Year	Initiative	Aim	Target	Originator	Running
1994	**Speed up the Grundfos Wheel**	Generate ideas to continuously improve Grundfos	Everyone at Grundfos	Top Management	No
1990's	**Idea Bank**	Gather and evaluating ideas	Everyone at Grundfos	Different managers over the years	Yes
2000-2007	**Creative@work**	Stimulate creativity and challenge habitual thinking	R&D, especially project teams	Department Managers, employees and IDEO	No
2006	**The Research &Technology Playground**	Clarify ideas and/or prepare ideas for inclusion in the Technology Planning process	R&D, especially those working with new technologies	R&T Management	Yes
2006	**Grundfos Challenge**	Students are challenged to come up with solutions to real-life business cases	Students of economics and engineering	Top Management and employees	Yes
2000	**Idea Catalogue**	Gather ideas in one document for later use	R&D	Individuals in different departments	Sometimes
2000's	**Creativity Room**	Stimulate creativity	R&D	N/A	Yes
2006	**Innovation Year**	Put innovation explicitly on the company agenda	Everyone at Grundfos	Top Management	No
2006	Innovation Model	Help discipline work with ideas	Everyone at Grundfos	Working group in Grundfos and consultancy firm	Yes
2006	Innovation Piano	Challenge habitual thinking – innovation is more than product innovation	Everyone at Grundfos	Consultancy firm	Yes
2005-2007	Innovation Day	Presenting and selecting ideas	Primarily R&D	Concept Manager	No
2006	Innovation Project Competition	Make different and more radical innovation projects	Everyone at Grundfos	Top Management	No
2008	**Innovation Intent**	Innovation Vision reaching for 2025	Everyone at Grundfos	Top Management	Yes
2008	Grundfos Talents	Finding and developing talents to realize Innovation Intent	Chosen Grundfos employees	Top Management and HR Management	Yes

As Table 1 shows, a range of different initiatives were carried out under the heading Innovation Year. To boost innovation activities, an Innovation Project Competition was held involving the whole organization worldwide. Some interviewees in my interview material stated that the biggest problem with the competition was that it lacked guidance. It was not clear what sorts of ideas management was interested in. Some of the interviewees also mentioned that it was this lack of guidance that lead to work with Innovation Intent, which should work as a guiding star for future innovation efforts at Grundfos.

5 Analysis

I have chosen three of the idea-promoting initiatives presented in Table 1 for further analysis. These are the Idea Bank, R&T Playground, and Innovation Intent.
The Idea Bank is Grundfos' 'problem child' – it has existed for years but has never really become rooted in the organization and has been changed many times. But it has managed to survive changes in scope, administration, management and anchoring in the organization. This is also the reason I have chosen it for further analysis, along with the fact that idea

suggestion systems are often considered to be one of the core activities in Idea Management and are widely studied in academia. Unlike the Idea Bank, the existence of the R&T Playground has been less turbulent and, according to Grundfos, more successful with respect to outcomes. Having chosen the Idea Bank, it is therefore interesting to examine what the R&T Playground is capable of that the Idea Bank is not. Many expectations rest on the shoulders of Innovation Intent. It has been heavily promoted worldwide in the organization. Many hope that Innovation Intent and the tools it brings along will help steer future idea work. Innovation Intent is Grundfos' latest initiative, and it is much more wide-ranging and ambitious than previous initiatives. It can be interesting to examine whether Grundfos, in its launching of Innovation Intent, has learned from previous experiences and incorporated these lessons into Innovation Intent.

5.1 The Idea Bank

Employees worldwide have access to the Idea Bank through the intranet. By pushing the button 'submit idea', employees are led to a form they can fill in with details about their ideas. The ideas are screened by a screening board consisting of four persons in R&D. If the idea seems promising but needs more development, a facilitator can help improve the idea. In addition to the screening board, a day-to-day manager and a secretary are assigned to take care of the Idea Bank's daily administration. The executive management is carried out by the Idea Bank board, consisting of six persons, also within R&D, who are entitled to make decisions regarding the ideas and determine which ones should be considered for implementation in the technology or product planning process.

5.1.1 Inscription

The political understanding [7] of idea work inscribed in the Idea Bank considers ideas as fixed entities 'out there', ready for implementation. The main challenge in staying innovative seems to be to gather as many ideas as possible and thus avoid missing any promising opportunities. Ideas can come from anywhere – perhaps the next promising innovation is currently lying in the drawer of an engineer, on a manager's notepad, a or in the head of a salesman. In the symbolic perspective [7], the Idea Bank presents idea work as a democratic process, as everyone in the organization is welcome to submit their ideas. On the surface, this signals that working with ideas is not only confined to the R&D professionals but is truly a cross-organizational matter. To the outside world, it signals an 'open' organization that is up-to-date with the current trends in best product development practice. In the learning perspective [7], the Idea Bank offers an internal learning process, as facilitators exchange knowledge with the idea-submitters and collaborate in the process of improving the ideas. The characteristics just described coincide with the understanding of idea work inscribed by the Idea Bank's 'designer', but in practice, the concept of the Idea Bank is read quite differently by its users.

5.1.2 De-scription

R&D professionals consider work with ideas to be hard work. Ideas do not just pop up while taking a shower, or if they do, it is a result of a longer process of working with a specific problem, a new material or maybe a customer. For some R&D professionals, their ideas are too valuable to trust to the Idea Bank, since they view working with ideas as a core activity in development work. In the interview material, the Idea Bank is referred to as the 'parking lot', 'the graveyard', and 'the garbage bin', terms that suggest that ideas rarely come further after they have been submitted. "*The Idea Bank is roughly speaking a place where you can park*

your ideas and hopefully get others to continue work with them" (Product developer 4). The Idea Bank is viewed by many as one of the last opportunities to get an idea through the organizational system. Many prefer to mobilize support for an idea through their own network or use alternative channels. According to R&D professionals' view, the main challenge for staying innovative is not how many ideas can be collected, but rather how to select the 'right' ideas. This is a challenge the Idea Bank is not designed to meet. In practice, ideas are submitted to the Idea Bank from many different Grundfos sites, not only R&D; however, since it is only R&D professionals who are represented in the management of the Idea Bank, it is inevitably the R&D agenda that decides what a good idea is for Grundfos. Therefore, the evaluation process is not very democratic.
Besides facilitating an internal learning process for idea-submitters by offering help to further develop their ideas, the Idea Bank also contributes to an organizational learning process. Currently, the Idea Bank board is discussing the future form of the Idea Bank, because its current scope and anchoring in the organization do not fit the future challenges Grundfos will face. But several attempts have already been made to adjust the Idea Bank and make it relevant for employees. One attempt was to call for ideas or solutions to specific problems. This was since modified to accommodate specific challenges identified by Innovation Intent. The possibility for facilitators to help idea-submitters develop their ideas was also incorporated along the way, since it was a problem that some ideas seemed promising but lacked a profound basis for deciding to adopt them. Giving the Idea Bank a catchy name was also tried. Periodically, campaigns were carried out to increase focus on the Idea Bank, and then there have been several changes in management structure and the persons involved. However, the set-up does still not seem to accommodate the practices of idea work at Grundfos. Looking at the above 'de-scription', it is clear that the Idea Bank has not played the role intended for it, or at least only partially. It has neither worked as a tool for providing significant new ideas, nor as a tool R&D professionals prefer to use in their work with ideas. In the R&D context, the Idea Bank, then, does not play an important role with respect to stimulating idea work. However, it should perhaps not be written off totally, since it has a symbolic effect in the rest of the organization and the outside world.

5.2 The R&T Playground

The Research and Technology Playground is: *"a frame which, without unnecessary bureaucracy, must enable and render visible fast settlements of non-planned ideas concerning realization of "Quick-wins" as well as prepare ideas for inclusion in the Technology Planning by making initial settlements. The spirit is that the idea maker himself uses some of his department time to work with the settlement and/or put together a small team of colleagues*" (Grundfos intranet). The Playground is primarily targeted those R&D professionals who engage in research and technology development activities, and who have an idea that requires resources for further development. The Playground is managed by the Technology Manager, who grants the necessary resources. No specific amount of money is set. Resources are given as needed, but if the project evolves positively, the context within which it should proceed is negotiated. The best ideas in the Playground have been rewarded some years with a prize.

5.2.1 Inscription

The political [7] understanding of idea work inscribed in the Playground is that idea work needs a driver or champion who cares about the idea and is interested in developing it. Furthermore, developing ideas requires resources and colleagues to discuss them with.

Symbolically [7], the Playground signals that it is legitimate to work with your own ideas, even if you are currently assigned to other development or research projects. Handing out rewards makes it even more legitimate, and is used as a means to encourage others to submit ideas. In a learning perspective [7], the name Playground indicates that this is a place where you can try things out and experiment with your ideas. If your idea succeeds, Grundfos will gain some quick-wins, and if the idea fails, Grundfos has still learned something, since in this specific area, clarification and insights have been gained.

5.2.2 De-scription

In the interview material, R&D professionals emphasize that in order to develop an idea and get the organization to accept it in practice, it is important to discuss it with colleagues, make it tangible through drawings or mock-ups, and mobilize support among decision makers. The Playground accommodates this process, because when Playground first accepts the idea, it is given a project number, which secures resources for further development, thus making it easier to build prototypes and demonstrate the principle of the idea. The project number makes it possible to book equipment and personnel in the workshop, and makes the department manager aware that the project is running. In practice, how fast a Playground project is carried out varies, since it is an activity that does not have the primary focus accorded to the 'official' development projects to which R&D professionals are assigned. Some projects are never completed, but there is general satisfaction with those ideas that do reach conclusion, useable or not, because clarification is achieved. Examples also exist of ideas that have turned into 'official' projects or are incorporated in existing ones. A good match exists between the understanding of idea work inscribed in the Playground and the idea work carried out in practice in R&D. It can be argued that the way of working with ideas – discussing with colleagues, building mock-ups and mobilizing support – has been institutionalized in the Playground, thus the de-scription matches the inscription. The Playground does play a role in stimulating idea work, especially by making it legitimate for R&D professionals to work with their own ideas. The question is whether those using the Playground would have found the means to work with their ideas anyway, if the Playground did not exist. *"It is for most parts a psychological thing, because this [work with your own ideas] you could have done always. This [the Playground] is just a name attached; engineers have always worked with their own ideas in every innovative company. The special thing here [at Grundfos] is that we accept it"* (Research and Technology Manager). Because the design of the Playground fits very well with the existing practices of idea work at Grundfos, its contribution to the overall organizational learning process about how to facilitate idea work is limited. However, it has been discussed whether a similar initiative should be established in one of the business divisions. During the interviews, it was mentioned that the Playground is aimed at technical ideas, and that a similar initiative for more business-oriented ideas is lacking. *"I can see that [this material] is really moving in [my business segment]. […]. But I do not have the technical competencies required to formulate what it takes. ….] There is no place to go"* (Business developer 1).

5.3 Innovation Intent

In 2008, the Group President launched 'Innovation Intent', an innovation vision extending to 2025. A white paper was published internally at Grundfos describing the visions for the future and some of the steps Grundfos has to take in order to fulfill them. During 2008, the Group President went on tour to visit Grundfos' companies throughout the world and promote the new vision. Some of the vision's headlines: by 2025, Grundfos should have 75,000

employees; 1/3 of the turnover should come from other products than pumps; and 50 percent of the technology platforms should be new compared to 2008. The slogan for Innovation Intent is "Concern, Care, Create", which indicates that sustainability should come first, that Grundfos will be there for a growing world, and that new technologies should be pioneered. Along with the Innovation Intent, three innovation platforms are launched to guide ideas into specific business segments.

5.3.1 Inscription

In a political perspective [7], the understanding of idea work inscribed in Innovation Intent is that idea work is a core activity that is necessary in order to achieve the goals that are set. Furthermore, it cannot be up to the individual at Grundfos to decide what a good or relevant idea is. Ideas need guidance and R&D professionals, as well as everybody else employed at Grundfos, should have a strong shared conception of the direction in which Grundfos is moving. Innovation Intent is a guiding star for the long-term innovation efforts. Especially the innovation platforms shall help managers prioritize focus on and investment in new ideas. Inscribed in the Intent is also the understanding that business development is as important as technology development, and that customers should also be considered relevant for gaining knowledge and insights in the development process. A green policy and clean technologies are also emphasized as important dimensions in the work with ideas. In a symbolic perspective [7], Innovation Intent signals a high level of ambition – 'only the best is good enough'. Competent and qualified employees are needed globally to come up with truly original and game-changing ideas. In a learning perspective [7], Innovation Intent can be viewed as a project of transition in which Grundfos is working towards mastering innovation activities through a more professional and streamlined innovation process, a transition that is expected to contribute to the organization's learning curve with respect to how to stimulate idea work.

5.3.2 De-scription

Innovation Intent is still only in its very beginnings. At the time I conducted my interviews in spring 2009, only a preliminary structure for implementing the changes facilitate by Innovation Intent was agreed upon. Therefore, the Intent had not yet had any effect on the daily work with ideas; but the R&D professionals shared their thoughts about what and how they expected Innovation Intent would influence their future work with ideas. In a political perspective [7], it was clear that the R&D professionals' de-scription of Innovation Intent matched the inscription. Innovation Intent, among both managers and developers, is expected to work as a guiding star and help differentiate relevant ideas from those that are not so relevant. Especially the innovation platforms are welcomed. Some interviewees also stated that in the past Grundfos had successfully used visions to guide idea work, but on a much smaller scale and only locally in various departments or projects. In this respect, then, Innovation Intent accommodates the idea work practices already existing in the organization. However, only time can show whether such a large-scale vision aimed at the whole organization will have the intended effect. Symbolically [7], a high level of ambition is inscribed in the Intent, especially the aims of developing totally new technology platforms and receiving 1/3 of the company's turnover from other products than pumps. In spite of the high level of ambition, the interview material does not express any concerns about being able to achieve these goals; on the other hand, there are not many comments about this. Some just observed that since they would be retired long before 2025, they questioned how much they could contribute.

With regard to learning, it is still too early to conclude what effect Innovation Intent can have on the organizational learning curve. However, during 2010, an organizational unit was established to work with the innovation platforms and make plans, especially about how to accommodate radical innovations. But these experiences are being kept secret for now from the rest of the organization.
It is difficult at this point to conclude whether Innovation Intent will come to play an important role in idea work or how the R&D professionals will integrate it into their idea work practices. So far, it has mostly been welcomed positively, and many expect at lot from it.

5.4 Summing up

In the foregoing analysis of idea-promoting initiatives, I have tried to answer the two sub-questions posed in connection with my main research question: What understanding of idea work is inscribed in the different idea-promoting initiatives? And what role do the different idea promoting initiatives play with respect to idea work? The analysis shows that the understandings of idea work inscribed in the Idea Bank, the R&T Playground, and Innovation Intent differ.
In the Idea Bank, ideas are viewed as fixed entities that are either intrinsically good or bad. The main challenge to staying innovative is to gather as many ideas as possible, and in this pursuit every employee in the organization is relevant.
The R&T Playground acknowledges that ideas need a driver to bring them forth. Furthermore, ideas have to be developed in order to be attractive to the decision makers in the organization. The R&T Playground is mainly targeted R&D professionals working with research and technology.
Innovation Intent views the work with ideas as one of the most important activities for achieving its goals. To stay innovative is especially a question of doing things differently than before, and every employee in the organization is expected to contribute. Especially R&D professionals, though, have a responsibility to lift future development activities up to a new level. What roles the initiatives play depend on how they are de-scribed by the users. The Idea Bank has neither provided significant ideas nor functioned as a tool R&D professionals prefer to use. However, it can be argued that the Idea Bank has a symbolic effect. The R&T Playground especially plays a role with respect to legitimizing R&D professionals' own work with ideas. It cannot be concluded as yet what role Innovation Intent has.

6 Discussion and managerial implications

The focus of this paper is on examining the explicit processes, systems and roles established at Grundfos in order to stimulate and support idea work. Each idea that promotes initiative contains a script, which is the materialization of the designer’s more or less informed presumptions and thoughts about how idea work should be approached and by whom. However, certain understandings of idea work are also embedded in daily practices. This phenomenon could be called the company’s constitution in relation to its work with ideas ("idea constitution"), with inspiration from Woolgar’s [10] constitutive perspective on ideas and Hildebrandt and Seltz’ [11] notion of a company’s social constitution. A company’s idea constitution comprises the implicit norms, values and practices that exist in the organization regarding work with ideas – e.g. what gets to count as an idea, who sets the direction, who is allowed to work with what kind of ideas, and how should ideas be worked through the organizational system? The constitution is formed through organizational history,

experiences, and negotiations, as well as conflicts and compromises. At Grundfos, the idea constitution has been built and rebuilt over the years. Both Poul Due Jensen – *we'll do it ourselves* – and Niels Due Jensen – *contributing to keep a high level of ambition* – have influenced the constitution along with the changing organizational structures, new technological possibilities, and trends in society. The idea constitution in a company is constantly challenged by such influences. Especially idea-promoting initiatives are interesting, as they have been configured for the deliberate purpose of impacting daily idea practices. Idea-promoting initiatives or concepts can be configured differently depending on a range of design variables. On the basis of the analysis of Grundfos' idea-promoting initiatives presented in the previous section, I identify three important design variables. The first variable concerns how the relations between the involved actors are configured: Who is supposed to provide the organization with new ideas, who should drive the ideas through the organizational system, and who is entitled to evaluate and make decisions about ideas? The second design variable concerns how access to resources is configured: Are resources freely given or constrained, and who can they be granted to and on what grounds? The third variable regards strategic concerns: Is it a local or global initiative, what direction is set out if any, and what is expected to be gained from the initiative? Depending on how the idea-promoting initiative is configured, the idea constitution will be affected in different ways and to different degrees. My main research question, posed at the beginning of this paper, is: What makes an idea-promoting initiative 'work' or not 'work'? Here, it could be tempting to answer that idea-promoting initiatives work when the inscribed understanding of idea work matches the understanding of idea work exercised in practice, or what I label the company's idea constitution. However, in order for organizations to sustain innovative capabilities, it is important to move up the learning curve. If the current idea constitution is only reproduced in a new idea-promoting initiative, the question is how much it actually changes practice. Having said this, some degree of congruity is needed in order to make an idea-promoting initiative work. If the idea-promoting initiative is too different in its approach to actual idea work compared to the idea constitution, the risk is that the initiative would not be accepted at all, and then neither immediate benefits nor long-term organizational learning would be gained. To make an idea-promoting initiative work thus requires some degree of congruence between the initiative and practice, but not more than the idea-promoting concept still can challenge current idea practices and contribute to new ways of stimulating, facilitating and supporting work with ideas.

The managerial implication of the present research is that it is the interplay between the explicit processes, systems and roles and daily practices with idea work that it is important to address and shape. Thus, Idea Management is not a question of how formalized the processes, structures and roles a company can establish to steer idea work are, but rather how well they can get new initiatives to match existing idea work practices and still challenge conventional thinking. Following this line of thought, it is important that the designers who configure the idea-promoting initiatives and the managers who implement them are aware of the understandings of idea work that are inscribed in the initiatives and the norms and values that are embedded in the company's idea constitution.

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