



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

Front End Innovation

navigating situated spaces of actors and models

Jensen, Anna Rose Vagn

DOI (link to publication from Publisher):
[10.5278/vbn.phd.tech.00010](https://doi.org/10.5278/vbn.phd.tech.00010)

Publication date:
2017

Document Version
Også kaldet Forlagets PDF

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Jensen, A. R. V. (2017). *Front End Innovation: navigating situated spaces of actors and models*. Aalborg Universitetsforlag. <https://doi.org/10.5278/vbn.phd.tech.00010>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.



FRONT END INNOVATION

NAVIGATING SITUATED SPACES OF
ACTORS AND MODELS

BY
ANNA ROSE VAGN JENSEN

DISSERTATION SUBMITTED 2017



AALBORG UNIVERSITY
DENMARK

FRONT END INNOVATION: NAVIGATING SITUATED SPACES OF ACTORS AND MODELS

by

Anna Rose Vagn Jensen



AALBORG UNIVERSITY
DENMARK

Dissertation submitted

Dissertation submitted: 07.01.2017

PhD supervisor: Professor Christian Clausen
Aalborg University

Assistant PhD supervisor: Assistant professor Liv Gish
Aalborg University

PhD committee: Associate Professor Søren Kerndrup (chairman)
Aalborg University

Professor Henry Larsen
University of Southern Denmark

Professor John Bessant
University of Exeter Business School

PhD Series: Technical Faculty of IT and Design, Aalborg University

ISSN (online): 2446-1628
ISBN (online): 978-87-7112-901-4

Published by:
Aalborg University Press
Skjernvej 4A, 2nd floor
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

© Copyright: Anna Rose Vagn Jensen

Printed in Denmark by Rosendahls, 2017

CV



Contact information:

Anna Rose Vagn Jensen
annarosevagn@gmail.com
www.linkedin.com/in/annarosevagn

Experience:

2017-: Product Specialist, Payments, Nets A/S

2014-2016: Postdoc, Technical University of Denmark, DTU Management Engineering, Engineering Systems

MIPI project: Methods for involving manufacturing employees in R&D processes in collaboration with Haas-Meincke and Alfa Laval, Kolding

EDGE project: ICT based transferal of knowledge from drilling rigs in operation back to design of new drilling rigs in collaboration with Maersk Drilling

2012-2017: PhD fellow, Aalborg University Copenhagen, Department of Development and Planning, Centre for Design, Innovation, and Sustainable Transitions

PhD project: Managing Front End Innovation

2010-20012: PhD student, Technical University of Denmark, DTU Management Engineering, Product Design and Development, Innovation and Sustainability

PhD project: Managing Ideas in Front End Innovation

2009-2010: Research assistant, Technical University of Denmark, DTU Management Engineering, Product Design and Development, Innovation and Sustainability

2006-2008: Innovation engineer, eyeD Innovation

Education:

2002-2008: Technical University of Denmark, Mechanical Engineering, Management Engineering

Master's thesis: Knowledge in Decision Making Processes, understanding decision-making processes in project portfolio management in developing underwater acoustic devices

Bachelor's thesis: Apparatus for Mixing of Chemotherapy, development of mechanical device for mixing chemotherapy in highly complex user environment

Publications:

Medarbejderinddragelse i produktinnovation: Hvorfor MIPI? Fordele og forudsætninger: Jensen, Christian Schou; Jensen, Anna Rose Vagn; Broberg, Ole. DTU Management Engineering 2016

Medarbejderinddragelse i produktinnovation: Hvad er jeres udgangspunkt? En diagnose af virksomheden: Jensen, Christian Schou; Jensen, Anna Rose Vagn; Broberg, Ole. DTU Management Engineering 2016

Medarbejderinddragelse i produktinnovation: Hvordan gør man? Metoder til inddragelse: Jensen, Christian Schou; Jensen, Anna Rose Vagn; Broberg, Ole. DTU Management Engineering 2016

Participatory Methods for Initiating Manufacturing Employees' Involvement in Product Innovation: Jensen, Anna Rose Vagn; Jensen, Christian Schou; Broberg, Ole. Accepted at the 2016 ISPIM Innovation Conference in Porto

Intervention Framework to Support Employee-Driven Innovation between R&D and Manufacturing Department: Jensen, Christian Schou; Jensen, Anna Rose Vagn; Broberg, Ole. Accepted at International Design Conference 2016, Dubrovnik, Croatia

A macro-ergonomic perspective on analyzing and designing knowledge transfer systems in engineering projects within the oil drilling industry: Broberg, Ole; Souza da Conceição, Carolina; Jensen, Anna Rose Vagn. Proceedings 19th Triennial Congress of the IEA. 2015

Employee participation in product innovation: Crossing organizational boundaries by alignment of work systems: Broberg, Ole; Jensen, Anna Rose Vagn; Gish, Liv. Proceedings 19th Triennial Congress of the IEA. 2015

Transferring knowledge from operations to the design and optimization of work systems: bridging the offshore/onshore gap: Souza da Conceição, Carolina; Jensen, Anna Rose Vagn; Broberg, Ole. Proceedings 19th Triennial Congress of the IEA. 2015

Towards a new perspective of managing ideas in front-end innovation as actor networks: Vagn, Anna Rose; Clausen, Christian; Gish, Liv. Presented and published at International Conference on Engineering Design 2013, Seoul, South Korea

Towards a New Framework of Idea Management as Actor Networks: Vagn, Anna Rose. Presented and published at ISPIM 2013, Helsinki, Finland

A literature review of idea management: Jensen, Anna Rose Vagn. Presented and published at NordDesign 2012, Aalborg, Denmark

Identifying knowledge in decision-making processes: Jensen, Anna Rose Vagn; Ahmed-Kristensen, Saeema. Presented and published at International Design Conference 2010, Dubrovnik, Croatia

ENGLISH SUMMARY

This is a paper-based dissertation where the papers are incorporated in the dissertation. The papers are produced as an integrated part of the PhD project and process and represent key outcomes of the different phases of the project. The dissertation consists of a literature study forming the basis for Paper 1, a practitioner study contributing to Paper 2, a case study of three industrial companies contributing to Paper 3, and conceptualisation of a new model as the main basis for Paper 4. The papers use the same set of analytical perspectives and sensitising concepts. This structure has been chosen to support an exploration of new understandings and ways of describing the managing of Front end innovation, and further to propose a new model for Front end innovation.

The project primarily applies theories and literature of innovation management, innovation in organisations, product development, and science and technology studies. As such, the dissertation combines scientific knowledge across different scientific approaches to innovation. The empirical data consists of workshops with practitioners, a survey in an industrial company, and interviews in three industrial companies. The methodological approach is based on interactive research and qualitative methods and analysis inspired and qualified by Situational analysis and Actor network theory. Collection and analysis of data has been an iterative learning process whereby the current understanding and approach to Front end innovation and its reflection in practices has been investigated. In the tension between employees and managers who are working with product development, business development, and technology applications in an organisational structure, the overall question has been how employees and managers are navigating the space of heterogeneous actors and models in Front end innovation.

In the literature study, a key finding has been the identification of primarily two approaches to Front end innovation. Approaches that either lean towards a structure-oriented focus or a social-oriented focus. The literature study identifies an opportunity to go across the two approaches where structural elements such as process models and organisational divisions and social elements such as knowledge creation and network relations could be included in a multi-perspective approach. The practitioner study shows how practitioners navigate and use many different understandings and models in the work with Front end innovation. This confirmed the complexity of Front end innovation in practice and at the same time identified an ability to navigate this complexity by using a wide range of different perspectives from both structural- and social-oriented approaches. The case study of three industrial companies identifies two perspectives in literature, a process model perspective and a knowledge perspective in understanding the managing of Front end innovation. The analysis further identifies a third perspective, translation. The case study provides both detailed descriptions, across the three companies, of how

practitioners navigate between models and actors by using approaches from the identified perspectives but also how this can be described and analysed as a translation process from Actor network theory. Based on the literature-, practitioner-, and case study, the study has provided input to the development of a new model of Front end innovation. The Front end innovation model raises new questions yet to be fully investigated. Some of these questions could for instance be answered through further studies of Front end innovation informed by a co-creating process with practitioners to further develop the model.

DANSK RESUME

Dette er en artikelbaseret afhandling hvor artiklerne er inkorporeret i afhandlingen. Artiklerne er produceret som en integreret del af ph.d.-projektet og processen, og repræsenterer centrale resultater af de forskellige faser af projektet. Afhandlingen består af et litteraturstudie, som danner grundlag for Artikel 1, et praktikerstudie som bidrager til Artikel 2, et casestudie af tre industrielle virksomheder som bidrager til Artikel 3, og konceptualisering af en ny model som det primære grundlag for Artikel 4. Artiklerne bruger det samme sæt af analytiske perspektiver og opmærksomhedsfremmende begreber. Denne struktur er blevet valgt for at støtte afhandlingens udforskning af nye måder at beskrive og forstå ledelse af Front end innovation, og videre at foreslå en ny model for Front end innovation.

Projektet anvender primært teorier og litteratur fra innovationsledelse, innovation i organisationer, produktudvikling og teknologistudier. På denne måde kombinerer afhandlingen videnskabelig viden på tværs af forskellige videnskabelige tilgange til innovation. De empiriske data består af workshops med praktikere fra industrien, en spørgeundersøgelse i en industriel virksomhed og en række interviews i tre industrielle case virksomheder. Den metodiske tilgang er baseret på interaktiv forskning og kvalitative metoder og analyser inspireret og kvalificeret af Situational analysis og Aktør-netværksteori. Indsamling og analyse af empiriske data er foregået i en iterativ læringsproces, hvorved den aktuelle forståelse og tilgang til Front end innovation og dennes afspejling i praksis er undersøgt. I spændingsfeltet mellem medarbejdere og ledere der arbejder med produktudvikling, forretningsudvikling og applikationer af ny teknologi i en organisatorisk struktur, har det overordnede spørgsmål været, hvordan medarbejdere og ledere navigerer i rummet af heterogene aktører og modeller i Front end innovation.

I litteraturstudiet er et vigtigt resultat identificering af primært to tilgange til Front end innovation. Tilgange som enten læner sig op ad et strukturelt orienteret fokus eller et socialt orienteret fokus. Litteraturstudiet identificerer en mulighed for at gå på tværs af de to tilgange hvor strukturelle elementer, som procesmodeller, organisatoriske opdelinger, og sociale elementer, som videnskabelse og netværksrelationer, kunne inkluderes i en multiperspektivisk tilgang. Praktikerstudiet viser hvordan praktikere anvender mange forskellige forståelser og modeller i arbejdet med Front end innovation. Dette bekræftede kompleksiteten af Front end innovation i praksis og identificerede samtidig evnen hos praktikere til at navigere i denne kompleksitet ved hjælp af en lang række forskellige perspektiver, hentet både fra strukturelt- og socialt orienterede tilgange. I casestudiet af tre industrielle virksomheder identificeres to perspektiver i litteraturen, et procesmodel-perspektiv og et viden-perspektiv i forståelsen af ledelse af Front end innovation. Analysen identificerer yderligere et tredje perspektiv, translation. Case studiet giver både detaljerede beskrivelser, på tværs af de tre virksomheder, af hvordan praktikere

navigerer mellem modeller og aktører ved brug af tilgange fra de identificerede perspektiver men også hvordan dette kan beskrives og analyseres ved hjælp af translationsprocesser fra aktør-netværksteori. Baseret på litteratur-, praktiker- og casestudiet har nærværende forskningsstudie givet input til udviklingen af en ny model for Front end innovation. Modellen rejser nye spørgsmål som endnu ikke er fuldt undersøgt. Nogle af disse spørgsmål kunne eksempelvis søges besvaret igennem yderligere undersøgelser af Front end innovation informeret af en samskabende proces med praktikere i videreudvikling af modellen

ACKNOWLEDGEMENTS

First of all, I would like to give special thanks to my supervisors Christian Clausen and Liv Gish, I am very grateful. Also, I would like to acknowledge the participating companies. Many different companies have contributed to this study in different ways and I am very thankful for all the practitioners who were willing to share their experiences. I would also like to thank the different research groups that I have been part of throughout the study. And last, I would like to express my eternal gratitude and thanks to my husband and our two daughters for keeping up our spirits for the long haul.

CONTENTS

Chapter 1. Introduction.....	15
1.1. motivation	16
1.2. Research design.....	18
1.3. Reading guide	21
Chapter 2. Literature study	23
2.1. A structure-oriented approach to FEI.....	23
2.2. A social-oriented approach to FEI	26
A Literature Review of Idea Management.....	33
Abstract.....	33
Introduction.....	33
Method	33
Review	34
Conclusion	41
References.....	41
Chapter 3. Methodology and analytical perspective.....	45
3.1. Multi-situated data collection.....	45
3.2. Analytical approach	49
Chapter 4. Practitioner study.....	53
4.1. Workshops	53
4.2. Survey	53
4.3. Practitioner insights.....	54
Towards a New Perspective of Managing Ideas in Front End Innovation as Actor Networks	63
Abstract.....	63
Introduction.....	63
Review of current understandings of idea management.....	64
Method of acquiring knowledge and collecting data	66
Idea processes in the perspective of actor networks.....	68
Empirical findings in the perspective of actor network theory	69

Discussion	72
Conclusion	74
References.....	75
Chapter 5. Case study.....	79
5.1. Agro	79
5.2. MedX	82
5.3. HiLite	84
Three Perspectives on Managing FEI: Process, Knowledge, and Translation	89
Abstract.....	89
Introduction.....	89
Literature review: Three perspectives on FEI	91
Research methodology	96
Results and analysis: Three perspectives used on three cases.....	98
Discussion	108
Conclusion	112
References.....	113
Conceptualising a Model for FEI: Navigating Networks and Translating Processes in Innovative Spaces	121
Abstract.....	121
Introduction.....	121
Methodology of the study	123
FEI models in literature.....	125
FEI models in case studies	130
Conceptualising the FEI model.....	134
Discussion	141
Conclusion	144
References.....	145
Chapter 6. Discussion	149
6.1. Understandings in literature	149
6.2. Practices of managing FEI	150
6.3. Reframing the modelling of FEI	152
Chapter 7. Conclusion	157

References.....159

FIGURES AND TABLES

Figure 1 Practitioner workshop exercise of Requirements for managing ideas	55
Figure 2 Initial theoretical framework of idea management illustrating how a process moves within a space from one configuration of content to another.....	73
Figure 3 Development funnel (Wheelwright and Clark, 1992))	125
Figure 4 Stage gate process for the front end of innovation (Cooper, 2001)	126
Figure 5 Integrated front end process model (Sandmeier, Jamali, Kobe, Enkel, Gassmann, and Meier, 2004)	126
Figure 6 Holistic model of the front end, NCD model (Koen, Bertels, and Kleinschmidt, 2012).....	127
Figure 7 Phases and factors in the transfer of creativity to practicable ideas (van Dijk and van den Ende, 2002).....	128
Figure 8 A model of organisational ideation (Hellström and Hellström, 2002).....	129
Figure 9 The evolution of a self-organised innovation (Koch and Leitner, 2008) .	130
Figure 10 A FEI model from Agro	131
Figure 11 FEI process model from MedX	132
Figure 12 Model of radical FEI from HiLite.....	133
Figure 13 Staging of early phases in product design (Clausen and Yoshinaka, 2007)	138
Figure 14 FEI model	140
Table 1 Study timeline and affiliations	18
Table 2 Research design	20
Table 3 Identified literature on a behavioural - structural continuum.....	37
Table 4 Overview of data collection in the practitioner study	46
Table 5 Overview of interviews conducted in case companies.....	48
Table 6 Practitioner workshop; Requirements for managing ideas in the FEI process	56
Table 7 Practitioner workshop, Needs and challenges for managing ideas in FEI ..	58
Table 8 Literature on idea management divided in the two foci of structural and social	65
Table 9 Overview of the process, knowledge, and translation perspective in the three cases	111

CHAPTER 1. INTRODUCTION

This publication disseminates my PhD study conducted between 2010 and 2016, initially in affiliation with the Technical University of Denmark and later with Aalborg University Copenhagen. The PhD study concerns the subject of organising and managing the front end of innovation (FEI) in product innovation companies. The study consists of theoretical investigations, empirical investigations, the application of new analytical perspectives to the subject, and the development of a FEI model based on my findings.

My PhD study was initiated and carried through, not only on the basis of my academic education as an engineer of Design & Innovation, but also my personal experiences and interests in the understanding of organising and managing FEI. Soon after finishing my candidate degree with a specialisation in innovation management I was hired as a research assistant. From this position I also worked towards a PhD scholarship. A while before, I had been exploring my ability to practice some of my training at a consultancy where I was supporting different companies in organising the early conceptualisation of new products. At the same time, during my educational training at DTU, I had a Master's course project of managing idea work in a large Danish product innovation company. The focus of interest in the study was the approach of practitioners of R&D and business development to organise, manage and perform early development of new business and technology ideas. We sought to understand the models, innovative processes, and specific FEI activities with views from the analytical perspective of actor network theory (ANT). During the course of my education, I have learnt the analytical perspective of ANT and it seemed to be able to engage with the complexity of actors, processes, and models both rooted in technology development, business units, organisational learning and managing approaches.

The master course project was limited to an indicative analytical study in a single company and it revealed more questions than answers concerning the organising and managing of innovation ideas and early innovative processes. Why was it so hard for technology development and business units to collaborate on new opportunities? Why did individuals carry new concept ideas across the structural boundaries of technology- and business development using informal routes? My interest was especially caught by the complex heterogeneity and need for an explorative approach that could allow the development of a new and complementary understanding and support of practices that, according to our experiences, did not seem to be available or sufficiently adequate at that time. The models and processes employed through management concepts seemed to be unable to capture and support the more elusive, complex and frequently informal practices of FEI.

During my employment as a research assistant, the relevance of the subject of managing innovation ideas in FEI was reinforced in a dialogue with significant practitioners of large global leading Danish companies. Not only were they concerned with the difficulties of fitting FEI into process models as known from new product development (NPD), but I also noticed a lack of vocabulary for FEI and what makes FEI different from NPD. The industrial practitioners, both managers and employees, thought of the ordinary processes of product development as something more destructive than productive for FEI, as one practitioner of innovation management said: *'innovation and new ideas should emerge and develop 'because of' managing structures and not 'in spite of'!*. I also identified this tension in academic literature, both in a critique of rational management process models to leave the FEI as this chaotic and complex environment and as a view of an inefficient FEI that had the great potential of becoming more efficient and successful if formalised.

1.1. MOTIVATION

This originated in a meeting with one of the most significant product innovation companies in the Danish medical device industry that, in many respects, were frontrunners in innovative processes that contributed to the basic ideas of the PhD project. This meeting confirmed the need for a clearer view of the complexity of FEI and a more sophisticated approach in managing ideas and FEI, as stated by the Vice President of product innovation: *'We do not need another idea management system...'*. To elaborate on this opportunity for researching the managing of FEI in product innovation companies, I carried out two workshops with practitioners from large well-established companies in Danish industry. These two workshops further framed the research and clarified the challenges and requirements that were discussed and dealt with in practice. A few key framing themes were consolidated, such as the challenges of managing the flow of ideas, evaluation and implementation of product ideas, an overload of low quality ideas in the managing process, lack of formalised processes of early idea development leaving it up to individuals to carry through ideas and making it an unmanageable process, a bias between long-term technology development and short-term business development creating a schism between business units and R&D, etc.

At that time, I was affiliated with the section of Product Design and Development at DTU Management Engineering, primarily researching the field of engineering design, and I was conducting research with a sub-group concerned with engineering knowledge management. At that time, it was intended that the PhD project would produce an idea management system as the research tradition in the group generally focused on an industrially supportive and applicable outcome in the form of a new recipe, model or tool. In the dialogue with practitioners, however, it was made explicitly clear that they did not want yet another idea management system, as the experience was that these systems only supported a fraction of what the FEI is

supposed to do and was not at all capable of capturing the more crucial practices of FEI. The idea management systems were able to collect and store many explicit ideas but did not have influence on the FEI processes that make ideas take place in an organisational structure. The practitioners from the Danish companies expressed a need for a more holistic view of the managing of ideas and the framing of FEI than what the practitioners understood from current models and systematising approaches. These practitioners perceived the area of ideas and FEI as something hard to grasp and especially something that did not work as management tools and theory suggested it would. At this point, I realised for the first time the profoundness of practices unaccounted for in the environment of the complex and elusive innovation processes comprising FEI in large product innovation companies. At the time, I recognised that a more fundamental rethinking of how current approaches within literature viewed the FEI was needed. This PhD project was not going to be a straightforward process and I was not convinced that the development of an idea management system would make a relevant contribution.

I decided to move to the related section of Innovation and Sustainability at DTU Management Engineering. This group was working with methodologies and theories that could support my PhD project in its reframing, was able to grasp complex organisational processes, and would inform the development of support with new insights. In this process I also decided to collaborate with another supervisor I had previously worked with who was more specialised in complex innovation processes in product innovation companies. As closing the circle of my scientific identification, the research group I now joined in continuing my PhD studies had developed the Design & Innovation engineering education in collaboration with the Product Design and Development group that I had been affiliated with so far in my PhD studies. These two groups were both concerned with innovation in product development but had very different views, approaches, and contributions to research. One group is concerned with engineering design studies and somewhat more allied to mechanical engineering, studying specific design situations and conceptualisation from the view of the design engineer. In contrast, the other group is concerned with science and technology studies and somewhat more focused on innovation in the context of technology, the organisation, and the society.

One of the strengths of the Product Design and Development group was the focus on synthesis and development of support of practices in industry, and one of the strengths of the Innovation and Sustainability group was the focus on descriptive analysis and the ability to comprehend complex innovation networks, social processes, and organisational structures. The group of Innovation and Sustainability of which I was now a part moved to Aalborg University Copenhagen and continued with the name of Centre for Design, Innovation, and Sustainable Transitions in 2012. As I am a product of both research areas described in the latter, it became evident for me to employ these strengths from both areas, yet this would also bring with it conflicts of perspective that can seem to make my research and scientific

identification difficult or less straightforward. Nevertheless, it gives me the opportunity for a creative process of breaking down current constructs and forming new perspectives to input my own contribution. As I enter the task of drawing and integrating from different perspectives, my PhD study is full of paradoxes – just like innovation processes in settled innovation companies – and this will shine through in my process. It will also be with the aim of developing new views of approaching FEI to develop a model that has the potential to support practitioners in their understanding and practicing of FEI in order to complement the current models and managing processes used in product innovation organisations. Below is an overview of my study timeline and affiliations:

Year	PhD study aim	Affiliation	Leave of absence
2010	Scientific and empirical identification	Section of Product Design and Development, DTU Management Engineering	
2010-2011			Maternity leave
2011-2012	Empirical understanding	Section of Innovation and Sustainability, DTU Management Engineering	
2012-2014	Development of empirical support	Centre for Design, Innovation and Sustainable Transitions, AAU CPH	
2014-2016			Postdoc position, DTU
2016	Writing dissertation	Centre for Design, Innovation and Sustainable Transitions, AAU CPH	

Table 1 Study timeline and affiliations

1.2. RESEARCH DESIGN

As an engineer of Design & Innovation from DTU, one essential driver is to develop a constructive contribution that can offer the potential to support the practices of innovation and design processes. I wanted to go further than descriptive analysis and engage in developing a model of FEI with a distinctive focus on proposing an approach that could support the practices of FEI. A Design & Innovation engineer is

educated in basic mechanical engineering subjects and reflective competences concerning users, manufacturing, organisational structures, and business design together in a holistic approach. The innovation aspect is, in particular, a focus on a sociotechnical perspective towards innovation, primarily received through theories and analytical perspectives of science and technology studies. The integration of engineering design understanding and applications, sociotechnical reflections and analysis, and creative synthesis makes the Design & Innovation engineer capable of understanding innovation as a sociotechnical process involved with technology development and business modelling together with an understanding of organisational structures and processes that support the innovation process. The inclusion of different aspects of innovation processes in companies such as technology development, organisational structures, and business processes also focus on a user-oriented approach. In applying this perspective in order to create support for FEI, in my view, a research project not only includes the ‘application’ but also a ‘user’ of what is developed. Therefore, it was also necessary to engage with industry early in my studies to find out more about the ‘user’ of my ‘application’ and what truly would be a need or business opportunity. From my early interactions with industry, I became encouraged to reframe the current approach and understanding of FEI. The insights I gained from interacting with industry led me to some basic assumptions:

- FEI is a complex setting of diverse types of knowledge creation engaging with process models in an organisational structure where new ideas emerge and go through conceptualisation
- To go from an objectified view of ideas to a view of ideas as heterogeneous networking processes impacts upon the understanding of challenges in FEI
- Employees in an organisation who work with creation of innovative ideas, develop and promote them engaging in relations to organisational structures, innovation tools and models, and others in the organisation
- Organisational structures may not support and can even hinder FEI processes
- The modelling and managing of FEI impacts the emergence and development of innovation ideas and can either hamper, challenge, and/or support FEI
- Current models of FEI management may not engage with more informal processes of FEI
- Understanding the emergence and development of ideas in FEI and, to some extent, formalising and structuring through organising and managing can increase innovation capability and idea quality

These assumptions form a basis that raises the question of how FEI could then be approached. This leads me to ask, how could FEI in product innovation companies

be investigated in order to enrich and extend the current understanding of FEI, and how could a model of FEI be developed in order to support FEI practices in product innovation companies? In these questions, there lies an understanding of the actual situation but also an understanding of a forward-looking strategic approach for FEI:

- *How are FEI viewed and understood in literature and which perspectives and models frame the approach to FEI?*
- *How are FEI organised and managed in practice in product innovation companies and which perspectives and models frame the approach to FEI?*
- *How could a new conceptual model reframe the understanding of FEI to support the practices of FEI?*

To reveal answers to my research questions, I developed a research design inspired by the design research methodology (Blessing and Chakrabarti, 2009) to guide my study. Below is an overview of the research study design in phases, activities, aims and outputs:

Research phase	Activity	Aim and output
Literature study	Review literature on FEI	Development of scientific identification Paper 1
Practitioner study	Engage with practitioners of FEI	Development of empirical identification Paper 2
Descriptive study	Case study of FEI	Development of empirical understanding Paper 3
Prescriptive study	Development of FEI model	Development of support Paper 4

Table 2 Research design

1.3. READING GUIDE

The dissertation is structured around four papers. In my view, this has not only made my papers the pillars but also framed them in a chronological order as the study has progressed. The first part of the dissertation is a literature review and Paper 1. Here, I introduce selected perspectives on FEI from literature and Paper 1 is a literature review that takes up idea management as a case to frame the literature study. The next part is going through the methodology and analytical perspectives of the study where I present research methods and analytical framings. The following part is a practitioner study with the aim of engaging practitioners in order to make the object of my study more concrete. Paper 2 follows this, where I explore an approach to FEI in the perspective of ANT. The next part of the dissertation, to which the previous parts have led, will present a case study through detailed case narratives followed by the case study in Paper 3 where the analytical perspective is further applied. Paper 4 follows, where I suggest a new FEI model based on my findings throughout my study. The next part will draw up and discuss my findings in the study and summarise my contributions. Finally, the dissertation will end with concluding remarks.

CHAPTER 2. LITERATURE STUDY

In this chapter I will analyse the main literature on FEI. I have divided the literature into two categories according to how I perceive a division in the literature on FEI. This division is also found in social theory, for instance in the framing of structuration theory by Giddens (1984) where a division is made between the social and the structures. In my categorisation, one category understands FEI primarily through a structure-oriented approach and the other primarily through a social-oriented one.

2.1. A STRUCTURE-ORIENTED APPROACH TO FEI

Overall, FEI is widely understood as a structured process systematised through a sequence of activities and frequently modelled as a process model of activities placed before NPD. FEI accounts for significant decisions in later NPD processes (e.g. Cooper, 2001; Koen et al. 2002). The FEI has been framed and modelled in different ways but frequently focused on the phases of generation, evaluation, and selection of ideas (e.g. Wheelwright and Clark, 1992; Boeddrich, 2004) that aim to enable the management of FEI. Managing FEI in terms of ideation, evaluation, and selection is seen as a way to organise and optimise the FEI in order to increase efficiency and target FEI towards NPD. Some studies also identify activities of opportunity identification and analysis (e.g., Koen et al., 2002) as a source of ideas and where the concept development is feeding NPD. Common to most studies is that they perceive ideas as specific objects with intrinsic properties in order to limit the consequences of uncertainty, focusing on the structural and measurable dimensions of FEI. Furthermore, frequently the focus is to formalise and structure the FEI in order to utilise the full potential of FEI in leveraging innovation capability (e.g. Koen et al. 2002; Markham, 2013). The approaches to FEI are frequently grounded in traditional linear and somewhat iterative process models and view ideas as entities with distinct qualities and predictable outcomes (Gish and Clausen, 2013) that develop somewhat independently through a number of distinct processes or stages. Here, management seeking structure and transparency focuses on resource allocation, process optimisation, and evaluation criteria. As a consequence, FEI can become more exploitative than explorative (Benner and Tushman, 2003).

Knowledge or idea management literature supplies a variety of frameworks, models and systems for navigating the stream of ideas in FEI. Recent literature has begun to investigate how idea management systems are integrated into the practices of idea processes in organisations and identify certain managerial implications (e.g. Bakker et al., 2006; Brem and Voigt, 2007; Björk and Magnusson, 2009). There is an emphasis on both human behaviour and the system's structure in managing ideas but the interplay between the two in which managerial implications then becomes relevant is still an area to be uncovered in depth. Overall, the literature points to the

importance of considering practices in integrating models, systems and structures in organisations but not much research is conducted on how people interact with and within these structures. In the structure-oriented perspective, process models such as the stage gate model (Cooper, 2001) also have considerations on knowledge when specific competencies and experience from functional departments are brought in and utilised to carry out activities in the stages and gates. However, this knowledge utilisation is more oriented around managing and exploiting available knowledge unlike knowledge creation. In knowledge management, systems are frequently in focus as a way to capture, store, and transfer explicit knowledge. In social-oriented perspectives knowledge considerations in relation to FEI will be more focused on knowledge creation (Nonaka, 1991) and flow (Wenger et al., 2002) in transforming tacit knowledge into explicit, combining knowledge to make new knowledge available for the organisation leaning towards a more explorative mode of knowledge activities which, again, is more prevalent in FEI compared to NPD (e.g. Reid and de Brentani, 2004; de Brentani and Reid, 2012).

Successful innovations are frequently initiated and predetermined in FEI (Markham, 2013). In some literature, the FEI is viewed as having the most promising potential for optimisation in managing innovation (Cooper, 2001; Herstatt, Verworn, and Nagahira, 2004; Reid and de Brentani, 2004). At the same time, FEI is considered to be chaotic, uncertain, and unmanageable (Gassmann and Schweitzer, 2014; Koen et al., 2002). Markham (2013) investigates the impact of FEI activities on product performance and concludes that they have more impact than NPD, strategy, or champions, and he thus suggests building more structure into the FEI to utilise this potential for positive impact on innovation capability. Over time, literature on FEI, has established a more consistent understanding that FEI differs significantly from NPD processes (Cooper, 1988; Smith and Reinertsen, 1998). Markham, Ward, Aiman-Smith, and Kingon (2010) describes how three key roles, the “champion,” “sponsor,” and “gatekeeper,” drive and promote the process of the FEI from research to acceptance in formal NPD. They describe the space between research and formal NPD as “the valley of death” due to the lack of resources needing skills and expertise. From this perspective, structural roles are brought forward, and the authors point to a predominant dependence on, sometimes, informal roles, such as idea champions, gatekeepers, and knowledge brokers. Here, the social-oriented perspective will also be relevant, which I will return to in the following section.

Studies of the role of the FEI can be linked to considerations of continuous and discontinuous innovation (de Brentani and Reid, 2012). While discontinuous innovation, or breakthrough innovation, relates to expected changes in either technology or the market or both, continuous innovation, or sustaining innovation, is viewed as merely modifications of existing products (Garcia and Calantone, 2002). They are connected in that the more breakthrough and discontinuous the innovation, the more “fuzzy” the FEI (de Brentani and Reid, 2012). According to Garcia and Calantone (2002), the degree of innovativeness of product innovation predominately

lies between the end points of breakthrough and sustaining innovation, and this would require the process of FEI to be flexible enough to include product innovation concepts that have different levels of innovativeness. Benner and Tushman (2003) use perspectives from organisation theories in their work on the management of innovation. They argue that process management that relates to the structural approach is fundamentally inconsistent with types of innovation processes other than continuous innovation. They further explain that dynamic capabilities are rooted in both explorative and exploitative innovation activities and mention the ambidextrous organisation that can provide support for both kinds of activities. They use the dominant focus on productivity to explain the focus on exploitative activities and the limitations of process management.

Dougherty (1992), who also studies product innovation through an organisational perspective, describes two interpretive schemes as barriers in linking technology and market knowledge in product design. These schemes are departmental thought worlds, where innovators are reluctant to synthesise their knowledge with other thought worlds, and organisational product routines, that hinder organisational learning. Entrepreneurial processes are one alternative way to overcome the barriers for product innovation in large organisations. Dougherty (1992) also describes that the successful innovators are those that are able to overcome the barriers of departmental thought worlds and organisational routine hurdles. These successful innovators have special abilities in finding and connecting the right dots in promoting product innovation in the organisation. Moreover, Rank (2008) discusses the coexistence of, and interdependencies between, formal organisational structures and informal networks. The author finds that managers in strategy making to a certain extent disregard formal work contacts and use informal cooperation ties, especially in a vertical direction. Koch and Leitner (2008) have studied and discussed a complexity perspective on self-organised FEI and found that self-organisation supports formal top-down structures and helps overcome bureaucratic processes but also that informal bottom-up processes run in parallel or precede formal FEI. We can argue that the ways in which FEI activities are performed may diverge from what is formally prescribed. If we want to turn away from trying to control the processes of FEI through standard top-down management tools and instead to understand, support, and utilise them through collaborative interaction between top-down structures and bottom-up self-organisation, we need to apply new perspectives to the matter to better understand what is going on and how to frame the FEI.

In the comprehensive literature review of innovation processes by Garud, Tuertscher, and Van de Ven (2013) they point out four different complexities as being associated with innovation processes: evolutionary, relational, temporal, and cultural. Instead of *controlling* these processes, as is one approach in innovation-management literature, Garud, Tuertscher, and Van de Ven (2013) draw attention to the *harnessing* of these complexities, as it is a far more productive and sustaining

approach to innovation processes. Scholars of innovation management identify informal practices, networking and entrepreneurial activities (e.g. Rank, 2008; Böhle and Bürgermeister, 2012; Koch and Leitner, 2008; Björk and Magnusson, 2009) as dominating the processes of FEI. The complexity theorist Stacey (1992) differentiates between the legitimate system and the shadow system in organisations. The legitimate system is the formal, explicit, and measurable side of organisational processes, whereas the shadow system is the informal, tacit, and uncertain side of organisational processes. In the shadow system, implicit knowledge and diversity in thought and approaches prepares the ground for creativity and in the interaction with the legitimate system of explicit procedures and routines, increased innovation capacity can be reached (Brown and Eisenhardt, 1997). The majority of innovation management literature deals with the legitimate system of process stages, centralised explicit knowledge, top-down planning and implementation and, in general, neglects the shadow system of informality. In order to gain an increase in innovative capability, I need to focus on the interaction between the legitimate system (formality) and the shadow system (informality). I see an interesting distinction in Stacey's definition of the shadow system and the legitimate system of the innovative organisation (Stacey, 1992).

The core of my critique lies in the many management approaches and models that have a tendency to draw on frameworks from the legitimate system and mechanistic view of organisational processes. While one could argue that FEI processes are particularly related to explorative activities, it is remarkable that most of the current understandings and conceptualisations of the management of FEI seem too focused on process structures to counter or replace the uncertain and what sometimes appear as chaotic and ad hoc informal processes in FEI. There seems to be a mismatch between how we try to structure and formalise the FEI and what really takes place. The point here is that the structural approach is limited in its understanding of FEI that inevitably also entails complex social processes and interactions.

2.2. A SOCIAL-ORIENTED APPROACH TO FEI

Social perspectives of innovation processes are widely recognised in literature dealing with innovation as well as FEI. For instance, social networks analysis (e.g. Otte and Rousseau, 2002) helps to map out a social structure and, depending on the study, it can lean towards a structural understanding of a social network or towards a social understanding dealing more with the social interactions and dynamics. When leaning towards a social understanding, more informal activities in the interactions between individuals in creating new ideas and bringing them forward can become relevant (e.g., Allen, James, and Gamlen, 2007; Björk and Magnusson, 2009). Literature on innovation not only recognises the influence of informal social processes, but also emphasises it as significant because of its implications for managerial practices and how product innovation companies organise innovation processes (Björk and Magnusson, 2009; Holahan, Sullivan, and Markham, 2014;

Lawson, Petersen, Cousins, and Handfield, 2009). In FEI, the social perspectives and informal characteristics are particularly evident (e.g. Reid and de Brentani, 2004, de Brentani and Reid, 2012; Markham et al., 2010). According to Markham et al. (2010), significant parts of development take place before the 'formal' product development process. Certain organisational roles enable the movement of projects from research to development. These roles are actors that exist in more informal layers of the organisation but are significant in moving projects across organisational boundaries in the innovation process of the company. Champions conceptualise ideas, sponsors provide resources for promising ideas, and gatekeepers evaluate and initiate decision-making (Markham et al., 2010). Again in de Brentani and Reid's (2012) continuous work on roles in FEI of radical/discontinuous innovation, roles are described as being central to the movement and success of innovations in companies. They describe roles such as boundary spanners, gatekeepers, and project brokers at different interfaces of the innovation process. The common denominator of these roles may be their capability for carrying different types of knowledge across organisational or cultural borders or drawing on, and gathering, diverse knowledge to establish new product concepts. Even though this research engages with individuals, roles, and social networking, it leans towards social structures and thereby a structure-oriented approach.

Böhle, Bürgermeister, and Porschen (2012) have an interesting approach in explaining approaches to innovation management. One approach, Planning-Oriented Innovation Management, to innovation management is explained through a path dependency perspective. Here, principles, perspectives, and approaches inherited from industrial production management relate to '*minimising uncertainty and limits of planning to the furthest extent possible and maximising planning, steering and control.*' (Böhle, Bürgermeister, and Porschen, 2012). I see the resemblance with the point that Benner and Tushman (2003) bring forward but, in the writings of Böhle, Bürgermeister, and Porschen (2012), the focus is on informal processes in an organisation. Social interaction in the setting of organisational and process structures is an important consideration in product innovation processes, for instance when informal decision-making processes in a network process perspective lay the foundation for formal decision making in gate meetings between stages (Christiansen and Varnes, 2007) or, alternatively, when early innovation processes are performed by informal entrepreneurs promoting ideas through creating relations (Schön, 1983), or when traditional management of planning and controlling meets its limits in handling informality in innovation processes (Böhle, Bürgermeister, and Porschen, 2012). Studying informal processes in organisational structures is not a new subject. In organisation studies it is widely discussed, albeit to a much lesser extent in an innovation perspective. The discussion of informality in relation to innovation and FEI is a subject with which few authors have engaged. Dougherty (2008) has a significant contribution on informality and innovation, bringing structures into the discussion but with a social perspective, where some structures hinder informal innovation while others support informal innovation. She relates

informality to reflective practices. Innovation literature has, over the years, contributed with an increased understanding of how innovation activities can be supported by the organising of processes in mature organisations (Dougherty 2008).

Understanding innovation through a social-oriented perspective can also become relevant when viewing FEI as the integration of different knowledge domains and departments. Knowledge sharing through social relations is an integral part of innovation in organisations in order to overlap the phases of innovation processes, especially to account for the more informal characteristics of innovation processes in organisations. Informal sharing of knowledge and insights in relations between actors are an unavoidable part of innovation processes in companies. In studies of innovation, especially in the area of innovation management, knowledge aspects are considered as significant in order to get a broader understanding of innovation processes in organisations (e.g. Tidd and Bessant, 2009). It may be described as recognition of social aspects as resources of knowledge, experiences, and competencies and the ability to create new knowledge from a diversity of sources and drive innovation ideas that can contribute significantly to innovation in companies.

When it comes to knowledge sharing and creation in interactions between individuals through formal or informal practices, using models with a structural perspective such as process models can be limited in its understanding of FEI. Takeuchi and Nonaka (1986) suggested the new product development game as an alternative or supplementary view to the NPD process and identify a challenge of dividing the process in sequential steps and instead they suggest viewing the product development process as a rugby game with stages overlapping each other significantly. Later on, other discussants have suggested similar alternative models that take into account the more iterative nature of innovation processes (e.g. Koen et al., 2002; Reid and de Brentani, 2004) in sharing knowledge and interactions between individuals. In the characterisation of the differences in the product development models, Takeuchi and Nonaka (1986) use concepts that reflect social aspects of innovation processes, such as self-organisation, learning, and creativity. In their view, innovation processes require more complexity and dynamic capabilities than is enabled in standard process models. In later work, Nonaka (1991) describes a social knowledge creation process where tacit knowledge and subjective insights can be utilised in innovation processes in organisations. The knowledge creation perspective is focused on sharing and creating knowledge both internally to coordinate and utilise existing knowledge and to extend the knowledge pool, for instance, through open innovation (Chesbrough, 2003).

The knowledge creation perspective is also in focus in studies of social networks as capable of gathering competencies, knowledge creation and diffusion, and driving innovation ideas (Allen et al., 2007, Björk and Magnusson, 2009, Gupta and Maltz, 2015, Brunetto et al., 2016). When recognising knowledge sharing and creation

between individuals through social relations, more complex and uncertain interactions beyond the rationality of process models are also recognised. As such, this implicates the balance of managerial support of both informal social network dynamics and formal process structures. In the context of FEI, these considerations would be critical in order to support managerial functionalities. With an offset in practices of knowledge management, social network analysis can be used as a tool for mapping and understanding informal networks and thereby support the managerial utilisation of the resources these networks provide in innovation processes (Allen et al., 2007). Björk and Magnusson (2009) also point to the importance of the informal aspects of social networks in developing innovation ideas and its implications for managerial practices. Brunetto et al. (2016) investigate how informal as well as formal relations between employees, managers and the organisation can be a way of overcoming resource-restricted environments and can be used as a source of innovative behaviour. This study also relates to the area of employee involvement in innovation. The concept of involved employees that share and exchange knowledge, competencies, and experiences through formal or informal interaction is thought to significantly contribute to innovation capabilities (Bessant, 2003, Hallgren, 2008, Kesting and Ulhøi, 2010, Sergeva, 2014). Employee participation can be both formally implemented through suggestion systems (van Dijk and van den Ende, 2002) or organisational and process structures but can also reside in informal social networks as discussed in communities of practice.

Communities of practice (CoPs) are individuals who '*...share their learning experiences and knowledge in free-flowing, creative ways that foster new approaches to problems*' (Wenger and Snyder, 2000). CoPs are informal in nature and can be a resource of innovation capabilities (e.g. Brown and Duguid, 1991; Pattinson and Preece, 2014). As much as it is related to learning, it is also related to knowledge management and has gained its place in innovation literature. Because of its ability to see informal processes of learning, knowledge creation and sharing in relation to organisational practice it has relevance for understanding FEI. CoPs can be enablers for learning for innovation (Pattinson and Preece, 2014). Emerging CoPs in companies can be a place for sharing and creating knowledge both within specialisations, across functionalities and organisational boundaries, and between companies. CoPs can also emerge as specific domains including and excluding members according to profession and creating powerful players with a risk of constraining innovative capability (Ferlie et al. 2005). In FEI, it would be relevant to utilise knowledge and expertise from different technical and market domains and thereby CoPs that allow different professions. As dispersed collaborative configurations (Pattinson et al. 2016), CoPs can enable innovation because diverse knowledge is combined and recreated (Nonaka and Toyama, 2003). The benefits of CoPs in leveraging innovative capabilities are well documented in literature (Bertels et al. 2011) and this offers the question, how to nurture the emergence of CoPs? In Pattinson et al. (2016), it is described as purposeful governance structures and Koen et al. (2014) claim that FEI can benefit from CoPs if they are supported on a

corporate level. Wenger et al. (2002) describe how to cultivate CoPs through strategic direction and context while Cross and Prusak (2002) define roles as central connectors, boundary spanners, brokers, and specialists (Pattinson et al., 2016). Here there is a clear reference to the balance between autonomy and control in supporting, managing, and/or cultivating CoPs and differentiating between formal and informal practices and structures, as previously discussed.

The social-oriented approach fills in the gaps that the structure-oriented approach leaves behind. I introduced this chapter by referring to social theory of dividing between the social and structures. In parallel, I see the same division in literature of FEI but I also recognise how this is limiting a more holistic and practice-oriented picture of FEI in companies. Giddens (1984) takes a step closer to a holistic view by suggesting the structuration theory, where the social recreates structure, and structure creates social interaction. Following this concept, in my view, FEI is constituted by social processes interacting with, and within, structures, and in applying ANT as an analytical perspective structures can become actors and together with other actors, both human and non-human, be part of the configuration and translation process of actor networks.

PAPER 1

The first paper in my dissertation relates to my first research question and the literature study. In the form of a conference paper, I have chosen a specific theme or case to build upon the literature review. The chosen theme within FEI for this paper is idea management. The paper investigates the literature on idea management and contributes to the PhD study with a scientific awareness and understanding of current approaches to themes within FEI. The paper seeks to map out literature on idea management across different research areas in order to find consistencies and/or inconsistencies that could lead to revealing gaps or opportunities for research.

Paper title: A literature review of idea management

Author(s): Anna Rose Vagn Jensen

In: Proceedings of NordDesign Conference 2012

Publisher: Centre for Industrial Production, Aalborg University

ISBN: 978-87-91831-51-5

Conference: The Ninth NordDesign Conference, 2012 - Aalborg, Denmark

A LITERATURE REVIEW OF IDEA MANAGEMENT

ABSTRACT

The objective of the paper is primarily to conduct a state-of-the-art literature review of Idea Management and, secondarily, to point out unanswered questions which are left behind in the reviewed literature. Scientific knowledge is primarily represented in innovation management literature but also considerably in literature on software and IT. In the background of the literature review, there are some weaknesses in the literature to be considered concerning the understanding of how people interact with idea management in their daily work practices and how different types of ideas are included or excluded in the idea management processes.

Keywords: Literature review, idea management, idea management systems, front end innovation

INTRODUCTION

In academic literature, front end innovation has, in the last decade, been given increasing attention as an area with a potential for increasing innovation capability. A passage in the literature suggests exploiting this potential through the concept of idea management. Ideas are the potential starting point for any innovation venture and by understanding and supporting idea processes in front end innovation, companies can strengthen their innovative capability. The paper aims to identify and review the current literature dealing with idea management. Idea management has ancestors such as the suggestion box and cousins such as the ideation process but, in this paper, idea management will refer to the management of the process of motivating, generating, evaluating and implementing ideas on an organisational level in the context of front end innovation.

METHOD

Idea management is naturally related to a context of certain literature which forms a background but also intersects with the literature of idea management. This is literature which deals with innovation, front end innovation, ideation and creativity, typically with a management or engineering design perspective. The paper reviews literature which explicitly uses the term “idea management”. Literature has been found through a search across a wide range of scientific databases using the keyword “idea management” appearing anywhere in the text. The literature has been found through access to multiple databases within all fields of science. The search

has resulted in more than 150 hits, which include journal papers, conference proceedings, book chapters, magazines and newsletters, and duplicate literature. The first selection was to eliminate duplicate literature, and the second selection qualified 29 journal papers and conference proceedings. Some publications were untraceable and therefore did not qualify, neither did articles from magazines and newsletters. As a result of insight into this idea management literature, it can be thought of as dealing with the management of ideas in two perspectives: behavioural and structural. The behavioural perspective is focused on understanding cognition, creativity, and social capital in managing idea processes and the structural perspective is focused on systems and designs for managing ideas. The structural and behavioural perspectives can be placed on a continuum line, one at each extreme, and literature on idea management can be placed somewhere on this line depending on how much effort is used on either, or both, extremes. The perspective is relevant because idea management is strongly related to the use of systems for capturing, sharing, storing and retrieving ideas, while still being a complex social human process in interaction with technologies. With this perspective in mind, the following section will review the identified literature on idea management.

REVIEW

Identified and selected literature has been placed in a table and on the suggested continuum. The placement on the continuum is the result of a qualitative and somewhat explorative analysis of the literature and serves as a way to produce a sense of the focus in the literature and to map the individual contributions against each other. A short review of the literature will now be conducted with the continuum in mind although independent of this perspective. The review is qualitative but seeks to be true to the terms of the literature. Further on, in the discussion section, a more critical view will be used in order to point out weaknesses and unanswered questions of the identified literature.

Ref.	Affiliation	Year	Author(s)	Title	Behavioural
[21]	<i>Academy of Management Proceedings & Membership Directory</i>	2002	Saatcioglu	Using grounded inquiry to explore idea management for innovativeness	
[26]	<i>Journal of Management Studies</i>	2006	Vandenbosch et al.	Idea management: A systemic view	

[15]	<i>International Conference on Engineering Design</i>	2011	Gish	Experiences with idea promoting initiatives
[10]	<i>Conference on Human Factors in Computing Systems</i>	2008	Coughlan & Johnson	Idea management in creative lives
[23]	<i>Creativity and Innovation Management</i>	2011	Selart & Johansen	Understanding the Role of Value-Focused Thinking in Idea Management
[22]	<i>International Journal of Product Development</i>	2010	Sandström & Björk	Idea management systems for a changing innovation landscape
[1]	<i>Conference on Human Factors in Computing Systems</i>	2010	Bailey & Horvitz	What's Your Idea? A Case Study of a Grassroots Innovation Pipeline within a Large Software Company
[2]	<i>Creativity and Innovation Management</i>	2006	Bakker et al.	Creativity (Ideas) Management in Industrial R&D Organisations: A Crea-Political Process Model and an Empirical Illustration of Corus RD&T
[25]	<i>R&D Management</i>	2002	van Dijk & van den Ende	Suggestion systems: transferring employee creativity into practicable ideas
[4]	<i>Journal of Product Innovation Management</i>	2009	Björk & Magnusson	Where Do Good Innovation Ideas Come From? Exploring the Influence of Network Connectivity on Innovation Idea Quality
[16]	<i>Human Systems Management</i>	1983	Green et al.	Idea management in R&D as a Human Information Processing Analog

[14]	<i>Organizational dynamics</i>	1983	Galbraith	Designing the Innovating Organisation
[3]	<i>Journal of Product Innovation Management</i>	2009	Barczak et al.	PERSPECTIVE: Trends and Drivers of Success in NPD Practices: Results of the 2003 PDMA Best Practices Study
[5]	<i>Creativity and Innovation Management</i>	2004	Boeddrich	Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process
[20]	<i>Journal of Technology Management</i>	2002	Nilsson & Elg	Managing ideas for the development of new products
[13]	<i>International Journal of Innovation Management</i>	2003	Flynn et al.	Idea management for organizational innovation
[9]	<i>International Journal of Technology, Policy and Management</i>	2007	Brem & Voigt	Innovation management in emerging technology ventures - the concept of an integrated idea management
[11]	<i>R&D Management</i>	2009	Enkel et al.	Open R&D and open innovation: exploring the phenomenon
[18]	<i>Annual Hawaii International Conference on System Sciences</i>	2010	Hrastinski et al.	A review of technologies for open innovation: Characteristics and future trends
[8]	<i>Technovation</i>	2009	Brem & Voigt	Integration of market pull and technology push in the corporate front end and innovation management - Insights from the German software industry
[24]	<i>Human Factors and Ergonomics in Manufacturing</i>	2009	Tung et al.	A custom collaboration service system for idea management of mobile phone design

[29]	<i>Journal of Software</i>	2010	Xie & Zhang	Idea Management System for Team Creation
[28]	<i>Communications in Computer and Information Science</i>	2010	Westerski et al.	A model for integration and interlinking of idea management systems
[27]	<i>International Journal of Web Based Communities</i>	2011	Westerski et al.	The road from community ideas to organizational innovation: A life cycle survey of idea management systems
[17]	<i>Conference on Human Factors in Computing Systems</i>	2011	Holtzblatt & Tierney	Measuring the effectiveness of social media on an innovation process
[7]	<i>International Conference on Internet and Web Applications and Services</i>	2008	Bothos et al.	A collaborative information aggregation system for idea management
[6]	<i>Expert Systems with Applications</i>	2012	Bothos et al.	Collective intelligence with web-based information aggregation markets: The role of market facilitation in idea management
[19]	<i>Annual Hawaii International Conference on System Sciences</i>	2011	Moos et al.	The role of innovation governance and knowledge management for innovation success
[12]	<i>International Journal of Innovation and Learning</i>	2009	Fatur & Likar	The development of a performance measurement methodology for idea management

Structural

Table 3 Identified literature on a behavioural - structural continuum

In an earlier contribution on the subject of idea management, Green et al. (1983) analysed the management of the flow of ideas in an R&D laboratory in a human information-processing perspective. Here the authors use the understanding of human information processing as an analogy of, for example, how the human brain processes information, synthesises, remembers, recalls it, etc. They present a logic with human information-processing on the one side and organisational information-

processes on the other, equally contributing to the flow of ideas in industrial R&D. Managerial implications are identified, concerning the generation of ideas, capturing ideas, retaining ideas and retrieving ideas. It is interesting that this early study predicts the future of idea management and its strong connection to the use of computer technology as an analogy to the human brain. This study was, however, before the explosion of information technology and one could only imagine how IT would take part in the work practices as idea processes and management. The analogy is interesting and, when brain mechanisms are placed outside the head of people on an organisational level, thought-provoking issues will occur in idea process practices. In a contribution at the same time, Galbraith [14] suggests a certain design of the organisation where innovation ideas, more specifically radical innovation ideas, have better conditions. The term of idea management is used on a more individual level as a cognitive and social process and concerns how ideas are developed and promoted through bargaining and negotiating in the organisation.

Idea management literature is primarily based in the field of innovation management in organisations and as a part of the development of information technology described above, idea management is also represented and developed in information technology literature dealing with applications of idea management systems. As an example, an idea management system for team creation has been developed by Xie & Zhang [29]. They seek to understand the process of team creation and to develop a software tool to support and enhance the process. In general, the idea process of the team creation is duplicated in the tool and made manageable through the main steps of idea recognition, idea selection, idea evaluation, and idea visualisation. The work of Westerski et al. [27] deals with the development of idea management systems and furthers it; from being nothing more than a box where employees could submit their ideas on a piece of paper, the web 2.0 techniques allow the complex submission of data and data handling in idea management systems. The work of Westerski et al. [28] suggests the use of semantic web principles to link organisational systems for better idea assessments.

Studies of idea management most frequently imply an IT system for the sharing and storage of ideas in innovation management literature. This is even on a global level both within an organisation and crossing the boundaries of the organisation. Brem & Voigt [9] suggest the integration of an idea management system where an internal idea management is integrated with external groups such as suppliers, customers, competitors, and other stakeholders, which will improve the chances of successful innovations. The idea management system can also be a sharing point between users, the market and organisations [24] and thereby also work as an instrument for handling open innovation [11]. Work by Bothos et al. [6], [7] show how idea management can even be placed outside the organisation and be performed through virtual markets where professionals and users evaluate and select ideas to be implemented into the organisation's development pipeline. Furthermore, Holtzblatt & Tierney [17] investigate how social media can influence the innovation process.

Hrastinski et al. [18] review technologies used for open innovation where one is idea management and points to certain implications in designing these systems in terms of increased customisation, attracting innovators, handling information overflow, and supporting the creative front end of innovation. The last implication is elaborated, and it is suggested that IT systems do not yet support the idea processes in the earliest stages.

Innovation literature particularly deals with front end innovation in a managerial perspective and, common for the fields which deal with idea management, is a recognition of a creative ideation process, which can be managed in order to reduce uncertainty in the front end of innovation and give stronger links to the innovation process of an organisation and thereby increase innovation capability. In the work of Saatcioglu [21] and Vandebosch et al. [26], ideas are viewed as movement and change, cognition and knowledge, and social interaction. The management process is viewed as recognising the need for ideas, idea generation and evaluation. This process is, with variations as seen in the latter, very common and agreed upon in the literature on idea management. In this particular study, Saatcioglu [21] and Vandebosch et al. [26] shows how the idea management process can be approached in different ways by certain manager archetypes found in the study. In this study, the focus is on the managers and how their personality types influence the management of ideas, and it is highlighted that this understanding can support the way idea processes are managed and thereby the performance of management in general. In this study, an IT system is not explicit and there is an understanding in the literature that human idea management can exist on its own but an IT idea management system cannot. As a consequence, the aim with idea management systems is to facilitate and support human idea management to lift innovation capability to a higher level of performance [19], [12].

Nilsson & Elg [20] investigate idea management systems and propose certain considerations to ensure successful implementation in order to increase innovation capability. These considerations are the purpose of the system, the role of information technology, the role of the submitter in realising his/her idea and the way in which ideas are transformed to the product development process. van Dijk & van den Ende [25] considers organisational-related factors for managing creativity in order to transform creativity into practicable ideas as divided into structural and cultural. Cultural factors consider factors such as management support, willingness for change and a clear strategy where structural factors consider evaluation and reward procedures and allocation of means for idea work. A proposed model is comprised of three phases, idea extraction based on the cultural factors, idea landing based on both cultural and structural factors, and idea follow-up based on structural factors. Flynn et al. [13] views the idea-generation process based on innovation theory as being types of innovations, innovation as a process, and the innovation process closely related to ideas and creativity as a human resource, a process, and cultural. Flynn et al. [13] proposes the idea creation methodology and the innovation

funnel together with a software tool to support the managerial process of idea creation and innovation. Boeddrich [5] proposes a set of general and specific requirements of idea management on the background of innovation models of organising the fuzzy front end of innovation and draws on a case study of computer-aided idea management. Brem & Voigt [8] build upon a range of idea and innovation management models and frameworks and suggests an advanced framework of a front end innovation approach for an innovation strategy in a frame of an integration of market pull and technology push mechanisms. Bakker et al. [2] adds a political process aspect to the understanding of idea management on the background of viewing creativity in relation to the organisation. Using the proposed model of the Crea-political process, an empirical study of an idea management software tool is conducted.

There is a shared understanding in the literature of idea management of innovation as depending on employee cognition, creativity, and social interaction. The literature on idea management is closely related to literature on ideation where social interaction, creativity and decision-making are essential topics. Caughlan & Johnson [10] investigate idea management processes on an individual and social level where capture, representation and development of ideas are essential processes. Bailey & Horvitz [1] investigate grassroots innovation pipelines within a company and how these can be structured and supported through idea management. Selart & Johansen [23] builds on a notion of creative thinking as being alternative- or value-focused which results in greater or lower number of ideas of greater or lower quality. In their study, the number of ideas did not relate to the quality of ideas, which has implications for idea management systems. They conclude that value-focused thinking has more potential for creating quality ideas, which has implications for how ideas are evaluated in idea management systems. Sandström & Björk [22] investigate the implementation of idea management systems and points out the managerial implications of informal idea processes and types of idea acceptable for the idea management system. In another work of Björk & Magnusson [4], they investigate the relationship between individual and group network connectivity and innovation idea quality based on a study of the data in an IT idea management system. It is recommended that social networks need managerial support while it is an open question whether or not social networks and ideation processes should be formalised. In the work of Gish [15], idea-promoting initiatives are examined in a company, how they are designed and how they are used in practice in idea work. In a discussion, it is argued that an idea management systems design that does not match the practices of idea processes in the organisation may have difficulties in being integrated in the organisation but, at the same time, a system which matches the practices may not challenge practices in order to increase innovation capability. The managerial implication of the study is the interplay between the explicit processes and system and the daily practices of idea work. The formalisation of idea processes should not be solely in focus but the way to facilitate practices and challenge them. Gish [15] finishes the contribution by encouraging managers who

implement idea promoting initiatives to be aware of, and understand, the design and intent of the system on the one hand and the daily practices of the organisation on the other. In a best practices study by Barczak et al. [3] they conclude that the results concerning idea management in the front end of innovation are ambiguous but agreed as an area in need of improved management.

CONCLUSION

The review shows that idea management knowledge is not only represented in innovation management literature but also in IT literature. Idea management literature primarily deals with best practice case studies and supplies a variety of frameworks, models and systems for manoeuvring the stream of ideas in front end innovation. Recent literature has begun to investigate how idea management systems are integrated in the practices of idea processes in organisations and to identify certain managerial implications. There is an emphasis on both human behaviour and the systems structure in managing ideas but also the interplay between the two, and which managerial implications become relevant is still an area to be uncovered in depth. The review leaves behind uncertainty regarding whether the idea management systems will live up their promises of increasing innovation capability. In particular, two unanswered questions are left behind; how are ideas viewed in the process of idea management – are they viewed as an entity which has gained enough structure and momentum to be submitted to the idea management system or are ideas viewed as mouldable, fragile and depending on social and political interactions like bargaining and negotiating to move ideas forward? And how are radical and incremental innovation differentiated and how does this influence the process of idea management? The reviewed literature points to the importance of considering informal idea processes in integrating idea management systems in organisations but not much research has been conducted on how people interact with idea management systems in their daily work practices and which managerial implications this brings. The literature also points to the difference in idea processes considering radical against incremental innovation but the issue is largely left behind when considering idea management. In the literature, these issues are indicated but not dealt with in depth.

REFERENCES

- [1] Bailey, B.P. & Horvitz, E., "What's Your Idea? A Case Study of a Grassroots Innovation Pipeline within a Large Software Company", CHI2010: PROCEEDINGS OF THE 28TH ANNUAL CHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS, VOLS 1-4, pp. 2065-2074, 2010
- [2] Bakker, H., Boersma, K. & Oreel, S., "Creativity (Ideas) Management in Industrial R&D Organizations: A Crea-Political Process Model and an

- Empirical Illustration of Corus RD&T", *Creativity and Innovation Management*, vol. 15, no. 3, pp. 296-309, 2006
- [3] Barczak, G., Griffin, A. & Kahn, K.B., "PERSPECTIVE: Trends and Drivers of Success in NPD Practices: Results of the 2003 PDMA Best Practices Study", *Journal of Product Innovation Management*, vol. 26, no. 1, pp. 3-23, 2009
- [4] Björk, J. & Magnusson, M., "Where Do Good Innovation Ideas Come From? Exploring the Influence of Network Connectivity on Innovation Idea Quality", *Journal of Product Innovation Management*, vol. 26, no. 6, pp. 662-670, 2009
- [5] Boeddrich, H., "Ideas in the Workplace: A New Approach towards Organizing the Fuzzy Front End of the Innovation Process", *Creativity and Innovation Management*, vol. 13, no. 4, pp. 274-285, 2004
- [6] Bothos, E., Apostolou, D. & Mentzas, G., "Collective intelligence with web-based information aggregation markets: The role of market facilitation in idea management", *Expert Systems with Applications*, vol. 39, no. 1, pp. 1333-1345, 2012
- [7] Bothos, E., Mentzas, G. & Apostolou, D., "A collaborative information aggregation system for idea management", *Proceedings - 3rd International Conference on Internet and Web Applications and Services, ICIW 2008*, pp. 289-296, 2008
- [8] Brem, A. & Voigt, K., "Integration of market pull and technology push in the corporate front end and innovation management - Insights from the German software industry", *Technovation*, vol. 29, no. 5, pp. 351-367, 2009
- [9] Brem, A. & Voigt, K., "Innovation management in emerging technology ventures - The concept of an integrated idea management", *International Journal of Technology, Policy and Management*, vol. 7, no. 3, pp. 304-321, 2007
- [10] Coughlan, T. & Johnson, P., "Idea management in creative lives", *Conference on Hu-man Factors in Computing Systems*, pp. 3081-3086, 2008
- [11] Enkel, E., Gassmann, O. & Chesbrough, H., "Open R&D and open innovation: exploring the phenomenon", *R&D Management*, vol. 39, no. 4, pp. 311-316, 2009
- [12] Fatur, P. & Likar, B., "The development of a performance measurement methodology for idea management", *International Journal of Innovation and Learning*, vol. 6, no. 4, pp. 422-437, 2009
- [13] Flynn, M., Dooley, L. & O'Sullivan, D., "Idea management for organizational innovation", *International Journal of Innovation Management*, vol. 7, no. 4, 2003
- [14] Galbraith, J.R., "Designing the Innovating Organization", *Organizational dynamics*, vol. 10, no. 3, 1982

- [15] Gish, L., "EXPERIENCES WITH IDEA PROMOTING INITIATIVES", Proceedings of the 18th International Conference on Engineering Design, pp. 83-92, 2011
- [16] Green, S.G., Bean, A.S. & Snaveley, B.K., "IDEA MANAGEMENT IN R&D AS A HUMAN INFORMATION PROCESSING ANALOG", Human Systems Management, vol. 4, no. 2, pp. 98-112, 1983
- [17] Holtzblatt, L. & Tierney, M.L., "Measuring the effectiveness of social media on an innovation process", Conference on Human Factors in Computing Systems, pp. 697-712, 2011
- [18] Hrastinski, S., Kviselius, N.Z., Ozan, H. & Edenius, M., "A review of technologies for open innovation: Characteristics and future trends", Proceedings of the Annual Hawaii International Conference on System Sciences, 2010
- [19] Moos, B., Beimborn, D., Weitzel, T. & Wagner, H., "The role of innovation governance and knowledge management for innovation success", Proceedings of the Annual Hawaii International Conference on System Sciences, 2011
- [20] Nilsson, L. & Elg, M., "Managing ideas for the development of new products", Inter-national Journal of Technology Management, vol. 24, no. 5-6, pp. 498-513, 2002
- [21] Saatcioglu, A., "Using grounded inquiry to explore idea management for innovative-ness", Academy of Management Proceedings & Membership Directory, 2002
- [22] Sandström, C. & Björk, J., "Idea management systems for a changing innovation landscape", International Journal of Product Development, vol. 11, no. 3, 2010
- [23] Selart, M. & Johansen, S.T., "Understanding the Role of Value-Focused Thinking in Idea Management", Creativity and Innovation Management, vol. 20, no. 3, pp. 196-206, 2011
- [24] Tung, W., Yuan, S. & Tsai, J., "A custom collaboration service system for idea management of mobile phone design", Human Factors and Ergonomics in Manufacturing, vol. 19, no. 5, pp. 494-509, 2009
- [25] van Dijk, C. & van den Ende, J., "Suggestion systems: transferring employee creativity into practicable ideas", R&D Management, vol. 32, no. 5, pp. 387-395, 2002
- [26] Vandenbosch, B., Saatcioglu, A. & Fay, S., "Idea Management: A Systemic View link", Journal of Management Studies, vol. 43, no. 2, 2006
- [27] Westerski, A., Iglesias, C.A. & Nagle, T., "The road from community ideas to organizational innovation: A life cycle survey of idea management systems",

- International Journal of Web Based Communities, vol. 7, no. 4, pp. 493-506, 2011
- [28] Westerski, A., Iglesias, C.A. & Rico, F.T., "A model for integration and interlinking of idea management systems", Communications in Computer and Information Science, vol. 108 CCIS, pp. 183-194, 2010
- [29] Xie, L. & Zhang, P., "Idea Management System for Team Creation", Journal of Software, vol. 5, no. 11, pp. 1187-1194, 2010

CHAPTER 3. METHODOLOGY AND ANALYTICAL PERSPECTIVE

The research approach in my study is based on qualitative research methods and analysis. In applying the selected qualitative research methods, I seek to understand the arena of my study, the companies, the practitioners, my research design and aims, the scientific knowledge, and the analytical perspectives used. This understanding and methodological approach is inspired by Clarke's (2005) situational analysis (SA) where I seek to accommodate and represent the heterogeneous and complex character of FEI. In this way, I consider and understand the human and non-human actors, key elements, their relations, concerns and controversies in my study arena. This has formed a study that first investigates literature and practitioners. Based upon emerging themes from these investigations, I apply chosen analytical perspectives in a multi-case study and then conceptualise a model based upon my findings. Collection of data has been carried out using methods of literature search, workshops, survey, and interviews. The methods used will be explained in more detail in the following sections. I will introduce and explain the analytical perspective and approach of ANT and SA in the last section of this chapter.

3.1. MULTI-SITUATED DATA COLLECTION

3.1.1. LITERATURE STUDY

My literature study has applied an explorative investigative approach. I have searched for FEI-related knowledge in a wide range of research communities such as engineering design, innovation management, knowledge management, and organisational learning. It has been a qualitative investigation where references in literature could lead me to other literature. The themes related to FEI are not necessarily named or thematised consistently, and this requires an open and explorative search for knowledge on the subject. In my papers, the literature reviews have been more framed according to the focus of the paper. Some literature, such as creativity and cognition as well as entrepreneurship and champion literature, related to FEI has been left out to limit the study. Furthermore, I have chosen to not engage in a deeper discussion on radical versus incremental innovation. Radical and incremental innovation can also be perceived as a continuum (Garcia and Calantone, 2002). In my experience with practitioners it can be very relative. What is radical for the company may be incremental, for instance for the market and what may seemingly begin as an incremental innovation can evolve to be concerned with radical business modelling. The concepts of radical and incremental will be present in my study but the distinction between them and placing them as opposites is not

the focus. Categories have emerged from the literature investigations and I chose to divide the literature roughly into two main categories as, otherwise, it would have created a large array of different themes which I have chosen to save for the literature reviews in the papers. This overall literature study has given me an overview to inform a more targeted approach in the literature reviews in the papers. Furthermore, the literature study has framed the practitioner study. According to main consistencies in literature, the practitioner study has used concepts and models from literature to create a frame for the interactions with practitioners.

3.1.2. PRACTITIONER STUDY

The practitioner study is inspired from interactive research (Eklund et al., 2008) where I, as a research system, interact with the practice system in order to obtain an understanding of the problems and issues of FEI practices through a joint effort (Svensson and Nielsen, 2002). I can both share an understanding with the practitioners and arrive at a different understanding, but the point is to develop understandings and perspectives that are highly relevant for the practitioners (Seim et al., 2014). In adapting this research approach, the findings would lay the ground for framing my further case study in the PhD project. The practitioner study consists of two workshops with participants from several large Danish product innovation companies and one survey carried out in one of the participating companies.

Method	Workshop 1	Workshop 2	Survey
Participants	6 companies	8 companies	115 respondents

Table 4 Overview of data collection in the practitioner study

3.1.2.1 Workshops

The workshop method was chosen to be able to invite and interact with a broad sample from industry, yet small enough to conduct a productive workshop. The workshop method brings together practitioners with real experiences from different industries and with a shared practice-oriented interest in FEI. It is an intensive session where the participants are actively and equally sharing experiences and creating new insights in an informal environment. The workshops support the interactive research approach and provided valuable insight in focusing and framing the further studies in the early phases of my project. Both workshops used a participatory approach inspired from design games (Brandt, Masseter and Binder, 2008) where we shared experiences and discussed the themes through presentations and exercises. The workshops each had a duration of five hours and were recorded through notes and video. Managers from six different companies attended the first workshop, and the second workshop was held three months later and was attended by managers from eight different companies, where some of whom had also

attended the first. The first workshop consisted of a design game and the second workshop was a session where each participant would share experiences through a presentation followed by a discussion. The workshops were scoped around the themes of requirements of managing ideas in FEI and the managerial challenges and needs for doing so.

3.1.2.2 Survey

To get a more nuanced view of FEI in these large Danish companies, I also needed to gain some insights of product developers' practices in the setting of FEI activities. In order to gain a broader overview of issues concerning ideas and FEI, I developed a survey that I deployed in one of the participating companies of the workshops that would also become case company later in the PhD project. The two workshops gave me a valuable insight into issues and concerns of managing ideas and FEI but it was from the managers' point of view. I needed to have a notion of how these issues concerned the developer and other employees working with FEI, and decided to create a broad, if relatively superficial, impression through a survey. The survey as a method collecting data was also chosen at an early stage to give practitioner insights in order to frame and focus the study. The survey was chosen to target a broad sample from one of the participating companies. In this way I had a chance to hear many different views on FEI activities through the eyes of product developers. The survey was carried out in one of the participating companies also being one of the case companies in the following case study. The survey contained both open-ended questions and closed statements. Answers to the statements were based on a Likert-type scale (Bryman, 2008) from a positive response over a neutral response to a negative response to statements given in the different questions. Questions and statements were informed from literature on FEI activities together with the issues discussed in the two workshops. The questions were developed with inspiration from literature on idea management, especially the work of Boeddrich (2004) and Bakker et al. (2006), and from the issues I revealed from the industrial practitioners' workshop. Questions and statements fell into five categories: 1) Background information on the respondent, 2) Idea motivation, 3) Idea work, 4) Idea roll-out, 5) Idea evaluation, and 6) Idea launching.

3.1.3. CASE STUDY

After the insight received from the two workshops and the survey, I decided to carry out a multiple case study design (Yin, 2009) in order to compare and contrast different Danish companies' approaches to organising and managing ideas and FEI. The case study design focuses on understanding the dynamics present within the specific case's setting (Eisenhardt, 1989) and thus allows me to investigate a specific practice. The case study approach enables me to address the complicated research questions and collect a rich array of evidence (Yin, 2009). The research design is an iterative process reacting to the empirical investigations from interviews

from a multiple case study. This multiple case study is not conducted with the aim of comparing the cases against each other as identical study objects where I try out different hypothesis, but rather to understand their differences and similarities in their own context. The only similarities that I could control were to investigate companies with similar structures and trajectory. The companies were all large, 250+ employees, well established, global businesses, and product innovation.

Through a search for companies that lay within the boundaries of the category of companies that I had been investigating so far, three companies agreed to contribute with interviews to my project. These three companies were large, well-established Danish companies with product innovation activities and in the same category as the companies who had initially expressed their concerns about FEI activities. Two of the case companies were selected among the workshop participants and the participating company of the survey, and one company was chosen from a FEI network group. To carry out case studies in more than one company allowed me to compare and contrast my findings and to develop generalisability to some degree. Three cases seemed to be enough to compare across companies, but still reasonable within the resources of the PhD project. The criteria for selecting the companies were age (>40 years), size (>500 employees) and having a mature R&D organisation for product innovation. No criteria were set for a specific industry or markets, only that the companies developed and produced physical products.

Case company	30 min. interviews	120 min. interviews
Agro	8	
MedX		2
HiLite		2

Table 5 Overview of interviews conducted in case companies

The collection of data was based on interviews with managers and employees from the three case companies. Semi-structured interviews (Bryman, 2008; Kvale and Brinkmann, 2009) were made in all three case companies and were recorded and transcribed. Questions included topics such as background information of the respondent, challenges in working with ideas and FEI, organisation of R&D activities, and innovation strategies. In the first company, eight short interviews lasting from a half to one hour were made with product developers and middle managers from three functional departments of FEI organisation and processes. Two contact persons in the company selected the interviewees according to instructions. In the second company, two long in-depth interviews were conducted with a Global R&D Director and a Project Management Office Manager, each with a duration of two hours. In the third company, three long in-depth interviews were performed in a

breakthrough innovation department, two interviews were made with the department director and one interview with a department employee. The interviews also had a duration of approximately two hours. I also received the current models of FEI that were in use in the case companies. These models were part of the interviews and used in analysis and conceptualisation. Furthermore, background information of the case companies was gained from company web sites, news articles, and previous interactions such as educational projects and network groups.

3.1.4. CONCEPTUALISING THE FEI MODEL

The conceptualisation of the FEI model has been based on the findings in the studies of literature, practitioners, and company cases. Besides being informed by the findings of the study, the model is conceptualised using the concepts of ANT.

3.2. ANALYTICAL APPROACH

The analytical approach and method has also been informed by Clarke's (2005) situational analysis (SA) and by ANT, and has been used with all the collected empirical data. As such, the perspectives of ANT and SA have also framed my overall qualitative approach in my studies by providing a range of sensitising concepts (Bowen, 2006). Analysis has been performed through categorising, coding and building understanding from data through the framing of ANT concepts and structure of SA. Clarke's (2005) analytical approach has grown from grounded theory (Glaser and Strauss, 1967) as a postmodern methodology and seeks to accommodate the complexity of heterogeneous phenomenon and is useful in practice-oriented qualitative research (Mathar, 2008). To create a sense of the complexity without reducing the empirical through objectivism and rationalism, Clarke (2005) primarily extends grounded theory by considering the multiplicity of perspectives, engaging with a relational perspective including both human and non-human actors, and a situational perspective to gain understanding of what is appearing and happening in the relational situations of heterogeneous phenomenon (Mathar, 2008). In my study, I take inspiration from situational maps, social worlds/arenas maps, and positional maps (Clarke, 2005). In situational maps, human and non-human actors are mapped and their relations are analysed. The mapping of social worlds keeps track of the different collectives that have a certain agreement or shared interpretation, for instance, the R&D department and marketing of a product innovation company as two different worlds that approach and perceive an innovation concept in very different ways. In FEI activities, these different worlds meet in a shared arena. Positional maps are different positions taken by actors in major discourses within social worlds and arenas.

3.2.1. ANALYTICAL PERSPECTIVE OF ANT

I have chosen to allow perspectives from ANT to inform the understanding and conceptualisation of FEI in product innovation companies. ANT is capable of helping to appreciate the complexity of FEI including the complexity of the organisation around FEI and to include the active role of non-human actors in this context. Through the lens of ANT we can see how the organisation, actor interactions, and technology shape each other in an ongoing process. If we can understand this shaping and networking process we may be able to tether it and internalise a more strategically proactive approach towards the seemingly chaotic, complex and unpredictable process of innovation. This approach also caters for a more holistic appreciation of organising and performing FEI. In methodological implications, ANT provides a theoretically informed approach to collecting data by gathering information from informants that are situated and related to the network of FEI and, in the analysis of the gathered data, ANT provides a vocabulary and certain constructs for interpretations.

ANT was traditionally developed by Michel Callon, John Law, and Bruno Latour in the 1980s and based within Science and Technology Studies. ANT offers a number of concepts for analytical perspectives. The focus is on *actors* and their *relations* in a network that change and develop through the processes of *translations*. Actors act through their relations with other actors. In actor networks, agency can be ascribed to both human and non-human entities (Law, 2002). This feature enables me to address both social and technical aspects of FEI processes and their intimate interactions in my analysis. This allows me to define and analyse how technology influences and shapes the social understanding and interactions, and vice versa. This is highly relevant to understanding FEI in product innovation organisations, where technology and products play an important role. The relations between both human and non-human actors define the actors, so the heterogeneity and dynamic in the relation between, for example, technical features of a product and human understanding and activities in relation to the product become an essential subject of analysis. Actor networks are continuously configured and reconfigured through the process of translation, which describes the dynamic or the displacement of the actor network in a destabilising or stabilising mode.

Callon (1986) has described the process of translation through four moments, *problematization*, *interessement*, *enrolment*, and *mobilisation*. In his work, Callon (1986) studies how researchers studying fishermen and scallops of St Brieuc bay established themselves in relation to each other. The researchers have defined issues of the overfishing of scallops to a critical level, threatening the livelihood of the fishermen, and advancement of the scientific knowledge concerning the farming of scallops. They investigate whether new techniques of farming scallops could resolve the issues – this is the moment of *problematization*. The moment of *interessement* concerns excluding and including actors in the network. The use of devices

(reference) can be relevant in this moment of translation. In the example of the scallops and fishermen, towlines are immersed in the bay to anchor the development of scallops and texts and conversations are used to convince the fishermen to follow the researchers' project. In the process of *interessement*, negotiations and trials of strength between the actors may lead to successful *interessement*, and thereby the moment of enrolment. The moment of enrolment establishes a powerful alliance between the actors in the network and through the moment of mobilisation, the network produces devices that speak on the behalf of the network and promote the network, for example, through scientific results in the form of tables and numbers. In the translation process, actors develop a shared interest and work in order to create sufficient momentum in reaching a goal through the translation process. In the moment of problematisation, an actor will make its agenda impossible for the network to disregard and thereby the network will have to respond to it. In the moment of *interessement*, an actor is made aware of the agenda by the network, and the actor will either respond positively by joining the network or will try to create an alternative agenda. In the moment of enrolment, actors are positioned in the network with acceptance, and in the moment of mobilisation, the actors are actively supporting the network in stabilising it.

Through the theory of actor networks, I see the FEI process as a sociotechnical process with symmetry between human and non-human actors (McMaster and Wastell, 2005). In addition to this, I do not see the technical dimensions as evidence based but in relation to the social where the evidence based are not "neutral representations of reality, but are instead part of complex networks of technology and social relationships" (Green, 2000). These theoretical perspectives enable me to move beyond structural social networks and process model descriptions. In my act of drawing on ANT that includes non-humans as actors in networks of translation, I do not intend to degrade humans into mechanistic and rational being, quite the opposite, I want to attract attention to non-humans as significant actors in the complex network of FEI (Sage, Dainty, and Brookes, 2011).

ANT has shown to be able to grasp the complexity of innovation processes (e.g. Akrich et al., 2002). In this respect, it has principally been used to describe how products are introduced, perhaps modified, and adapted into society. Some studies are around specific products and their use while other studies consider how products are adapted or rejected in society as a process where socio-material stability is destabilised by introducing new products and how the process of re-stabilising the socio-material occurs. In my study, actor network theory not only gives me a certain analytical perspective but also provides me with certain sensibilities, both in collecting data, analysing and synthesising. My understanding, operationalising and applying ANT is a process that has been taking place for more than ten years. ANT is both compelling and repellent and, in my process of becoming an academic through my PhD study, I have experienced making my peace with ANT and developing a useful and constructive relation with this analytical perspective. Being

a trained engineer and applying ANT can be paradoxical. In natural science, we primarily view the world through the perspective of a positivistic rational mindset and ANT challenges my basic perceptions as an engineer. However, through paradoxes there is also the opportunity to develop new insights.

While ANT has served as my theoretical tool in my project in the shape of an analytical perspective, theories from literature have been used in operationalising my analysis in framing, contrasting and comparing my findings. These theories have primarily been drawn from organisational, innovation management, and science and technology studies. However, what I have been struggling with in using ANT is that it does not give anything if I expect it to perform as a theory. In a way, it can be viewed as a methodology, a way to approach and understand the world. If I consider an idea as having essence, I also consider it to have some kind of truth in itself, but through ANT, the idea does not have an essence to begin with – the idea instead exists in the constitution and configuration of a network of relations and actors. This network creates a certain essence or programme that is under constant change related to the developments in the network that constitutes the idea. The models that I find in literature that describe the processes of FEI, such notions of an idea do not fit within those models. In these models, the idea is required to have a certain stability to be generated, evaluated and selected. ANT gives an opportunity to disregard this framing and explore a completely new way of considering ideas, conceptualisations and FEI.

CHAPTER 4. PRACTITIONER STUDY

As a preliminary study, I have conducted two workshops with participants from a number of Danish companies and one survey in one of the participating and case study companies. This was performed with the purpose of offering me insights into what practitioners' concerns were, both to compare and contrast the obtained knowledge from the literature study and to give focus to the needs of practitioners in FEI. As mentioned in the introduction, two workshops with the aim of becoming familiar with issues that industrial practitioners were dealing with were held in the initial phase of the PhD study. Managers of innovation, idea development, technology screening, and product innovation from twelve different companies attended these workshops. The companies were all large, well established and global companies and the managers would provide insights into FEI in their approaches and dealings with managing ideas in early innovation processes. The aim of the workshops was not only to find out more about how product innovation companies deal with FEI in practice, but it was also to make relevant companies interested in becoming case companies for further studies in the PhD project.

4.1. WORKSHOPS

The first workshop started with an introduction of each participating company. The introductions were PowerPoint presentations of the companies and their work with FEI and idea management. The first workshop continued with an exercise in the form of a design game about requirements for managing ideas, where I provided an illustration of a generic FEI process model which the participants had to fill out with requirements and needs. The figure was created based on my first literature review of idea management and is reminiscent of model features from NCD model (Koen et al. 2002) and Front End model (Boeddrich, 2004). The generic FEI model was used on the first workshop to collect managerial requirements that related to specific phases of FEI. In addition to sharing experiences, the participants added requirements and needs for each phase of the FEI process for managing and structuring FEI (Figure 1). In the second workshop, each participating company was focused on specific challenges and needs in managing idea and FEI. This exercise was based around a discussion and the documentation of findings was notes and recordings of the discussions and the presentations. The workshops gave me a valuable insight into practitioners' concerns in their dealings with FEI.

4.2. SURVEY

The survey questions were divided in different categories of FEI processes, as in the first workshop exercise. The first part was questions relating to nationality, gender, age, functional area, their experience, and how extensively they were involved with

ideas in FEI. The second part concerned their motivation and opportunities to work with new ideas and feedback from corporate structures. The third part entailed how they worked with new ideas individually, cross-functionally in interaction with others and how they could gain support from their network and managers. The fourth part investigated how they worked with formal structures and procedures when bringing ideas forward in the organisation, cross-functionality, and navigational processes. The fifth part of the survey concerned feedback and evaluation processes in interaction with organisational structures and decision makers. The sixth and final part related to gaining formal backup from the organisation but also if the employees knew and understood the formal procedures for this. The survey gave me both a quantitative result but also many qualitative perspectives from the respondents through the open-ended questions. The survey was returned with a response rate of approximately 75%, equivalent to 115 respondents out of 153, and therefore expressed a broad and trustworthy insight of issues in that particular company. The respondents were divided into 51% male, and 49% female respondents covering the organisational functions of Research and Development at 74%, Production and Operations at 18%, Administration and IT at 5%, Marketing and Sales at 3%, and Finance at 1%. Of the respondents, >80% were between 31 and 50 years old and around 38% had 1-5 years of experience in their functional area, 30% had 6-10 years of experience, 17% had 11-15 years of experience, and 10% had 16-20 years of experience.

4.3. PRACTITIONER INSIGHTS

The figure below is the design game output from the first workshop, where requirements for the managing of ideas in FEI were placed in a generic but adapted process model of FEI. Figure 1 shows that requirements for managing FEI activities are well understood in the first phases of the process. In the later processes, where phases are about 'landing', 'evaluating', 'funding', and 'launching' ideas, there are less known requirements. This could suggest that the process of promoting and gathering support for ideas and projects is less assured. The statements from industry, that it is not a problem to get ideas but it is a challenge to turn ideas into acceptable and viable concepts, is also indicated in this exercise. Markham et al. (2010) describes the 'valley of death', between research and implementation of ideas and concepts in the pipeline of NPD. Moreover, Hellström and Hellström (2002) describe a rather complex route from idea to implemented innovation project.

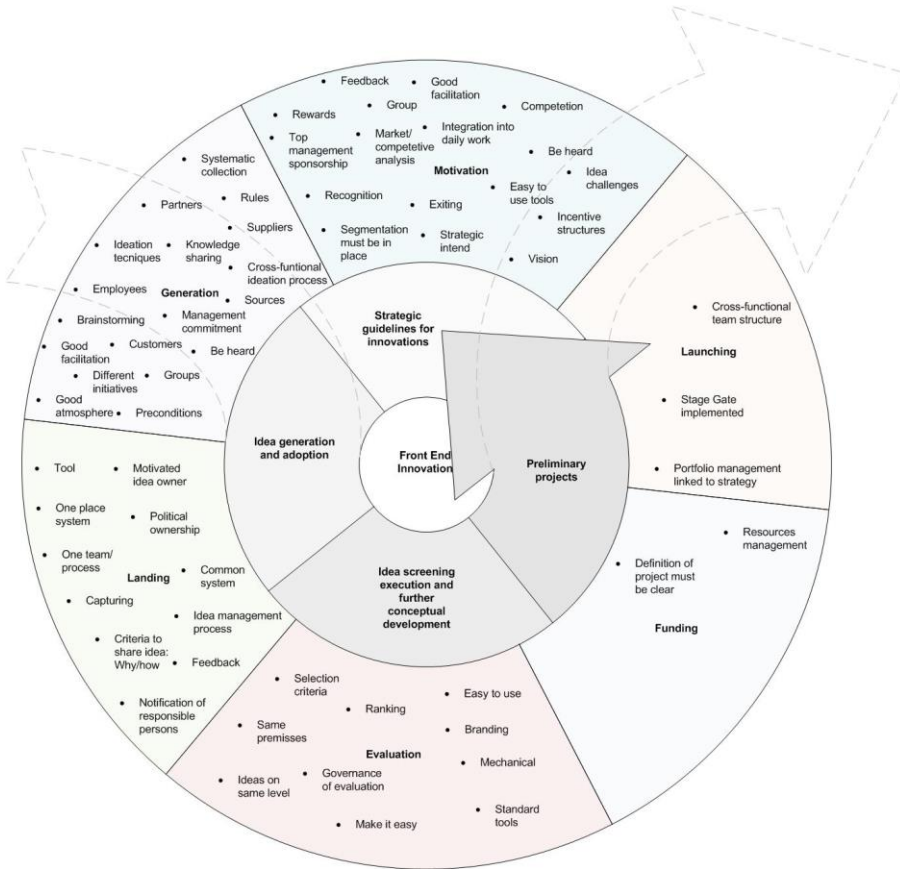


Figure 1 Practitioner workshop exercise of Requirements for managing ideas

In the table below, the results from the exercise were structured according to categories that emerged from the data. In each phase of the FEI process, elements fall into categories of structure, people, process, and content (Table 6). This very first indication of practices of FEI showed that there were more issues at play than the structural perspective as process models could account for. For instance, in the last phase of the FEI process, the stage gate model is placed. Therefore, according to practitioners, the stage gate model is not in play before the end of FEI. This is not surprising, but it indicates that standard process models are not applicable to structuring FEI activities. Thus, according to the managers attending my workshops, the stage gate model is only implemented in the last phase of the generic FEI process. Moreover, what I also see is a great number of requirements for managing ideas in FEI in the phases of the generic FEI model before the stage gate even begins along with a great variety in kinds of requirement.

Phases	Structure	People	Process	Content
Motivation	Groups Idea challenges Incentive structures Top management sponsorship Rewards	Feedback Be heard Competition Exiting Recognition	Good facilitation Integration into daily work	Easy-to-use tools Market/competitive analysis Vision Segmentation must be in place Strategic intend
Generation	Groups Partners Supplier involvement Sources	Cross functional ideation process Knowledge sharing Be heard Good atmosphere	Systematic collection Ideation techniques Good facilitation Management commitment	Rules Different initiatives Preconditions
Landing	One place system Common system Notification of responsible persons	Motivated idea owner Political ownership	Capturing ideas Idea management process One team process Feedback	Tools Criteria to share idea: why/how
Evaluation	Governance of evaluation Standard tools	Easy to use Make it easy	Ranking Mechanical Branding	Selection criteria Ideas on same level/premises
Funding			Resources management	Definition of project must be clear
Launching		Cross functional team structure	Stage gate implemented	Portfolio management linked to strategy

Table 6 Practitioner workshop; Requirements for managing ideas in the FEI process

As the practitioners claim, they need support for understanding and supporting FEI but they do not have a straightforward answer for this at this point. The companies attending the workshops all had a process model for FEI, to some extent a miniature reflection of the stage gate model, but it was clearly the general opinion that the current models did not support FEI as a whole.

Table 7 below represents findings from the second workshop where the participating companies presented and discussed challenges and needs related to FEI. The findings or the statements from the second workshop also fall into the same categories as the exercise on requirements for managing FEI in the first workshop.

Structure	People	Process	Content
Need of a structure for handling knowledge Need to understand the organisational needs Need a structure which fits to the organisation	Need of a space to share ideas Need of a room for everyone in the company – not top-down management Need of a community to connect the brains of the employees	Need of a tangible process to show what ideas bring Need of continuous improvement of the process Need of NPV assessment in very early stages in the process	How do we make sure idea inputs enhance the business? Need to develop business case in early stages of idea selection The level of detail of business case increases together with increasing data quality
Need of a platform to capture ideas – not only an IT system but all about innovation Implementation of idea management system Need of a system that gathers all idea/knowledge-bases	Need to give direction to employees Idea managing at the same time educating employees	At a point management intervenes In management review there is some predefined criteria Need for idea selection to be more explicit Need of a small group of people to manage ideas	Need for updating portfolio continuously to follow up on feasibility of projects Killing projects is good and healthy, shows you have better ideas Emphasising quality over quantity Need of knowing where to focus and what to bring forward?

<p>An IT system will never alone be a success</p> <p>The IT system is a tool/facilitator and does not do the business itself</p> <p>It should be an open source system</p> <p>IT system that can be developed continuously</p> <p>The front end process is in sight in the IT system</p>	<p>Discussion is a key activity in developing ideas</p> <p>No criteria when voting except employees' subject criteria</p> <p>Democratic approach is very motivating</p>	<p>Co-development/co-creation, need of an open product structure</p> <p>Important to save criteria to motivate employees</p> <p>Management too busy to take initiatives seriously</p>	<p>Motivating ideas by suggesting scenarios: ideas on cost, new drugs, healthcare, efficiency etc.</p> <p>Need to communicate the scenarios/areas</p> <p>Need of more elaborated customer complaint feedback</p>
<p>Need of high level governance in every concept development as an innovation board</p> <p>Need of cross-functional teams to create detailed business cases, takes a couple of months</p> <p>Workshops</p> <p>Need of different skills in portfolio management and funded projects</p>	<p>The most important thing is to create the culture of togetherness and mindset for innovation</p> <p>It was a challenge to bridge the global community</p>	<p>Before implementing IT system there were small communities and the process was very unstructured</p> <p>If everything is informal or unclear, people spend too much time finding out how to bring forward ideas</p> <p>Top management scores the project with a strategic view individually followed up by discussions on scores, full-day meeting with all available information</p>	<p>Need to consider IPR</p> <p>IPR is very challenging in open innovation</p> <p>Need to handle open source idea capturing</p>

Table 7 Practitioner workshop, Needs and challenges for managing ideas in FEI

At the same time, the statements also fall into a progressive structure such as those provided with the generic process models. The progressing process involves offering

space and possibilities for knowledge to be combined and created for ideas to initially emerge. Moreover, there is then a need for some assessment or evaluating structure that assesses the match between ideas and strategy and organisational capability. Following this, the next stage is how to create a direction and pursue a conceptualising process, and finally, how to get support to deliver concepts for development. There are both structural and social elements at play at the same time.

The first notion I received from the survey was the role of process models being somewhat passive because they did not relate or support FEI in the view of the respondents. Either they described not knowing of formal processes or structures or they described somewhat entrepreneurial behaviour in FEI activities. The issues that concerned developers were much more related to their everyday practices and how they handled specific content in developing ideas. Accordingly, design engineers working with ideas in FEI were, at the same time, struggling with overly rigid structures of stage gate, such as models that did not reflect or support their practices and ways of working with new ideas and struggling with insufficient supportive structures of procedures and processes of FEI. While the managers expressed problems to get a hold on FEI processes, the employees expressed frustration concerning formalising management models that did not support but rather hindered the practices of FEI. I also noticed how the responses to my questions in the survey were very closely linked to the specific technologies and users of the products that were developing in the company. This could indicate how FEI activities are situated and connected to specific contexts and contents of innovation of specific projects in the specific company.

The preliminary study not only contributed with insights into industrial practices of FEI but also gave rise to further qualifying and scoping the research focus and research design of the study. I realised that a further study could benefit from investigating more than one company to reveal more characteristics of FEI but also frame some similarities of managing ideas in FEI that could form a basis for some kind of generalisable approach to FEI. Together with the workshops, the survey gave an insight into the problematic issues concerning early innovation processes and the development and promotion of ideas in product innovation companies. A more critical view on the issues I was studying grew from my first encounters with industrial practices and my view of managing ideas in FEI was of recognising the complexity issues. The workshops and the survey informed me of a phenomenon that both had similarities across the different companies but it was also clear that both context of the different companies and the content of what they were developing made them face some of the same challenges but in different ways.

PAPER 2

The second paper is related to my second research question. The paper was developed into two papers presented and published at ISPIM 2013 and ICED 2013 conferences, and therefore contains a few modifications between them, albeit based upon the same idea and process. The ICED 2013 paper has been made a part of my dissertation. The second paper in the dissertation presents my first interactions with practitioners and understanding of my empirical data. At the same time, the conference format was an opportunity to interact with relevant research communities on the questions that I ask and the analytical direction in which I take my research.

At the ISPIM conference, I presented my ideas together with three other authors who suggested different idea management systems based on standard process model approaches. The main argument was that this was what management were able to comprehend even though it was agreed that the process model approach did not reflect the real practices of idea management nor FEI. The audience expressed interest in the new approach in using the analytical perspective of ANT as a way of enabling a more holistic approach to idea management and FEI as a whole.

At the ICED conference this analytical approach was acknowledged as well as the methodology applied. I received positive reactions to the way I had approached the study and involved the practitioner arena through my interactive research, and how practitioner insights received through different methods framed my further studies. The paper takes up the case of idea management in FEI in product innovation companies. The insights gained from the practitioner study and from interviews in case companies lay the ground for an indicative and explorative analysis structured by a generic idea management process but in the perspective of the elements from the translations process of ANT.

ICED 2013

Paper title: Towards a new perspective of managing ideas in front end innovation as actor networks

Author(s): Anna Rose Vagn Jensen, Christian Clausen, Liv Gish

In: DS 75-3: Proceedings of the 19th International Conference on Engineering Design (ICED13): Design For Harmonies, vol. 3, Design Society, 2013, pp. 181-190

Editors: Udo Lindemann; Srinivasan V; Yong Se Kim; Sang Won Lee; John Clarkson; Gaetano Cascini

Publisher: Design Society

ISBN: 978-1-904670-46-9

Conference: 19th International Conference on Engineering Design, Seoul, South Korea

ISPIM 2013

Paper title: Towards a new framework of idea management as actor networks

Author(s): Anna Rose Vagn Jensen, Christian Clausen, Liv Gish

In: XXIV ISPIM Conference: Helsinki, Finland (2013), Innovating in Global Markets: Challenges for Sustainable Growth

Publisher: Laapeenranta University of Technology Press

ISBN: 978-952-265-421-2

Conference: The XXIV ISPIM Conference, Helsinki, Finland

TOWARDS A NEW PERSPECTIVE OF MANAGING IDEAS IN FRONT END INNOVATION AS ACTOR NETWORKS

ABSTRACT

The innovation process in R&D organisations has been a subject of discussion for decades. Product development processes are well established in R&D organisations and improvements have been implemented through theories as Lean product development and agile methods. In recent decades, more diffuse processes have been identified as front end innovation processes. The front end innovation is distinguished from linear product development and characterised as more informal, unstructured, and unpredictable. This paper presents the preliminary results of a PhD project concerning idea management in the front end innovation of R&D organisations. Through theoretical and empirical investigations of managing activities of idea processes, an indicative analysis in the perspective of actor network theory is performed. The analysis shows how managers and employees navigate in a complex environment of organisational structures, technical features and design, creativity and social interaction. The analysis inputs an initial conceptualisation of a new theoretical framework of idea management. The theoretical framework suggests a dynamic network structure comprised of the dimensions of space, content, and process.

INTRODUCTION

The front end of innovation (FEI) in R&D organisations is considered a complex space of different interacting stakeholders striving towards developing innovative ideas into viable product concepts. In this paper we outline a preliminary framework concerning the management of idea processes in FEI of R&D organisations. The framework is based on the empirical work of the first author's PhD project, and integrates a socio-technical perspective. During the 1990s, the focus of innovation processes in R&D organisations was especially on implementing New Product Development (NPD) models (Cooper 2001), Integrated Product Development (Andreasen & Hein 2000) and Concurrent Engineering (Wheeler et al. 1991). The aim was to improve communication and integration between departments, and to optimise the NPD process. In the 2000s, Lean Product Development evolved to make the NPD process leaner (Haque & James-Moore 2004). Principles of eliminating waste, the improvement of resource utilisation and front end loading were adopted from lean manufacturing, yet limited literature is available to provide

step-by-step instructions (Wang et al. 2012). Moreover, the Scrum model has been reintroduced to improve agility and assist improving time to market compressions.

In parallel to these developments of the product development process, focus has shifted to the early processes of the product innovation in R&D organisations, FEI (e.g. Smith & Reinertsen 1998). Reid & de Brentani (2004) distinguish between front end activities and traditional NPD and define a radical innovation process with characteristics of complex decision-making in interfaces between individual and organisational levels. Well-known examples of representing FEI are the New Concept Development (NCD) model (Koen et al. 2002) and the Innovation Funnel (Wheelwright & Clark 1992). As ideas are the beginning of any innovation endeavour and closely related to FEI, the concept of idea management focuses on enabling management of knowledge- and decision processes in FEI to increase innovation capability (e.g. Tidd & Bessant 2009).

However, challenges arise in trying to fit FEI with generic and rigid models of idea management, which are based in traditional process management perspectives. Barczak et al. (2009) conclude that the management of ideas is a subject without stabilised consensus and managing of ideas seems to be carried out contextually and in an ad hoc manner in innovation organisations. Moreover, the problem of ambiguity that lies in the challenge of balancing explorative and exploitative activities (Pavitt 2005) defines the FEI. Van de Ven and Engleman (2004) identify the central management problem of pushing ideas throughout the organisation and turning them into profitable businesses as still being relevant. In order to make the managing of ideas more consistent with FEI, we expand current understandings by bringing a socio-technical perspective into play, namely actor network theory (ANT). Our research question is as follows: How could a perspective of ideas such as socio-technical networking contribute to a new understanding of management implications of idea processes in front end innovation?

The paper is structured as follows: First, we provide a review of the current understandings of idea management in chapter two. Then, in chapter three we present how we have acquired knowledge and collected data for our research. Following this, in chapter four we establish a new perspective on idea processes through actor network theory. Subsequently, in chapter five we discuss and develop the outline of a theoretical framework and, finally, we conclude in chapter six.

REVIEW OF CURRENT UNDERSTANDINGS OF IDEA MANAGEMENT

Idea management literature is primarily rooted within the area of innovation management in organisations. In a systemic perspective, Vandenbosch et al. (2006) view ideas as movement and change, cognition and knowledge, and social interaction. They describe the managerial process as recognising the need for ideas,

idea generation, and evaluation. This idea management process is, with variations, consistent throughout the literature. Moreover, in information technology literature idea management is discussed in developing and investigating applications of idea management systems (e.g. Boeddrich 2004). Idea management literature can be roughly divided into two foci: a structural focus with attention to optimisation of organisational and development processes and a social focus with attention on the interaction between people in innovating activities. Contributions with these two foci are summed up in table below.

Structural focus	Social focus
Different factors of organisational structures and culture influence the process of idea management (van Dijk & van den Ende 2002)	Idea management processes of capture, representation and development of ideas can be seen as essential social processes in the performance of idea management systems (Coughlan & Johnson 2008)
Certain considerations of roles and purposes can improve the process of idea management (Nilsson & Elg 2002)	Informal grassroots innovation processes can be supported through idea management (Bailey & Horvitz 2010)
Specific and general requirements are needed in order to implement an idea management system in organisations (Boeddrich 2004)	Managerial facilitation and informality of individual and group networks influences idea quality (Björk & Magnusson 2009)
Creativity and ideas categorised as more value-focused in contrast to ideas as different alternatives creates more quality ideas but demands contextual evaluation criteria (Selart & Johansen 2011)	Political processes can be used in understanding creativity in relation to the organisation (Bakker et al. 2006)
IT systems for the sharing and storage of ideas can cross the boundaries of the organisation by integrating external groups like suppliers, costumers, competitors, and other stakeholders (Brem & Voigt 2009)	Managerial implications of idea management systems can be identified in terms of customisation, attracting innovators, handling information overflow, and inadequate support of informal idea processes in the earliest stages (Hrastinski et al. 2010)
Application of the idea management system in the FEI provide ideas with a certain general structure which enables managers to make easier decisions between many different ideas and for colleagues to better feedback on ideas (Montoya-Weiss & O'Driscoll 2000)	Informal promoting and bargaining of ideas in early fuzzy product development is suggested to become formalised to openly develop, evaluate and select ideas in order to make processes more accessible without compromising creativity (Hellström & Hellström 2002)

Table 8 Literature on idea management divided in the two foci of structural and social

The themes of the contributions presented in the table point to both formal and informal aspects of idea development processes in innovating organisations. In the reviewed literature, we see that idea processes and the management of these processes need to be considered on both a structural level of organisational conditions and procedures and on a social level in social interaction and the creation of new knowledge. At the same time, these processes are shown to be both formal and, indeed, informal. In the work of Gish (2011), idea-promoting initiatives are examined in a company. It is argued that an idea management systems design that does not match the, frequently informal, practices of idea processes in the organisation may have difficulties in being integrated. At the same time, a system which matches practices, may not challenge practices in order to increase innovation capability. The managerial implication of the study is the interplay between the formal system and the informal practices of idea processes. The formalisation of idea processes should not be the sole focus at the expense of ways to facilitate practices and to challenge them.

It is our impression from the literature review that the informal aspects of idea processes plays a significant role in innovation idea processes but how much attention in analysis and development of theoretical frameworks this has been given is limited. The reviewed perspectives of idea management primarily focuses on structural or social aspects of managing ideas, albeit largely at the expense of investigating the dynamics between these aspects and much on the expense of understanding how the content of ideas, being technologies, design and product specification, influences how individuals or groups understand ideas, carry ideas forward, and decides upon innovation ideas in a R&D organisational context. It is our intention is to extend the current understandings of idea management with the use of actor network theory in order to reframe idea processes in FEI.

METHOD OF ACQUIRING KNOWLEDGE AND COLLECTING DATA

The acquiring of knowledge and collection of data has been gained through iterative and practicable theoretical and empirical studies.

ACQUIRING KNOWLEDGE

The search for literature on idea management was performed in multiple databases with the truncated keywords of 'idea', 'innovation', and 'management', which resulted in a large volume of literature. The literature was qualitatively selected or rejected by title and/or abstract. The method of rolling the snowball (Bryman 2001) was used to follow interesting and relevant references, themes, or theories in selected papers, which were found in the initial database search. The criteria for selecting relevant literature was a clear focus in the selected literature on managing ideas in a R&D organisation context but with no limits on the theoretical

perspectives used. The acquired knowledge offers both empirical studies and theoretical perspectives for analyses and can be mapped as creativity and conceptualisation in engineering design, organisational studies of innovation, management of creativity and innovation, and actor network theory.

COLLECTION OF DATA

The empirical data used in this paper stems from R&D activities in large well-established Danish companies. The companies all work on a global level and play a significant role in a demanding and uncertain environment that continuously challenges their innovation capability. The empirical data is supplied from two industrial workshops, attended by participants from five and eight different companies respectively, a questionnaire conducted in one company, and semi-structured interviews from three different companies.

The first workshop had the theme of requirements for idea management and the second had the theme of challenges of idea management. The first workshop was attended by managers from department levels from five different companies. The managers were both from product development and business development departments and engaged with managing ideas in their organisation. The participants were asked to point out specific phases of idea management and define specific managerial requirements for these phases. Managers from project- and department levels from eight different companies attended the second workshop. Managers were again both from product- and business development departments engaged with managing ideas and were asked to present and discuss challenges of idea management. The workshops had a duration of five hours and were recorded by video and notes.

The company questionnaire contains both open-ended and closed statements and all statements are based on a Likert-type scale. A Likert-type scale collects answers from respondents on a scale from 'strongly agree' to 'strongly disagree' with the statements in the questionnaire. The statements are based on the literature search and empirical findings from the two industrial workshops and fall into five identified process phases; Idea motivation that concerns the motivation to consider new technology, markets and opportunities, Ideation that concerns the first development of ideas, Idea presentation that concerns the presentation of ideas to more formal and corporate structures, Idea evaluation that concerns feedback and steering of ideas, and, finally, idea execution that concerns the implementation and final budgeting of ideas in the corporate development structures. The respondents of the questionnaire are employees involved in innovation idea development from different functional areas such as R&D, marketing, technology development, and production. The questionnaire was returned with a response rate of circa 75%, equivalent to 113 respondents. The respondents are equally distributed among male and female. The respondents cover the domains of Research and Development by 73%, Production

and Operation with 18%, Administration and IT with 5%, and Marketing and Sales with 3%.

Nine semi-structured interviews with managers and employees were conducted with the focus on managing innovation and ideas in three industrial companies; one interview with an R&D director of the same company in which the questionnaire was conducted, two interviews from a radical innovation department of an industrial company, and six interviews from a company of which one was from technology development, two were from business development, and three from concept development. The interviews lasted from 30 to 120 minutes.

IDEA PROCESSES IN THE PERSPECTIVE OF ACTOR NETWORKS

In this section, a new perspective of how innovation idea development can be described as actor networks will be introduced. First, there will be a brief introduction to the perspective of ANT, then a comment on why this theoretical perspective could be useful in the context of managing ideas in FEI, and, finally, the empirical findings will work as illustrations and exemplifications of the perspective.

ACTOR NETWORK THEORY

ANT is based within Science and Technology Studies, primarily developed by Michel Callon and Bruno Latour in the 1980s. ANT offers a number of concepts for the analysis of a network of human and non-human actors. It emphasises how the relations between actors are configured, defining a certain idea or socio-technical arrangement and the processes stabilising or destabilising the network as translation. In actor networks, agency can be ascribed to both human and non-human entities (Law 1992). This theoretical feature enables the analyst to address both social and technical aspects of ideas and their intimate interactions. The relations between both human and non-human actors define the actors (Jensen 2003), thus the heterogeneity and dynamic in the relation between, as an example, technical features of a design concept and human understanding and activities in relation to the design concept becomes an essential subject of analysis.

Actor networks are continuously configured and reconfigured. The process of translation describes the dynamic or the displacement of the actor network and may be characterised through four phases (Callon 1986): problematisation, interessement, enrolment, and mobilisation. In the translation process, actors develop a shared interest and work together in order to create sufficient momentum in reaching a goal through the translation process. In the problematisation phase, an actor will make their agenda impossible for the network to disregard and thereby the network will have to respond to the agenda. In the interessement phase, an actor is made aware of the agenda by the network, and they will either respond positively by joining the

agenda or will try to make an alternative agenda. In the enrolment phase, actors are positioned in the network with acceptance. In the mobilisation phase, the actors are actively supporting the network and provide it with stabilisation.

ACTOR NETWORK THEORY AND IDEA MANAGEMENT

When dealing with idea development in the context of technologies and innovation, as is the case here, it seems highly relevant to explore a theoretical perspective that pays attention to human as well as non-human based interaction and brings socio-technical analyses to another level. In the work of Legardeur et al. (2010) the early phases of an innovative design process are investigated in the perspective of ANT to understand the complexity of social interaction in relation to new ideas and concepts. This work demonstrates an effective way to uncover processes of ideas in the frame of managing ideas. Actor network translations and idea management are both grounded in the view of a process structure but the underlying understanding of processes is different. The intention of drawing on ANT in the analysis of idea management, is not to dismiss the generic process models of idea management but rather to suggest an alternative or a complementary perspective that could uncover more of the complexity of innovation idea development in order to identify more forward-looking and strategic managerial implications. The resemblance between the generic process of idea management and the actor network translation process is noticeable. When opening up the phases and the interfaces of the process models, the difference between the actor network translation process and the generic process of idea management is substantial. In contrast to the traditional process models, the ANT translation process includes the interactions, content and changing relations between multitudes of diverse actors. In the following sections, the phases and interfaces are opened up to exemplify and illustrate the perspective of ANT through an indicative analysis of empirical findings.

EMPIRICAL FINDINGS IN THE PERSPECTIVE OF ACTOR NETWORK THEORY

The empirical examples used to illustrate the actor network perspective on idea processes will be structured according to the generic process model of idea management parallel with the translation process of actor network theory as mentioned in the above. In this way, the complementary perspectives of idea processes through the prism of actor networks will be visible.

IDEA NEED/PROBLEMATISATION

A stabilised actor or actor network may be destabilised through the translation process as it is not a closed system but rather related to other actors or actor networks. The identification of new demands in the market, societal changes or detection of new technology as opportunities in need for new ideas in the R&D

organisation, can initiate an enquiry of what is currently agreed upon as good solutions that fit the market in question. When organisations grow, develop, and seek or maintain their innovative capability, it is necessarily connected with the need for new ideas. Opportunities can come from every sort of relation both in and outside the organisation.

The empirical results from the interviews describe how organisations are trying to create these opportunities by framing new innovative spaces that can lead to new opportunities. In an interview, a global R&D manager discusses how they deliberately create problematisation by intersecting different knowledge domains inside the organisation, enabling the creation of new frames of understanding technical potentials and user needs. In a radical innovation department in a global company, they set up workshops with participants from different work domains in the organisation, and more importantly, from outside the organisation to map future market and technology trends in order to frame opportunity spaces or scopes of innovation idea development. These opportunity spaces create the ground for new network formations of ideas to take form. As a necessary means for a translation process to progress in order to stabilise the network of an idea and give it sufficient momentum to reach the development pipeline, intersement around new ideas created on the basis of new opportunities is initiated.

IDEA GENERATION/PROBLEMATISATION-INTERSEMENT

The generation of new applications of new or known technology is viewed as a problematisation of the current state in the perspective of ANT. In the data from the company survey, respondents refer to both users' needs, personal networks inside and outside the company, and collaboration with close and distant colleagues as important factors when generating new ideas. Through the lens of ANT, in this situation, current understandings of users and technical applications are questioned and reframed and the actor network is creatively destabilised. The problematisation can come from any source, both from an existing as well as an unfolding relation between any types of actors; if a user points to a certain issue, a designer discovers another possible application of a technology etc.

The creation of innovation ideas and their development are outcomes of a synthesis between a diversity of knowledge but also unforeseen meetings through different kind of relations between individuals, things, and structures. Different sources of knowledge domains are brought together, interacting with each other and resulting in a continuous flow of negotiations in design processes but also in engaging with the organisation in order to promote ideas and present them to corporate structures and formal procedures. In the perspective of ANT, this is the beginning of the intersement and enrolment in the translation process.

IDEA EVALUATION/INTERESSEMENT-ENROLMENT

The evaluation phase is characterised by an interaction between evaluators and ideators and ANT shows how the networks reconfigure as an outcome of the translation process in order to bring the idea forward. The foci, opinions, agendas, and goals can be very different between actors and to constructively stabilise a strong interest for the vision of the idea is very important in order to move the idea forward. The actor network perspective highlights the knowledge relations, knowledge transfer and if they are sufficient enough to promote ideas, and on which levels evaluation takes place.

The case results show that a great number of evaluating processes take place in an informal way between ideators and closest manager but also through the personal network of the ideator in- and outside the organisation. The survey results indicate that management ‘takes over’ in this process; hence the ownership and focus of the actor network may be displaced in some way. The understanding of the idea can be very different between designers and managers, and the actor network perspective reveals how important aspects of the idea concept can be developed in another direction than the intended one when new actors engage. It is important to make relevant choices of actors who can speak for the case of the actor network and help promote it in order to improve the chance of success. The empirical results show that it is necessary to ‘sell’ the idea to key decision makers or to actors who have significant influence on the process.

IDEA SELECTION/ENROLMENT-MOBILISATION

This phase of the idea process is explicitly turning to face more formal and corporate structures. This phase also describes a significant displacement in an organisational context. In the interviews, department managers tell about how top-level managers' selection of ideas is very unpredictable. This is also a phase where the actor network of the idea is given a formal project acknowledgement and it is frequently handed over to a different project team for product development. This transition is delicate and some organisations have good experience in letting key project members from the latter phases continue in the phases of product development.

In the interviews, it is said that handing over a project can also be met with resistance. Difficulties in handing over projects from concept development departments to product development departments are not unusual and the actor network perspective identifies important actors and relations of which to be aware in managing these processes. The interviews demonstrate, across different companies, that a general consideration is the importance of top management ownership of an idea to better the chances of successful implementation. In terms of ANT, top management is a powerful actor who has a special ability to mobilise important

actors across the organisation. However, this ability may both support and hinder the stabilisation of a specific actor network.

DISCUSSION

In this paper, we have described the complexity of innovation idea development in FEI and suggested illuminating this complexity through an analysis in the perspective of ANT. In a related study, Legardeur et al. (2010) show how insights into the management of ideas can be gained through the use of ANT. The complexity consists of informal social interaction and sense making, engaging with technology and design, and acting with and in formal structures of an innovation organisation. The work supports our argument of the complexity that idea development encompasses and that ANT can be a useful analytical perspective. A key challenge in the handling of front end complexity is to address both formal and informal aspects of innovation idea development equally. ANT has been shown to be capable of ordering and analysing the complexity both on formal and informal levels and highlighting different relevant elements and dynamics that implicate the management of idea development, namely which competencies to involve, what outcome of knowledge creation to focus upon, and how to push new ideas and concepts through the organisation. These implications suggest a more sensitive and collaborative management of ideas in terms of changing the focus from process management to the staging of creative and innovative spaces (Clausen & Yoshinaka 2007) and on supporting and challenging practices of idea processes (Gish 2011).

OUTLINING A NEW THEORETICAL FRAMEWORK OF IDEA MANAGEMENT

The analysis has laid the ground for the outlining of a new theoretical framework of idea management. Three dimensions, space, content, and process, are considered to be essential and to comprise the theoretical framework. The dimensions are interdependent so that changes in one will cause changes in the other. The dimension of space is defined by inclusion and exclusion: what and who are in and what and who are defined outside of the idea development network. The space may be characterised through its resources, knowledge, competences, and location. Typically, all these elements include the formal (management endorsement, business plan, project definitions) as well as the informal (experiences, engagement, framing) aspects. Content refers to the content of the ideas produced or adopted in the space. It may be described through characteristics such as configuration, relations, requirements, quality parameters, etc. Again, these characteristics contain formal aspects (requirements and standards) as well as informal aspects (meaning, experiences). Process is defined by the real movements between actors or between actors and things and may have characteristics such as creative destabilisation, constructive stabilisation, and reconfiguration. In a formal sense, this may include measurable achievements, while informally, we can talk of the sense of learning and

movement ‘whether we are getting somewhere’. The framework suggests a sensible management of idea development by strategically including specific actors creating content in their relation to each other, and management reacting to signals from the network by strategically inputting the network to support or challenge the process of the idea networking, see figure below.

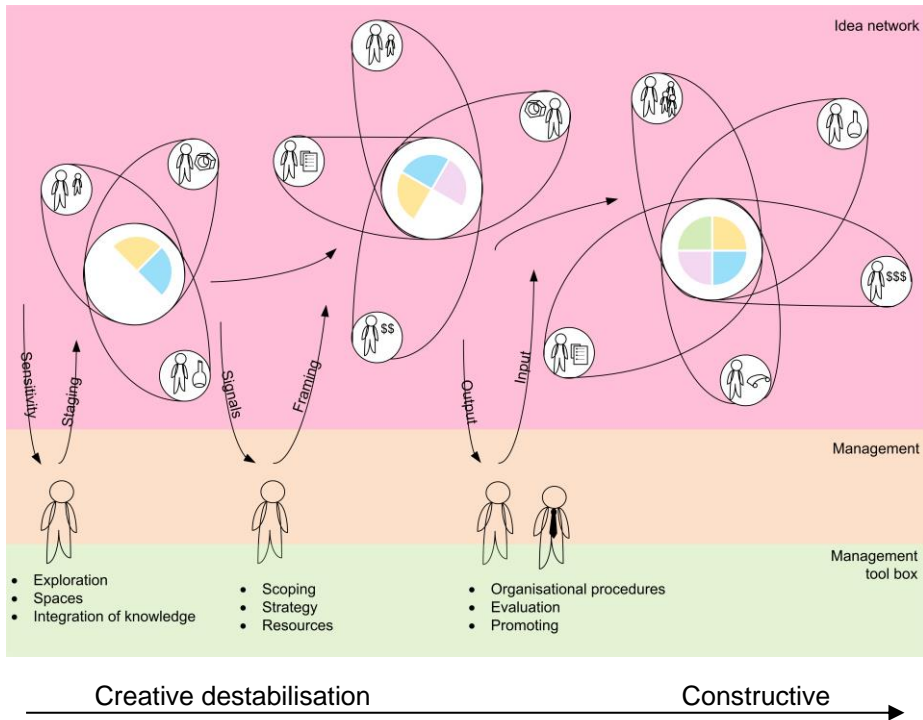


Figure 2 Initial theoretical framework of idea management illustrating how a process moves within a space from one configuration of content to another

Small circles in the periphery of the network illustrate the dimension of space with different illustrations symbolising different actors with specific abilities, competencies, potentials, and locations. The lines that connect the small circles with the main circle in the middle illustrate the specific content of the connections. These connections create the network between the actors. The process is illustrated by the arrows between the three evolving networks and symbolises the change of the network configurations throughout time through the processes of creative destabilisation and constructive stabilisation. Sensitive management is placed outside the network and stage idea development by drawing on different management tools or concepts.

In dealing with innovation ideas, there is a question of when and how do ideas begin? In the perspective of the suggested framework, new ideas emerge when new relations are made in current networks and go through creative destabilisation. For the idea to become a success, idea management needs to constructively stabilise the network. In the framework, it implied that instead of arbitrary coincidences that spark a new idea, it is possible to strategically create the frames and conditions for actors to create and explore new possibilities and make new relations/stage innovative spaces.

In the introduction and the literature review, challenging issues of FEI and idea management were pointed out and we would like to comment upon these regarding the proposed framework. The framework is a construct which is added substance by relevant actors; thereby it is made situational, fitting it to the context of specific FEI activities. The space is created by identifying relevant actors at different levels in- and outside the organisation as being stakeholders. The actors' form of relations specifies the content. In so doing, influential formal and informal actors and relations are considered when steering knowledge creation and pushing ideas forward in the organisation. Managers can stage the degree of exploring and exploiting activities by framing spaces including specific actors for creative thinking or for scoping of ideas. The overview of space and content in the dynamics and non-linearity of the network renders it possible to navigate the process and making decisions of idea development.

CONCLUSION

In this paper, we argue that current views and models of innovation idea development and its managing in FEI do not have the means to engage thoroughly with the complexity of the task. In the reviewed literature, we primarily highlight inadequate regard paid to the complexity of informal social interaction, engaging with technology and design specifications, and acting with, and in, the structures of an innovation organisation. We have suggested using the socio-technical perspective of ANT to bring new understanding to the management of idea development and empirical findings have been used to illustrate this perspective. The notion of idea development as actor networks has been introduced to underline managerial implications and input the development of a theoretical framework. The framework opens up for a new understanding of idea management that aims at meeting the identified challenges of idea processes in FEI.

A more sensitising management of idea development in innovating organisations can make way for more qualified innovation ideas, while at the same time recognising the complexity of different stakeholders that can either hinder or promote idea processes. A concept for managing ideas should continuously configure and reconfigure the network of idea processes by supporting and challenging it. We suggest that the management of idea development as actor

networks may improve current understandings by adding a reflexive approach. We further suggest that any manager of, or participant in, idea processes of organisations could benefit from considering: How to create a creative and supportive but also supported space; how to cater for real interactive processes which contribute to perform progress, and finally, how to ensure that the content of the idea processes meets reasonable expectations and is appreciated by stakeholders. Space, content and process should in this respect be seen as closely interlinked dimensions of idea development processes, which have to be catered for.

The intention of the final stages of the research project is to pursue the preliminary outcome presented in this paper as a springboard to a deeper empirical study in order to further develop, and to some degree test, a practical implementation of the suggested framework for idea management FEI.

ACKNOWLEDGEMENTS

We would like to give special thanks to the company participants involved in the empirical study.

REFERENCES

- Andreasen, M.M, Hein, L. (2000) *Integrated Product Development*, IPU, Institute for Product Development, Technical University of Denmark, Copenhagen.
- Bailey, B.P., Horvitz, E. (2010) What's Your Idea? A Case Study of a Grassroots Innovation Pipeline within a Large Software Company, *Proceedings Of The 28th Annual CHI Conference On Human Factors In Computing Systems*, vol. 1-4, pp. 2065-2074.
- Bakker, H., Boersma, K., Oreel, S. (2006) Creativity (Ideas) Management in Industrial R&D Organizations: A Crea-Political Process Model and an Empirical Illustration of Corus RD&T, *Creativity and Innovation Management*, vol. 15, no. 3, pp. 296-309.
- Barczak, G., Griffin, A., Kahn, K.B. (2009) PERSPECTIVE: Trends and Drivers of Success in NPD Practices: Results of the 2003 PDMA Best Practices Study, *Journal of Product Innovation Management*, vol. 26, no. 1, pp. 3-23.
- Björk, J., Magnusson, M. (2009) Where Do Good Innovation Ideas Come From? Exploring the Influence of Network Connectivity on Innovation Idea Quality, *Journal of Product Innovation Management*, vol. 26, no. 6, pp. 662-670.
- Boeddrich, H. (2004) Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process, *Creativity and Innovation Management*, vol. 13, no. 4, pp. 274-285.

- Brem, A., Voigt, K. (2009) Integration of market pull and technology push in the corporate front end and innovation management, *Technovation*, vol. 29, no. 5, pp. 351-367.
- Bryman, A. (2001) *Social research methods*, Oxford University Press, Oxford.
- Callon, M. (1986) Some elements of sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay, in Law, J. (1986) *Power, action and belief: a new sociology of knowledge?* Routledge & Kegan Paul, London.
- Clausen, C., Yoshinaka, Y. (2007) Staging socio-technical spaces: translating across boundaries in design, *Journal of Design Research*, vol.6, no.1/2, pp.61-78.
- Cooper, R. G. (2001) *Winning at New Products: Accelerating the process from idea to launch*, 3rd ed. Cambridge, MA: Perseus.
- Coughlan, T., Johnson, P. (2008) Idea management in creative lives, *Conference on Human Factors in Computing Systems*, pp. 3081-3086.
- van Dijk, C., van den Ende, J. (2002) Suggestion systems: transferring employee creativity into practicable ideas, *R&D Management*, vol. 32, no. 5, pp. 387-395.
- Gish, L. (2011) Experiences with Idea Promoting Initiatives, *Proceedings of the 18th International Conference on Engineering Design*, pp. 83-92.
- Haque, B., James-Moore, M. (2004) Applying lean thinking to new product development, *Journal of Engineering Design*, vol. 15, no. 1, pp. 1-31.
- Hellström, C., Hellström, T. (2002) Highways, Alleys and By-lanes: Charting the Pathways for Ideas and Innovation in Organizations, *Creativity and Innovation Management*, vol. 11, no. 2, pp. 107-114.
- Hrastinski, S., Kviselius, N.Z., Ozan, H., Edenius, M. (2010) A review of technologies for open innovation: Characteristics and future trends, *Proceedings of the 43rd Hawaii International Conference on System Sciences*, 1-10.
- Jensen, T. E. (2003) Aktør-Netværksteori - en sociologi om kendsgerninger, karakter og kammuslinger, *Papers in Organisation*, no. 48, Copenhagen Business School.
- Koen, P. A., Ajamian, G. M., Boyce, S. (2002) Fuzzy Front End: Effective Methods, Tools, and Techniques, in *The PDMA toolbox for new product development*, Wiley, New York.
- Law, J. (1992) Notes on the Theory of the Actor Network: Ordering, Strategy and Heterogeneity, *Systemic Practice and Action Research*, vol. 5, no. 4, pp. 379-393.

- Legardeur, J., Boujut, J. F., Tiger, H. (2010) Lessons learned from an empirical study of the early design phases of an unfulfilled innovation, *Research in Engineering Design*, vol. 21, no. 4, pp. 249-262.
- Montoya-Weiss, M., O'Driscoll, T. (2000) From Experience: Applying Performance Support Technology in the Fuzzy Front End of NPD, *Journal of Product Innovation Management*, vol. 17, no. 2, pp. 143-161.
- Nilsson, L., Elg, M. (2002) Managing ideas for the development of new products, *International Journal of Technology Management*, vol. 24, no. 5-6, pp. 498-513.
- Pavitt, K. (2005) Innovation processes, in Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds) *Oxford Handbook of Innovation*, (pp.86–114), Oxford, Oxford University Press.
- Reid, S. E., de Brentani U. (2004) The Fuzzy Front End of New Product Development for discontinuous Innovation: A Theoretical Model, *Product Innovation Management*, no. 21, pp. 170-184.
- Selart, M., Johansen, S.T. (2011) Understanding the Role of Value-Focused Thinking in Idea Management, *Creativity and Innovation Management*, vol. 20, no. 3, pp. 196-206.
- Smith, P. G., Reinertsen, D. G. (1998) *Developing products in half the time: new rules, new tools*, John Wiley & Sons, New York.
- Tidd, J., Bessant, J. (2009) *Managing innovation*, John Wiley & Sons, West Sussex.
- Vandenbosch, B., Saatcioglu, A., Fay, S. (2006) Idea Management: A Systemic View link, *Journal of Management Studies*, vol. 43, no. 2.
- Van de Ven, A., Engleman, R. (2004) Central problems in managing corporate innovation and entrepreneurship, *Advances in Entrepreneurship, Firm Emergence and Growth*, vol. 7, pp. 47-72.
- Wang, L., Ming, X. G., Kong, F .B, Li, D., Wang, P.P. (2012) Focus on implementation: a framework for lean product development, *Journal of Manufacturing Technology Management*, vol. 23, no.1, pp. 4-24.
- Wheeler, R., Burnett, R. W., Rosenblatt, A. (1991) Concurrent engineering: Success stories in instrumentation, communications, *IEEE Spectrum*, vol. 28, no. 7, pp. 32-37.
- Wheelwright, S. C., Clark, K. B. (1992) *Revolutionizing product development: Quantum leaps in speed, efficiency, and quality*, Free Press, New York.

CHAPTER 5. CASE STUDY

In this chapter I would like to give a thorough introduction to the case companies, and the following paper will provide an analysis. The following case narratives focus on how the companies have organised their FEI activities, the challenges they meet and what aims they have in carrying out FEI. My three case companies have been given pseudonyms in order to anonymise them. One case company has been named Agro, the other MedX, and the last has been named HiLite. In this chapter, through a set of headlines, I will first describe Agro, then MedX, and finally HiLite.

5.1. AGRO

Agro operates within solutions for agricultural production and specialises in high-technology analytical instruments. Agro is a leading global company and was founded almost 60 years ago by a father and son, both civil engineers. The company is family owned and has had a steady increase in business, expanding by acquiring affiliated businesses. Agro focuses on its core technologies, although it is now increasing its focus on user friendliness and, foremost, a customer-driven innovation process. The company wishes to become better at integrating functional departments in the FEI and become more innovative. Its historical heavy focus on a set of rather stable technologies, a traditional functional organisational structure, and a strict focus on the existence of a market need before initiating innovation projects supports continuous innovation processes, and the company faces a challenge in its desire to become more innovative. Agro continuously seeks to meet this challenge for the FEI in its R&D processes.

The R&D organisation is divided into functional departments but joins temporary project teams across functions in the business innovation (BI) organisation. BI projects are rather well-defined projects based on distinct technological ideas and concepts or customer needs. The primary functional departments are Technology Development (TD), Business Development (BD), and Concept Development (CD). A standard stage gate model formally structures the organisation of the FEI, where the functional departments join specific stages depending on the relevance for their functions and domains.

5.1.1. TECHNOLOGY DEVELOPMENT AND EXPLORATIVE ACTIVITIES

The employees in TD have advanced skills in developing and applying advanced analytic technologies. They continuously collaborate with external academic and industrial researchers worldwide. They attend conferences, are frontrunners, and are up to date with the latest research within their field. TD does not work by a formal process, because that would not fit their practice; they are much more explorative

and experimental in their work with new ideas. The formal activities in relation to the corporate structures are few, but an important task is to continuously report progress in formal projects carried out in collaboration with other departments, such as BD, in BI projects. In between reporting, TD employees work as they see fit in the process of development. The leader of TD explained that employment in the department usually requires extensive experience from several years of employment within the company. Activities in the department are explorative; employees use about 20% of their time to explore new applications and technologies. TD engages very informally with stakeholders as well as with other departments. Agro's new strategic focus on customer needs requires the description and validation of a market need in order to initiate development projects, which has increased TD's collaboration with both BD and CD, but based upon informal relations.

5.1.2. BUSINESS DEVELOPMENT WITH A CUSTOMER FOCUS

BD has close connections to Marketing and Sales, and employees have a business profile. In BD they talk about the customer and the requirements of the products to fulfil the customers' needs. A focus on a fast and accurate production process that fulfils governmental regulations and helps their customers maintain their position in the system of agricultural product lifecycles is thus dominant. BD, the manager explained, is where development begins; there has to be a market-based demand or a specific reason for a new development project to launch. BD responds to information from sales channels, market analysis, and customer representations and proposals but is also very much aware of tendencies that indicate potential new regulations and demands for agricultural productions. Consequently, BD employees write up requirements for improvements or new technology applications and start collaborations with TD and CD in BI on specific projects based on business roadmaps. This is the more formal description of the functionality of BD. In everyday practice, what goes on between definition and decisions about requirements is informal communication and informal stakeholder management.

5.1.3. CONCEPT DEVELOPMENT THROUGH ENGINEERING DESIGN

The main activity for CD is the mechanical development of concepts. However, CD wishes to specialise in user needs and user experience. On the surface, CD could be regarded as simply responding to requests for new concepts from TD and BD, but it also claims to have a way to identify new opportunities through user-driven innovation. As part of their responsibility, CD is implementing user experience (UX) techniques that can identify new opportunities for improvements of their products. CD also has a strong stake in BI projects. Processes of ideation, conceptualisation, and design thinking lie in the domain of CD, and with modest success, CD has initiated cross-functional opportunity-searching processes, such as workshops and interest groups, but it has yet to see these initiatives take root and deliver a significant outcome. It has been, and still is, a challenge to work cross

functionally on new opportunities for concepts independent of formal project establishment.

5.1.4. INTEGRATION OF FEI FUNCTIONALITIES

The functional departments have different foci and aims in their approach to the FEI, but their interactions with formal structures, such as the corporate stage gate process, have similarities. The stage gate process, in particular, serves as a platform for communication between departments. On the one hand, the developers use the formal stage gate process to communicate their progress and gain strategic perspectives on the concepts being developed, on the other, there is room for working with development activities as the employees see fit. The formal structures of the stage gate process and BI projects support communication on several levels and between functions, and they are combined with stakeholder management, as one interviewee explained. When presenting ideas and concepts for decision makers at gate meetings, it is important to have them involved in the process beforehand because, as another interviewee explained, the decision makers are very exposed in gate meetings, where they have to decide on complex product concepts and guide the developers. Decisions at gates are already made before the gate meetings, and the involvement of the decision makers in the whole FEI process thus has an informal character. Agro has a focus on formalising a diversity of processes to create specific structures that fit different types of projects, such as BI projects. However, these structures are created after an innovation concept has already been roughly defined in terms of technology, market, and customers, and are thus merely extensions of the standard stage gate process. In the description of TD, BD, and CD and the organisation of BI, the departments appear to have a structured and efficient process for ideas and concepts that fit the current strategy and innovation processes, but ideas and concepts that do not fit into the current way of organising the FEI are left to more informal and entrepreneurial processes.

Agro wishes to organise the FEI so it could also support more radical ideas, but each department has its own approach to working with early innovation processes, such as technology scouting, user-driven development, and new market analysis, and none of them can deliver radical new ideas within their own structure. The organisational structure of BI integrates the FEI functions in innovation projects, but BI projects are still part of a well-structured stage gate model where activities are somewhat exploitative and ideas and concepts are rather predefined. The functional departments and formation of project teams based on an already well-defined idea or concept tend to support only incremental innovation; this organisation of FEI processes seems like a fundamental challenge for Agro in creating ideas that are more radical and may hinder its wish to include a user focus in the FEI. Agro seems locked into traditional ways of organising product innovation with a heavy focus on technology refinement. The company thus relies on rather informal processes and

entrepreneurship to foster innovations that are more radical, such as a user focus, and this makes the process difficult to manage.

5.2. MEDX

MedX started with the work of an entrepreneurial practitioner who succeeded in convincing a manufacturer to invest in a novel idea 60 years ago. The company grew rapidly on a global scale, operating within the medical device industry, and is now a globally leading company. MedX products address delicate and intimate healthcare needs. The entrepreneurial practitioner designed the first product to help a close relative regain a normal and active everyday life in spite of a disabling intimate condition. Today, the users and their intimate everyday life are still a central driver in the development of new products and resonate all the way to the FEI. The mechanistic company structure and the fixation on the user as the driver for innovation have resulted in incremental product innovation. Thus, more explorative employees had to obtain entrepreneurial abilities in order to cater for more radical innovation. In later years, a focus on more-innovative products has led to different attempts to organise FEI processes, e.g., technology development and technology scouting. These attempts, however, have been expensive and unfruitful, have lacked a market focus, and have left developers that do not fit the ideal champion profile unsatisfied. As a reaction to these challenges, MedX has reorganised its FEI processes.

Product development activities are carried out in four large product divisions, each focusing on a specific customer segment and specialising in core technologies. MedX has developed a strong standardised NPD process. The FEI activities, in comparison, are decentralised, fragmented, and dominated by informal processes because no formal structures have been able to embrace the developers' and managers' practices. The traditional way of organising product innovation (e.g., strong functional divisions between R&D, production, sales, marketing, and strategic management, and a low tendency to work across knowledge domains) has created certain challenges for the FEI activities.

5.2.1. A "FUZZY" FEI

Before reorganising the FEI, FEI activities were highly uncoordinated across functions. The marketing and sales department focused on opportunities and market needs. Strategic Management held strong views regarding which direction business should develop. Technology Development had certain ideas of what new technological areas were promising. Moreover, R&D had its view of what product designs should be delivered to the user. In the late '90s and early '00s, MedX launched a number of initiatives to strengthen the FEI: To channel internal and external ideas, a technology scouting department was established; to stimulate creativity and ideation, a physical environment was established, and to

accommodate promising ideas, ad hoc technology projects were launched. However, these structures were detached from innovation activities in the divisions. Technology Scouting was unable to follow through with ideas, developers did not perceive the creative environment as a place for serious FEI activities, and the ad hoc technology projects were uncontrolled. The developers promoting new ideas had to navigate informal structures where individual characteristics such as experience, reputation, profound knowledge of the organisation and strong networking abilities were critical. Here, new ideas emerged *in spite of* the possibilities for innovative processes, not *because of*, explained the R&D manager. The random processes of this “fuzzy” front end ended up in unacceptably long, costly and unsuccessful FEI projects being terminated at a late stage.

5.2.2. FROM “FUZZY” TO MEANINGFUL FEI

As a response to these front end challenges, management initiated a more controlled and transparent FEI process. The need for more control could easily mean implementing traditional process management by extending the NPD process with even earlier stages, but MedX’s recent experiences provided for a more reflective approach. MedX introduced a strong FEI agenda to drive new ideas and concepts. The users, being with the users, and developing ideas and concepts in close relation with the users, constitute the DNA of MedX. Before the reorganisation of the FEI, this user-focused approach supported only incremental innovation, which led to detached technology projects without market direction. Today, MedX takes what it calls “a deep dive” into an unambiguous business direction. Technology projects are thus closely connected with a market potential, e.g., connected with an articulated user need or market opportunity, and technology projects are now an integral part of the FEI. The user is still of central concern to MedX, yet the user does not dictate the direction. Today, the focus is on business and market potential. Technology Scouting manages the core technologies and technology projects, but it always discusses ideas for new technologies with other parts of the development organisation. Technology development and market analysis are now connected in the FEI, and there are strong interfaces between departments in the innovation value stream: Sales and Marketing, Production, and R&D.

5.2.3. A FLEXIBLE FEI BACKBONE

To support the new FEI agenda, MedX has developed a so-called backbone process upon which new projects are based. To customise an open process around what seems meaningful for the specific project, developers talk about a “development space.” This situated approach considers the specific content of the project, e.g., what kind of technology, users, and manufacturing processes are involved. A meaningful structure is created for the specific project by considering the company context and articulated strategic directions. Equally important, MedX adapts the process as the involved conditions evolve during the process. The global R&D

director spoke of meaningful and flexible processes. Flexible FEI processes do not mean unstructured processes; rather, each project is highly structured, but the process structure of a project that involves complex technology development is different from one that involves deep user research. The processes are thus tailor-made for each project. The R&D director also discussed the full integration of Marketing and Sales, Production, Technology, Strategic Management, and R&D in FEI projects through formal and timely procedures. Cross-functional activities are of key importance, and he emphasised top management's commitment from the beginning. The discussions that dominated gate meetings previously are now taken up at an earlier stage.

MedX has been through the same process as Agro of discussing and reorganising unsatisfying FEI processes. It attempts to combine situated strategies and ad hoc innovation projects for ideas that do not fit the formal stage gate structure with a common FEI that should be able to encompass all kinds of projects, both sustaining innovation and fostering more breakthrough innovation. The process is not a stage gate process as it is more cyclical and flexible. The situated approach, adapting the FEI process to the content and context of each project, links informal practices and social interactions to a formal frame, making an FEI process that is close to real activities and easier to manage. MedX thus tries to organise a formal FEI that includes social processes with the intention of making these social processes visible practices. As a project management officer explained, the company cannot rely on social entrepreneurial activities or idea champions alone.

5.3. HILITE

HiLite is a globally leading company supplying the market for residential house construction. A visionary entrepreneur founded the company in the 1940s, although today the company is owned by a holding company. The company is somewhat conservative, bound by a well-established supply chain network, and has a strong product paradigm. Products developed are highly standardised, as are the innovation process and further downstream processes, to ensure a high-quality product that maintains its position on the market. The product paradigm creates a shared and somewhat rigid understanding of how new ideas are conceived and what kinds of ideas are acceptable. Nevertheless, this case study is an example of a company that tries to create a strategic and organisational space for radical innovation. Following the industrial discourse on innovation in the '00s, HiLite was on the lookout to expand its product platform programme and business and decided to establish a radical innovation department. With a strategy for doing radical innovation within an established product paradigm, the company was faced with a strong internal dilemma, as it was not willing to risk the highly standardised product platform.

The new radical department would be working with radical innovation in a very definite framing. The goal for this department was to seek out radical new

opportunities but with the use of the company's core competencies. For example, new concepts should not overlap or risk the current business but should, at the same time, be within the same strategic frame and paradigm; new concepts should not disturb current innovation processes but should simultaneously be within existing technical competencies, and new concepts should have potential to be worth the risk of restructuring the value chain network. These criteria chalk out a narrow path that would imply an adversarial character of radical innovation and challenge how the department would tackle the job of creating a new platform for the company in an ambiguous environment of innovation. From the empirical data, we can categorise three strategic processes created by the radical department that organises the FEI: continuously interacting with top management, framing radical innovation processes, and engaging with ordinary development.

5.3.1. CONTINUOUSLY INTERACTING WITH TOP MANAGEMENT

The explorative process of the radical department does not fit the standard corporate stage gate model, so an alternative approach to the discovery and conceptualisation of opportunities is adapted within the radical department. However, this process is still subject to corporate structures, such as the stage gate process. The formal link to corporate structures is established through steering group meetings joined by top managers and experts. When interacting with the steering group, the radical department's explorative process is confronted with linear approaches to concept development. For example, in order for the steering group to make decisions, it is important that the group be introduced to clear data it can assess. This, however, creates a dilemma because concepts and business cases are frequently relatively rough and vaguely described. At the meetings, ideas can be at different conceptual levels but are introduced as subjects for ongoing discussion as to their fit with the organisational strategies and capabilities and potential for creating business. The central theme discussed at the steering group meetings is to either send it to ordinary development or keep it in the radical department for further development. It is a continuous consideration of the consequences a certain concept will have for the current business, and it is a significant challenge to negotiate the balance between the potential of a new concept and the risk to the established value chain. Steering groups and decision makers are exposed in the setting of the relatively brief formal meetings, confronted with the need to conduct complex and opaque decision making. As a result, much more informal and ad hoc activities and practices are played out between meetings.

5.3.2. FRAMING RADICAL INNOVATION PROCESSES

On the background of their interaction with top management, employees in the radical department can concretise the narrow path of radical innovation, and in order to frame their work, they develop a mental model that can frame their search for ideas, namely they create strategic spaces where they can seek out ideas within their

scope. In the configuration of these strategic spaces, external knowledge and competences are very important; thus external consultants from different knowledge domains are invited. Future trends in urban life, discourses of sustainability, innovative architectural thinking, and possible industrial partners are some of the sources delivering newness to the innovation process. They scan societal trends and assess how they fit with the company's competencies at various levels and along the value chain. There are several strategic spaces within each category, such as urban life, sustainability, or indoor climate. Within the various spaces, the group plans sessions where ideas are generated.

The interaction with the steering groups is facilitated through stage gate meetings related to a process with a linear logic. The radical department, however, operates with completely different frameworks in its internal idea management process. The stage gate model focuses on reducing the number of ideas, a quantitative focus. The framework of strategic spaces, however, focuses on the qualitative content of ideas and concepts. The radical department can work with different types of framework and mental models and use them in appropriate combinations for different tasks. Thus, the group does not follow formal processes but selects different informal approaches, such as whether to create strategic spaces in the search for radical new ideas or to follow the quantifications of the funnel model.

5.3.3. ENGAGING WITH ORDINARY DEVELOPMENT

The processes of handling ideas and concepts and placing them in relevant and fitting innovation projects take a great deal of attention away from the main task of the radical department. Even though the intention has been to work with radical ideas without disturbing ordinary development, the radical department is nonetheless involved with it. The department maps and evaluates many ideas and interacts with the surrounding organisation through the accepted ideas and concepts. Concepts that are far from the core product platform remain in the radical department for incubation, and relevant competences are brought in from the main organisation. Temporary project groups are established to focus on these concepts, and after a while, spin-offs and the project groups are transferred to the ordinary front end organisation. Although the incubation of radical ideas is placed in the radical department, this activity draws a considerable amount of time and resources away from the main task of seeking new innovative opportunities. Concepts that are close to the core product platform are immediately placed in the ordinary development process. Because both types of project steal employees from the radical department, the department slowly contracts.

It is interesting how the breakthrough department is capable of feeding the ordinary development organisation with new ideas. According to the interviewees, the breakthrough department has successfully developed several concepts enhancing the product platform. The main obstacle for these processes has been the transfer of

concepts from the breakthrough department to ordinary development. Different views of how to approach conceptualisation and development but also the breakthrough department's political agenda to try to avoid interference with ordinary development processes create resistance toward concepts from the breakthrough department. After not only developing a breakthrough concept that ensured a major increase in revenue over the next decade, but also successful concepts for ordinary development and proactively challenging the understanding of what HiLite is capable of, the breakthrough department lost its backing from top management. Consequently, after four years, the breakthrough department closed down.

Following these narratives of my case companies, I move on to Paper 3, which analyses the case companies through three perspectives.

PAPER 3

The third paper in my dissertation relates to the second research question, and partly to the third research question. In comparison to Paper 2, Paper 3 performs a deeper analysis of the case companies through three different perspectives derived from literature and discusses implications of using the perspectives and related models to manage FEI. The analysis reveals a dominant use of process models in approaching FEI but also finds a knowledge perspective that can extend the limitations of process models. Furthermore, the investigations reveal an emerging perspective of translation that is able to integrate the different managerial approaches to become strategic elements in navigating situated spaces of actors and models in FEI. As a continuation of Paper 3, Paper 4 will take up the challenge of conceptualising a model using the perspective of translation as a key element.

Paper title: Three perspectives on managing FEI: Process, knowledge, and translation

Publication outlet: Submitted to International Journal of Innovation Management

Author(s): Anna Rose Vagn Jensen, Christian Clausen, Liv Gish

THREE PERSPECTIVES ON MANAGING FEI: PROCESS, KNOWLEDGE, AND TRANSLATION

ABSTRACT

This paper presents three complementary perspectives on the management of front end innovation (FEI): a process model perspective, a knowledge perspective and a translational perspective. While the first two perspectives are relatively well established in literature, we offer a translation perspective as a complementary emerging perspective responding to the complexities of FEI. The paper combines a literature review with an empirical examination of the application of these multiple perspectives across three case studies of FEI management in mature product developing companies. We find the three perspectives simultaneously in play in each case, offering competing but also complementary approaches in the management of FEI. While the process models represent the dominant, albeit rather simplistic perspective, they primarily serve as a reference point and communication device. Here, the knowledge perspective seems to offer a supplementary perspective by filling the gaps left by the formal processes with informal cross boarder knowledge exchange. In comparison, the translation perspective is found to represent an emergent approach in managing FEI where process models, knowledge strategies and objects become integrated elements in more advanced navigational strategies for key players.

INTRODUCTION

Over the last decade, companies have become increasingly interested in understanding and organising the front end innovation (FEI) because of its potential for leveraging the innovative capability of the company. Through workshop dialogue and knowledge sharing with industry over the past ten years, we have experienced that practitioners in industry deal with a number of challenges when organising FEI. A main challenge is that the key focus by management has been on understanding how the FEI works as a process that can be described with a number of activities and phases before delivering concepts for the formal new product development (NPD) process. However, although the activities and phases seem logical and work as preferred management tools to assess progress and secure strategic alignment, the practitioners seldom experience these process models as being of help in exploring new ideas and opportunities in the early phases. The FEI thus continues to be an interesting topic, especially because of its complexity and interpretive flexibility, but also because FEI is considered to be a critical part of the

innovation process, as decisions made here have a significant impact in the later processes of product development, production and market launch. FEI therefore also has a substantial potential for optimisation if provided with clarity (Koen et al., 2002).

FEI has been widely treated in innovation literature (e.g. Smith and Reinertsen, 1998; Khurana and Rosenthal, 1998; Reid and de Brentani, 2004; Markham, 2013). Traditionally, FEI models have grown out the work with NPD models, and therefore a vast amount of the contributions in literature evolve around understanding FEI as a process (e.g. Khurana and Rosenthal, 1998; Boeddrich, 2004; Koen et al, 2002) just as in practice. However, understanding FEI as a process, i.e. that formal structures and well-defined processes mitigate risk and improve overall efficiency and effectiveness of the process, does not explain nor offer strategies for individuals enacting certain organisational roles to stimulate creativity and flexibility and secure organisational support for ideas and concepts (Schön 1983; Howell, 2005). This is performed through networking processes, thus FEI can also be viewed as informal networking processes where the focus is on how to enable the flow of knowledge across boundaries, knowledge sharing and creation through social interactions between individuals. Cockayne (2004) has described FEI as loosely connected network processes taking place before a specific innovative concept is formed and accepted by the subsequent new product development (NPD) process.

The ability to manage knowledge in innovation processes is considered key to innovation capability and performance (e.g. Tidd and Bessant, 2009; Adams et al. 2006). Nonetheless, when provided with either a process or a knowledge perspective, managing FEI appears as a continuous conflict between systematisation/exploitation and creativity/exploration (Verworn and Herstatt, 1999; Benner and Tushman, 2001). However, important aspects of FEI may not be recognised nor explained with the process or knowledge perspective. Thus, a third perspective would stress the network formation processes not just as knowledge processes between social actors, but also as socio-material interactions in FEI. In the translation perspective, human and non-human actors join forces in the conceptualisation of new concepts. Akrich et al. (2002) describes innovation in the making as a very complex task that entails the mutual translation of relevant actors as well as material objects and product concepts. In earlier work, we have suggested that the successful effort of FEI can be viewed as an actor network going through a translation process (Vagn et al. 2013).

With this paper, we would like to draw attention to the multiple perspectives on FEI. We take our point of departure in the tensions between the offered process models and their limited support for practitioners facing challenges of navigating the complexities of FEI and ask: What are the different perspectives offered on managing FEI and to what extent do they compete or supplement each other in practice? We answer this question by providing an overview of three perspectives

we have identified in literature: 1) a process perspective, 2) a knowledge perspective, and 3) a translation perspective. The first perspective accommodates FEI challenges through well-defined processes and formal structures such as extending the Stage Gate model (Cooper 2008) into FEI. The second perspective underpins the necessity of knowledge sharing and creation and builds on literature discussing the formal and informal knowledge aspects of innovation in organisations (Takeuchi and Nonaka, 1986). The third perspective seeks to provide a conceptual vocabulary to a third approach that is not well described in the innovation literature yet is increasingly acknowledged (Akrich et al, 2002; Garud et al, 2013). This perspective is able to describe the dynamics of FEI acknowledging and emphasising the relational interaction between human actors and non-human actors such as process models. The translation perspective builds on actor-network theory (Callon 1986). To better understand the implications of the three perspectives, we exemplify them with three industry cases. The three cases applied in the present paper have been collected from three large Danish industry companies through qualitative research methods.

LITERATURE REVIEW: THREE PERSPECTIVES ON FEI

THE PROCESS PERSPECTIVE: FROM LINEAR NPD MODELS TO ITERATIVE FEI MODELS

As outlined in the introduction, the process perspective represented by the process models is a dominant perspective in the innovation literature. Process models were first applied in new product development (NPD) to standardise the product development and diffusion effort and improve overall efficiency and effectiveness of the process (Cooper 2008). Later on, the process perspective has also made its entry in FEI. One could argue that many of the FEI models are merely an extension of the NPD process upstream. Decades ago, as a reaction to the linear NPD process models, Takeuchi and Nonaka (1986) suggested the new product development game as an alternative or supplemental view to the NPD process: *'Under the old approach, a product development process moved like a relay race, with one group of functional specialists passing the baton to the next group.'* (Takeuchi and Nonaka, 1986). Nonaka and Takeuchi identify a challenge of dividing the process in sequential steps and instead it is suggested to view the product development process as a rugby game with stages overlapping each other significantly. Later on, discussants have suggested similar alternative models in FEI that take into account the more iterative nature of innovation processes in sharing knowledge and interactions between individuals (e.g. Koen et al., 2002; Reid and de Brentani, 2004).

In the pursuit of improving efficiency and effectiveness of innovation activities, researchers began focusing on the early phases of the NPD process in the 1990s, arguing that the most significant benefits can be achieved here (Khurana and Rosenthal, 1998), and that many of the NPD practices do not apply to the early

phases of the innovation process (Koen et al, 2002). The early phases are both referred to as Front End Innovation (FEI) and as Fuzzy Front End (FFE). Similar to the Stage Gate model, process models have been developed for FEI. Khurana and Rosenthal (1997) have, for example, proposed a FEI model consisting of three pre-phases before entering the NPD process. In pre-phase zero, a preliminary opportunity is identified, in phase zero the product concept and definition is developed. and in phase one, the company assesses the business and technical feasibility of the product and plans the NPD project. Different suggestions of how to organise FEI have been proposed, many of them illustrated as linear processes. However, Koen et al (2002) argue that a sequential process would not work for FEI, and thus developed a non-sequential relationship model called the New Concept Development (NCD) model. The NCD is circular in shape. In the middle, an engine exists comprising leadership, culture and business strategy. Around the engine five activities are pictured: Opportunity identification, opportunity analysis, idea generation and enrichment, idea selection and concept definition. In addition, in the final layer of the model, the influencing factors such as organisational capabilities, the outside world etc. appear. Even though the Concept Development Model is circular and iterative, it still represents a process perspective.

The NPD and FEI process models are normative which mean they prescribe an ideal process for innovation and handling ideas, and primarily serve as a tool for management (Verwonn and Herstatt, 2002). The main focus in the process models is the activity of transforming an initial input to a functioning output (Florén and Frishammar 2012) and, in this sense, the model's black box – the work with ideas – does not offer a broader understanding of the interactions going on in the process. A main focus in the process models is the time perspective, which is prevalent in going from one stage to another, moving an idea forward, which is also one of the advantages of the process models. Another focus in the process models is the formal structure, which implies an organisation with functional structures and well-defined responsibilities for each stage in the process and a set of rational criteria for deciding whether or not to proceed. The journey of the idea is well steered and the shift in actors involved from one stage to the next seems well defined. In this sense, the process models work as effective project management tools. Although creativity is agreed to be a fundamental ingredient in innovation, the process models emphasise managerial decision making. Researchers have strived to reduce the fuzziness in FEI by developing process models (Schweitzer and Gabriel, 2012), although others oppose structure as destructive to creativity, while flexibility, ambiguity, and keeping a broad set of possible options open is vital for innovation success (Schweitzer and Gabriel, 2012). Gassmann et al. (2006) argue that the art of managing the fuzzy front end is not the art of dictating what everyone has to do at what time, nor is it the art of letting chaos reign. Therefore, FEI models have also been criticised for being overly abstract and not lending themselves to concrete actions for employees (Gaubinger and Rabl, 2014). Consequently, they neither work as an explanation of what is really taking place in innovation processes.

NPD process models are integrated into many large companies today and play an important role in helping managers negotiate resources, obtain an overview of activities, and keep momentum and track of time, which is also some of the major strengths associated with implementing process models. FEI models are not disseminated to the same degree as NPD models in companies today, perhaps due to their more abstract and less instructive nature, as well as their newer arrival in literature. While the process models contribute with an overview and progress in NPD, they tend to treat the work with ideas in FEI as merely objects that have to be pushed forward in the process, leaving actors and agency black-boxed.

THE KNOWLEDGE PERSPECTIVE: FROM EXPLOITATIVE KNOWLEDGE MANAGEMENT TO EXPLORATIVE KNOWLEDGE CREATION

The knowledge perspective can be viewed as an alternative to the process perspective. Whereas the process perspective focuses on controlling activities and exploitation, the knowledge perspective illuminates the creative, informal and explorative aspects of innovation. Innovation concerns creating new possibilities through combining different sets of knowledge, e.g. combining knowledge of technical solutions, marked trends, and user needs. Innovation thus combines differing knowledge pieces into a configuration (Tidd and Bessant, 2009) and the conceptualisation of products and services draws on many different pools of knowledge. In relation to FEI, knowledge management is especially associated with scanning and searching the environment to discover new opportunities. A very common approach in searching for new ideas is the idea suggestion system, where employees can submit their ideas (van Dijk and van den Ende, 2002). Sometimes companies also open up to suggestions from outside the organisation, also known as open innovation (Chesbrough, 2003). A newer tendency in the same vein is idea competitions (Ebner et al, 2009). The underpinning idea of these approaches is to capture and store the ideas so they can be retrieved at a later stage when needed. The challenge, however, seems that the ideas are revisited infrequently. Another approach in FEI to open up for new opportunities is to have workshops and seminars with internal specialists or external experts who can create new knowledge in a particular area available for the rest of the organisation, e.g. for functional departments or projects groups. This type of knowledge sharing is somewhat explorative in nature since you do not always know what you are looking for, and it is thus also difficult to predict the outcome.

Less formal and more self-organising setups for knowledge sharing also exist in organisations, and what characterises these is that management cannot control the aim or content of knowledge sharing, because it runs through informal processes. Management can, however, support or obstruct these processes. Knowledge sharing through informal social relations is an unavoidable and integral part of innovation in organisations and takes place in order to overlap or integrate phases in the

innovation processes or to fill knowledge gaps. For instance, intrapreneurs, also known as idea champions (Schön, 1983; Mullins et al, 2008), perform early conceptualising activities such as promoting ideas through creating informal relations in the organisation. This perspective frequently focuses on the individual. However, informal sharing of knowledge can also take place in networks across the organisation such as communities of practice. Communities of practice (CoPs) consist of people who *'...share their learning experiences and knowledge in free-flowing, creative ways that foster new approaches to problems'* (Wenger and Snyder, 2000). CoPs have an ability to utilise informal processes of learning, knowledge creation and sharing and are thus a resource of innovation capabilities (e.g. Brown and Duguid, 1991; Pattinson and Preece, 2014). CoPs can be a place for sharing and creating knowledge both within specialisations, across functionalities and organisational boundaries, and between companies. In relation to FEI, it is relevant to utilise knowledge and expertise from different technical and market domains and CoPs can enable innovation because diverse knowledge is combined and recreated (Nonaka and Toyama 2003). In relation to CoPs, Cross and Prusak (2002) define roles such as central connectors, boundary spanners, brokers, and specialists. Moreover, in de Brentani and Reid's (2012) continuous work on roles in FEI of discontinuous innovation, roles are described to be central to the movement and success of innovations in companies. They describe roles such as boundary spanners, gatekeepers, and project brokers at different interfaces of the innovation process. The common denominator of these roles may be their capability for carrying different types of knowledge across organisational or cultural borders or drawing on and gathering knowledge to establish new product concepts.

To explain innovation, Nonaka and Takeuchi (1995) argue that we need a new theory of organisational knowledge creation. They criticise the traditional information processing understanding of innovation where an organisation processes information from the external environment to adapt to new circumstances. Instead, they propose that organisations create new knowledge from the inside out. The basic assumption of their model of knowledge creation is that knowledge is created through the interaction between tacit and explicit knowledge and takes place through a spiralling effect between four modes starting at the individual level and expanding throughout different organisational levels. Knowledge creation and the search for new opportunities have the side effect that existing knowledge domains and power bases can be challenged, especially when radical ideas are proposed, for instance when digital solutions threaten analogue ones. Therefore, a dilemma is present when management wants radical innovation and, at the same time, wants to protect the core business. In these cases, the informal and self-organising setups for knowledge sharing become even stronger and the requirements to the navigational efforts of the organisational members increase.

THE TRANSLATION PERSPECTIVE: STRATEGIC DEPLOYMENT OF CONCEPTUALISATION

In the lenses of Actor Network Theory (ANT) (Akrich et al., 2002) innovation is viewed as processes of network formation through which ideas and concepts are translated into stable sociotechnical networks of heterogeneous relations connecting social, material and technical elements into a meaningful whole. Here, innovation processes are treated as sociotechnical processes where the technical and social dimensions are treated on equal terms (McMaster and Wastell, 2005). Technical dimensions are seen as not just “neutral representations of reality, but are part of complex networks of technological and social relationships” (Green, 2000). In the perspective of ANT, a successful FEI process – being able to create an innovation opportunity and lead product ideas into good currency (Van de Ven, 1986) – would be described as an actor network going through a series of successful translations. In a successful translation process, weak relations of unstable ideas are turned into a stable actor network with strong relations where the actors are reinforcing their shared programme of a product concept. In this case, a product concept is accepted in the formal corporate structures through an alignment with or at the expense of the prior order. As pointed out by Lundberg and Sandahl (2000) *'according to ANT, actors are fighting/struggling in the process of establishing a network and their fights and struggles are the driving force in this process'*.

The sociotechnical translation model offers a rather different understanding and ontology compared to the process and knowledge perspective by including both social and material actors and the content and meaning of the emerging idea and product concepts. It maintains a focus on describing the ‘real’ processes of interaction in idea and conceptualisation as they appear through ethnographic empirical studies. ANT offers a rich vocabulary to analyse the processes involved in the making of a heterogeneous network, and to see how actors are influenced and relations, content and meaning concerned with the idea or concept are translated. Michel Callon (1986a) describes translation as the following set of actions; problematisation, interessement, enrolment, and mobilisation while at the same time adjusting that order (Wastell, 2006). ‘Interessement devices’ are non-human elements, which are circulated by key actors in order to move other actors and make them interested in supporting the idea. The notion of ‘devices’ (such as interessement devices) can thus be seen as a sensitising concept towards particular means of intervention and ordering (Latour and Woolgar, 1986). Particular devices may work as translators of technological opportunities, market conditions, and user practices, as well as corporate strategies (Akrich, 1995; Clausen and Yoshinaka, 2007, 2009). The implication of this understanding is that process models should not be taken at face value but rather be seen as a device (a heterogeneous object including the model, its checklists, gates and staff), which performs as translator configuring the relations between engineering designers and management.

Other authors have pointed at the navigation of different competing framings of what constitutes a promising product idea as a key task in the management of ideas in an organisational context (Gish and Clausen, 2013). Here, emerging actor networks forming around new ideas frequently will have to compete with the existing highly stabilised networks around current trajectories. Others have pointed to the role of product concepts as intermediary objects that either represent ideas or enable the mediation across interests and social worlds of practice (Boujut and Blanco, 2003).

The concept of punctualisation (Callon, 1986b) indicates that any node in the network (an actor) can be opened up and analysed as an underlying network. A ‘stabilised network’ can be analysed as one actor – a punctualised network – only if the different actors of the underlying network accept that someone or something can speak on behalf of the whole network. The translation model offers a reflexive perspective in contrast to the prevailing normative and prescriptive models. While this perspective is unsuited to offer best practice advice it stresses the transfer of lessons learned from a deeper understanding of single cases assisted by a reflexive use of key concepts as sense-making devices. Moreover, this approach offers a number of navigational strategies to be used by key actors together with modes of staging and facilitation of idea work and innovative processes. These navigational decisions could include the selection and design of material objects to be engaged in network building. While ANT analysis primarily offers feedback and learning locally and provides support for navigational decisions, there are also cases where an ANT analysis leads to the definition of obligatory passage points for a network of actors to succeed (Legardeur et al. 2010).

RESEARCH METHODOLOGY

The present paper consists of a literature review and a multiple case study. In the following, we first present how we have identified the relevant literature followed by how we have collected and analysed our case data. As an overall methodological approach, abduction (Timmermans and Tavory, 2012) has framed our analysis. In our open approach to understanding the cases in interaction with selected literature, a multi-perspective on FEI emerged. This view consists of three perspectives: process, knowledge, and translation. We revisited the interview data in order to exemplify and analyse the perspectives. The existing frameworks of FEI helped us to recognise phenomena not yet accounted for in the FEI literature; however, it was a back-and-forth exercise. Starting with relevant frameworks for FEI, the analysis of the data led us to look for new frameworks. The literature review helped us examine and label the phenomena we observed, but different paths were also travelled to reach a robust explanation. The coding of our interview data was conducted in three steps, albeit iteratively: (1) an open coding informed by framework from the reviewed literature, (2) an adjustment of categories according to emergences in the

empirical data, and (3) a more structured coding based on the final categorical perspectives.

LITERATURE REVIEW

As a first step, we employed an explorative review of literature dealing with FEI. A simple framing of the search was to identify different ways of approaching, analysing, and modelling FEI in product innovation companies. It was a method to get the snowball (Bryman, 2001) rolling, where one paper or book would lead to another paper or book. At the same time, our empirical interactions would reframe our literature investigations in an iterative process and sharpen the emerging perspectives. At one point, the three perspectives would emerge as a dialogue between the empirical findings and the literature review and we focused on a deeper investigation of representative literature within process, knowledge, and translation perspectives. In our review of the literature, we seek to present the perspectives true to original ideas while pointing to areas of significance for the understanding of FEI that the perspectives do not cover in their view.

CASE STUDY

A multiple case study design (Yin, 2009) was chosen. In this way we were able to study the same phenomenon across the cases and in different settings. A case study focuses on understanding the dynamics present within the specific case's settings (Eisenhardt, 1989) and thus allows the researcher to investigate a specific practice. In choosing case studies, industries have not been distinguished but structural similarities such as size, maturity, global business, and product development activities were criteria. The first author set out to find three large, well-established Danish companies with R&D activities. The criteria for selecting the companies were age (>40 years), size (>500 employees), and experience with FEI activities. No criteria were set for a specific industry or markets, only that the companies developed and produced physical products. The three companies in the present paper have been given pseudonyms: Agro, HiLite, and MedX.

To collect data, semi structured interviews (Bryman, 2001; Kvale and Brinkmann, 2009) were conducted at all three case companies and were recorded and transcribed. Questions addressed topics such as background information of the respondent, ways and challenges in working with ideas and conceptualisation, organisation of R&D activities, and strategies for carrying out conceptualising FEI activities. Number and length of interviews vary according to the time and effort each company could invest. Thus, the data collection methods vary slightly across the three cases. We see no problem in comparing across the three cases, as the information given was rich and qualitative regardless of difference in quantitative measures. At Agro, eight interviews lasting up to one hour were conducted with employees and middle managers from three functional departments: Concept

Development, Business Development, and Technology Development. At MedX, two interviews were conducted with the Global R&D director and a Project Management Office (PMO) manager, each interview lasting two hours. At HiLite, three interviews were conducted in a radical innovation department, two with the department director and one with a business developer, each interview lasting two hours.

To generate insight, a case narrative for each case was written (Eisenhardt, 1989). The aim of writing up the case narratives was to identify and present the companies' challenges when organising FEI activities while also being aware of the actors' individual agendas and perspectives. Due to the article format, the cases are only presented briefly. To analyse interview data, we used an abductive analysis (Timmermans and Tavory, 2012). The analysis is recursive and iterative in nature; thus, data and theories are revisited in the research process as previously described. The potential relevance of unanticipated and surprising observations relies on the observer's theoretical lenses, but in contrast to deductive research, the researcher remains open to emerging themes.

RESULTS AND ANALYSIS: THREE PERSPECTIVES USED ON THREE CASES

AGRO

Agro operates within solutions for agricultural production and specialises in high-technology analytical instruments. Agro is a leading global company, which was founded almost 60 years ago by a father and son. Agro focuses on its core technologies and application areas, although there is increasing focus on customer-driven innovation. FEI is divided into the functional departments of Technology Development (TD), Business Development (BD), and Concept Development (CD). A standard stage gate model formally structures the process, where the functional departments join specific stages depending on the relevance for their functions and domains.

“We cannot handle something, if it is not following our process”. (Business Manager)

The process perspective is a quite explicit and dominant paradigm in the Agro case. Agro operates with a stage gate process, and the managers of Business-, Concept- and Technology Development Departments are very much aware of the company's stage gate process and refer to it and its stages throughout the interviews. This is done in terms of discussing the “ideation process”, the “concept phase”, “G0-G1”, and “development chain” among many other examples:

“We begin with the idea, for us it means a project, and we would begin with what we call G0 – our first gate, where we have an idea and need to figure out how to proceed with it.” (Concept Manager, Agro)

In particular, the Business and the Concept Development departments take ownership of the stage gate model, actually the Business manager refers to the individual stages as if they are entirely responsible for them:

“From G0-G1, it is Business Development, and from G1-G2, it is Concept Development.” (Business Manager, Agro)

Whereas the Business and Concept Development departments are ‘owning’ and comply with the different stages of the stage gate process, the Technology Department, although acknowledging the stage gate model’s significance in the company, does not see itself equally loyal to or even suited for the ordering mechanism of the model:

“We are in the front end of the innovation process. And that actually means that we work a bit outside [the stage gate process] that we have in this house. Because it doesn’t work if we should work according to a process.... [...] If I meet with an external professor from a University and say ‘I need to pass ‘Gate-something’’, well he wouldn’t care, it won’t be of his interest at all. I can simply not manage [the project] in that way. I need to perform up till ‘Gate 1’, and what is before ‘Gate 1’ you need to let me be free to do as I want.” (Technology Manager, Agro)

Because the stage gate model is the controlling management mechanism in Agro’s new product development activities, the more ‘fuzzy’ activities in FEI seem to stand in immense contrast. Here our second analytical perspective, the knowledge perspective, suddenly becomes evident when examining this contrast. During all interviews emphasis is placed on cooperation and knowledge sharing. However, the structure and purpose of the cooperation and knowledge sharing seem to follow different patterns. One pattern relates to the stage gate model and the formal set-up of the organisation. The stage gate model prescribes some obvious interfaces and knowledge sharing between the different departments:

“There is, of course, also a ‘leg’ called business. [...] Of course we work together with [the Business manager] and his department, because we do not make anything that we cannot sell.” (Technology Manager, Agro)

In general, the three interviewed managers refer extensively to each other and their interdependence on each other’s departments and knowledge areas and competences. Another pattern of knowledge sharing relates to FEI activities, where there is a need to open up to the outside world in order to create new insights and innovations:

“Out in the world, a large network exists. We try to participate in conferences, and we try to create some open innovation events.” (Technology Manager, Agro)

Whereas the purpose of the first pattern is to share important knowledge regarding specific concepts and products in NPD in order to make a joint effort, the purpose of the second path is to invite new knowledge into the company. The first pattern is characterised by its highly designated purpose, whereas the second is more explorative. A third pattern (similar to communities of practice) is also evident in the case. The employees in the Concept Development Department (as well as other departments) are assigned to different projects and thus contribute with their specific knowledge to that project within the stage gate paradigm. However, a need for creating “spaces” outside the planned projects and share knowledge across organisational or structural boundaries exists:

“I have helped in starting many ‘spaces’ – some knowledge sharing forums – and this company offers many opportunities for bottom-up processes. Not much is coming from above [...] but they support a lot of the initiatives individuals come up with. [...] I had a need for knowledge sharing. And they accepted that we meet once a month. Now it is a quite well built network and new employees enter it quickly.” (Employee, Concept Development, Agro)

In some cases, cooperation and knowledge sharing develops. In this case, what started as random knowledge sharing takes form with a purpose and develops into an idea that needs championing and gatekeepers:

“Then there are those projects we start ourselves. There is somebody, and this is highly individually, who is very good at catching [Jens] or [Thomas] in their lunch break and saying ‘I am sitting on this thing, it is so interesting, but I have some doubts about how to run it’. [...] In my view, this is common stakeholder management. If you want somebody to accept your ideas, then it is necessary to involve them in the process.” (Business Manager, Agro)

This is the point where the knowledge sharing activities transform into our third perspective, the translational perspective. The translational perspective is not so obvious in the Agro case. However, some hints are given in-between in some of the interviews. In Agro, they have a certain type of projects called Jump projects. These projects are more radical than ordinary projects:

“The Jump projects have their own life. They get more money and attention from top management. We have actually made a template regarding the market potential and the kind of technology we work with. [...] I think we are in a process where we are figuring out how to use it, how we should prioritise, [...] When we can see that this fits into the rest and it has a possibility to be realised, then we move it to become a project, a GO project”. (Concept Manager, Agro)

To get approval from Top Management your line of argument has to be accurate and convincing. In an organisation such as Agro where emphasis is put on formal processes, roadmaps, and clear-cut roles and responsibilities, you have to pursue the formal channels to gain support. One strategy is to make a document, such as the template mentioned in the quote that is based on a rational line of thought.

MEDX

MedX's products address delicate and intimate healthcare needs and the user and the intimate everyday life of the user are central drivers in the development of new products and resonate all the way back to FEI. MedX has gone through reorganisation where a new FEI unit was established. This has been done to ensure a more market-driven approach and viable concepts acceptable for NPD. MedX has experienced expensive development projects without market direction that is rejected by the NPD pipeline. The interviews are focused on the structure of FEI, the practices of FEI, and how ideas are conceived and transformed into concepts delivered to NPD.

In discussing FEI with our interviewees, the NPD process is an element that is hard to avoid. The purpose of FEI is not solely to generate viable concepts acceptable for the NPD and the process perspective also seems to be the immediate source of explanatory concept. During the interviews, NPD is continuously brought up both as a reference and a contrast to FEI. The primary touchpoint between FEI and NPD is the deliverance of a design brief and the development of a concept ready for product development. The NPD process is essential for MedX in developing the product from concept to launch, or "*from a to b*" as the R&D Director phrases it:

"...at gate 1 we have something substantial to show, we believe it can create good business. Gates 1 to 2, we commit each other, on the product, business, and production. Between gate 1 and 2 is our concept development. Gate 2, is design freeze and then there is a stretch from a to b. Finish the design, production, user testing, sales organisation, etc. The usual process of developing a product up to market launch." (R&D Director, MedX)

The consciousness about NPD processes is both used to understand how concepts suggested by FEI can be accepted but also to contrast the character of FEI to that of NPD. As a consequence of this awareness, we see that the interviewees sometimes frame their explanation of FEI by applying a process perspective or by contrasting to it when explaining how FEI is different from NPD. Frequently, we encounter statements such as "*the process model shows how it is supposed to be done, in reality we do it like this...*". To view product development activities through a process perspective and to frame them through process models serves as way of creating a common understanding of planning and controlling the process towards a viable product ready for market launch. The way FEI is perceived through a process perspective is as a funnel or as a solution space diverging or converging. The R&D

Director describes how important it is that people are invited to join the journey of FEI:

"It is the journey towards the funnel, the idea is to avoid saying, now we have a great idea and then just run it through, but to keep the space open for as long a time as possible and then narrow it in a good and right way. And to narrow down the space, we have a touchpoint with management so they join this process. There can be 100 ideas when we have a design brief; these we can narrow down to three directions and in one direction we have five concepts and two of them will be recommended. We do not decide but we recommend, so we keep on inviting people on the journey so they are not left in the dark – that is important."
(R&D Director, MedX)

This somewhat explains the process of FEI, but in terms of the dynamics and what makes FEI happen, MedX perceives FEI as much more than a process:

"Before, we prioritised to go straight from innovation roadmap to innovation brief. Now, we want it to take some time, we can't just say that it needs to be a square with four holes in it, it is a completely different approach, it can be anthropology studies, it can be everything. We try to say, before we start, what are we missing, what knowledge, what do we need to understand about this problem to make the right brief? And there can be many dimensions but typically, it is a user approach. In the front end, we will not be limited by what is possible or impossible but take an offset in what it is supposed to be able to do."
(R&D Director, MedX)

While the process perspective is primary in describing NPD, it is secondary in describing FEI where we see clear examples of the knowledge perspective. In relation to the stage gate process in MedX, the R&D Director explains how they care about providing the right competencies and functions in the different stages of development, not names of individuals but rather competencies and functionalities. We see here a rational and exploitative view on knowledge and a knowledge perspective primarily related to knowledge management. In contrast, the knowledge perspective in FEI is more explorative and relates to specific individuals:

"We have a group of people who are really competent to run these front end processes. We have a certain group, 4-5 people, but they are quite diverse. [...] We try to put a coordinator on this front end process and ask him to spend the time up to the innovation brief. What is the focus? And then gather people. You can do anything here, user visits, technology input, prototypes, idea generation, but in common we try to have a very holistic approach in the beginning, so it is not only the product but also everything around the product." (R&D Director, MedX)

The R&D Director exemplifies how they constantly challenge the perceived use practices by placing the developers among users. Furthermore, he explains how different areas of expertise are brought into play in the space of FEI. At the same time, drawing on knowledge from the specialised departments in the organisation, it is also important to bring in new knowledge and expertise from outside the organisation. However, it has to be relevant for the direction set for the FEI space in question. An innovation roadmap, defined by selected people in the organisation, will create the framing and directions for FEI:

"...a multidisciplinary group of people engaged with strategic work, people from R&D, marketing, together with experts from different areas, and consultants. It can be people with special knowledge. It is a knowledge picture that needs to be put together." (R&D Director, MedX)

In sketching out FEI in MedX, the R&D Director is quite concerned about how the configuration of people, knowledge, and expertise will create the desired output of FEI. Each FEI project is unique and challenges understandings in new ways. Knowledge and expertise brought into FEI projects has to be situated and relate to the relevant opportunities identified:

"...we have defined what we want to do in the innovation space, there is a headline, and it is the understanding and the solution space that are being defined towards the design brief so we have the right cornerstones for further concept development. [...] The design brief should be understood both by a marketing guy, production, etc. The design brief is not about making the product, it is about framing what we should make." (R&D Director, MedX)

When we begin to view FEI and NPD in MedX from the translation perspective, it is clearly evident in how FEI is approached in MedX but we also see indication that the translation perspective is equally useful in relation to NPD but is more visible and indicative in FEI. Before establishing the FEI organisation in MedX, the Global R&D Director explains how expensive and unfruitful technology development projects were driven up to the product development pipeline and then terminated because of too many unanswered questions concerning markets and production. He explains that this unfruitful effort in developing technology and the termination of the projects at a relatively late stage was caused by the lack of involvement and coordination with marketing, sales and production, thereby missing crucial buy-in from these parts of the organisation, as well as top management. In meeting this problem, he further explains:

"By inviting top management from the very beginning, approving the innovation roadmap, being part of starting up the projects in the front end innovation, seeing them when they are through the front end and go to concept development, and again see them when they go to product development. [...], top management are updated on a continuous basis. This has resulted in being free from the

discussions that could arise before at the pipeline of product development, they have disappeared, because you have commitment early on..." (R&D Director, MedX)

The understanding is, that for FEI to delivery concepts that are acceptable for NPD as a process, it has to be framed so that NPD understands the concept and is able to develop the intended product. In order to be able to navigate concepts so they are accepted by NPD, the FEI has to understand what the process of NPD concerns. In this way, the structure and process of NPD becomes an element to navigate in and with. In MedX, we gain the impression that process models are perceived and used as an important tool that provides a frame to develop products but they are also aware of continuously adjusting the processes according to practices. They view the stage gate process more as a tool capable of supporting a common understanding of the innovation process that enables people from different areas of the organisation to communicate around the development of products but also to trace and assess the progress of development. The process models have to be meaningful for the people working in them:

"Every time we implement or adjust stage gate processes in MedX, it is extremely customised. Because of a very dialogue-based culture you will get a lot of pushback if you don't make a process that works and can deliver results. It happens all the time, things are in constant development and are continuously adapted to what makes sense." (PMO Manager, MedX)

The PMO manager further describes how process models in MedX are continuously negotiated and adapted to fit the way people in MedX develop products. As the PMO manager points out, there is a significant amount that process models cannot say anything about:

"The process models do not say much about the configurations and the dynamics going on inside the model and that is the focus in my world and this you can get a sense of by walking around the departments and divisions and observe and understand how meetings occur and who are involved when and things like that, that is what sets the pace." (PMO Manager, MedX)

In the translation perspective, MedX are using process models as a navigational tool. They consider whom they should bring in and when in the process in order to move a conceptualisation process and have concepts accepted by NPD. The translation perspective captures the complexity of conceptualisation. We see that the process model sets the timeline and creates a shared understanding of where we are in the process and progress of innovation. We also see the involvement of top management and the different functional departments in the FEI organisation constitute a shared space for explorative yet strategic knowledge-creation aiming towards developing an acceptable concept for NPD. In MedX, their approach to FEI serves as a good example of what process models are limited to account for the complexity which

innovation processes entail. In FEI, knowledge is translated through people, tools and models in a conceptualising dynamic in order to deliver acceptable concepts to the pipeline of NPD. The translation perspective is able to turn our attention to the dynamics being created, the navigational abilities and efforts, and a situated strategic outlook.

HILITE

HiLite is a globally leading company supplying the market for residential house construction. A visionary entrepreneur founded the company in the 1940s. Today, the company is owned by a holding company. The company is somewhat conservative, bound by a well-established supply chain network, and has a strong product paradigm. The products developed are highly standardised, as is the innovation process in itself and further downstream processes, to ensure a high-quality product that maintains position on the market. The product paradigm creates a shared and somewhat rigid understanding of how new ideas are conceived and what kinds of ideas are acceptable. Nevertheless, this case study is an example of a company that tries to create a strategic and organisational space for radical innovation. Following the industrial discourse on innovation in the 2000s, HiLite was on the lookout to expand its product platform programme and business and decided to establish a radical innovation department. With a strategy for conducting radical innovation within an established product paradigm, the company faced a strong internal dilemma, as top management, on the one hand, wanted to expand the product programme but, on the other, would not risk disrupting the current highly standardised product platform.

Hence, the HiLite case is concerned with the role and working of a small FEI unit (5-20 employees) in a large mature organisation. The unit was established as a support for the top management referring to the concern director (ranking number 2 in the corporate hierarchy). Through a number of organisational changes it ended up being located under sales and marketing. The task of the FEI unit was to contribute both radical and less radical ideas. After having contributed one major radical idea the unit was transformed into an organisation dedicated to the implementation of this idea leaving the role as FEI unit vacant. The case is thus concerned with the working of the FEI unit during its five years of operation.

The process model perspective is less clear but still quite prevalent in this case. First of all, the FEI team was, from the outset, expected to feed ideas and concepts into the product development process at the development department but also to a variety of business units in the larger concern. While the development department was concerned with the further development of the current product platform as well as updates and improvements of the product, top management also wanted to receive more radical ideas in order to develop a new business line to complement the existing one. An idea funnel process including stage gate-like meetings with a

steering group located with top management was set up in order to facilitate decisions concerning the passing and uptake of new ideas. While the FEI team was concerned with the development of the qualitative content of ideas and concepts, the funnel model included a quantitative focus on the production of a particular number of ideas but also the selection of ideas. The FEI team saw the funnel as a necessary communication device with top management (steering committee) even they did not consider the brief gate meetings as reflecting the quality of the suggested ideas nor the processes taking place.

”They hardly understand the complicated idea suggestions” (Head of FEI unit), and “[The funnel model] is made and then moderated a couple of times. It’s really designed so that a linear mind can understand it, but there’s nothing in it that really is linear. If you do not think about it as something linear but something that happens all the time, this is how you should perceive it”. (Business developer, HiLite)

Besides the task of contributing ideas for new businesses lines, the FEI unit have increasingly been expected to take on the tasks of handling ideas and concepts and placing them in relevant and fitting innovation projects down the line. A clash between the explorative processes of the FEI unit and the exploitative and incremental processes of the development department being occupied with incremental innovation was expressed.

”This is engineers who are fantastically skilled in optimisation and work on a clearly defined task about a better insulation ...(...)... they are not creating new business but are hopefully sustaining the business we have (...) ...this is their role and they do it well”. (Department director, HiLite)

While at the FEI unit at HiLite, the process perspective was seen as underlining the incremental and path-dependent innovative processes, the generation of more radical ideas was based on knowledge sharing and knowledge recombination. Accordingly, the exchange of knowledge across the company’s internal as well as external markets and technological sources and the facilitation of idea generating workshops became the most important approach. Here, the company’s internal and highly established knowledge positions and taken for granted assumptions were challenged by inviting experts and experience from university as well as other industries. A key challenge was to identify and develop ideas with a relevant strategic fit. Ideas had to be different to the existing product platform in order to create something new that would not challenge the existing business, yet in contrast, new ideas should be sufficiently close that they could build on existing competences.

“We organise these opportunity meetings where we try to look out into defined areas, what happens within materials, for the city, people etc. where the world is heading. Then we link it to what HiLite stands for, competences, visions, values, strategies ... out of that we define a number of what we call ‘strategic spaces’

where there is a good match between the two dimensions.” (Department director, HiLite)

“This could not be carried out by the development department...they are much more technology driven and not oriented towards open innovation” (Business developer, HiLite)

A concern for the FEI unit is the current knowledge silos of the organisation, which are perceived as key obstacles for cross-disciplinary collaboration. A poor alignment between sales and marketing located at the headquarters in Copenhagen and the ordinary development departments located with the factory located in the province is taken as a prominent example. The FEI unit, however, has developed its own local model or approach of working with innovation. The model merely exists as an internal guideline to be adapted to the specific situation and task. It does not follow formal processes but rather selects different informal navigational approaches, such as whether to continue to build up ideas within strategic spaces or to pursue top management support and/or promoting new ideas towards other departments.

“It is our own decision whether to pitch ideas to management or to develop them further... Frequently I am surprised to hear top management’s priorities, and frequently they do not agree internally.”

“Basically, we have the competences to get the ideas into the HiLite machinery” (Department director, HiLite)

Concepts that are close to the core product platform are immediately placed in the ordinary development process in order to prevent using scarce FEI resources on development activities.

“Projects being close to the core can easily be kicked along.” (Department director, HiLite)

Concepts that are far from the core product platform remain in the radical department for incubation, and relevant competences are brought in from the main organisation.

“Projects like these (the radical ideas), they face resistance and people have difficulties understanding them and they can neither apply resources to them nor mobilise the competences needed. A project like this (a new business line proposal, author comment) they had to establish a new department, it demands more from the management, it costs some resources” (Department director, HiLite)

Such navigational strategies of how to promote, translate, and negotiate the uptake of ideas and the development of concepts and business plans frequently take into account the vested interests, as a FEI project manager recalled:

”If top management said it’s a good idea, and we got the licence to press things through, it might entail some dissatisfaction among line managers saying: ‘now they have taken our resources once again’... I guess it created some irritation elsewhere in the organisation” (Department director, HiLite)

DISCUSSION

In the following section, we will discuss our main findings across the three cases.

THE PROCESS PERSPECTIVE AS A REFERENCE POINT AND A COMMUNICATION DEVICE

In all three cases, we see the process perspective as being highly present in the reflections of FEI approaches. Process models, such as the stage gate model, work as a general reference point either as a prescriptive model for some of the FEI activities such as managing the flow of ideas, or they define the target for the FEI activities and the criteria to feed the NPD with ideas and concepts. Process models are considered to provide a formal structure with measures of progress. As such, our interviewees frequently portray process models as management tools that are primarily concerned with the control of progress and frequently in quantitative terms. It is also explained how the process models can define project organisations and departmental functions referring to specific stages of the overall process such as conceptualisation, business development and so on. This seems to somewhat support a rational and exploitative perspective on the organisation of knowledge flows where specialised knowledge centres in the organisation provide resources to activities in specific stages of the process. Even though the process perspective is prevalent in all cases its role and status vary considerably. Both in MedX and HiLite, we see how process models are actively used as navigational tools in translating ideas into acceptable concepts where the NPD process model in Agro is providing direction and support for ideas and concepts that can fit into their process model frame. Therefore, while we find the NPD process used as a reference for progress and functional organisation in all three cases it is also seen as a contrast to FEI or activities with explorative characteristics. Process models are, in this manner, described as setting the conditions of FEI activities and signalling a particular order of innovation (path dependencies, incrementalism etc.) or possibilities and limitations in FEI. However, process models are not (or only to some extent) considered as prescribing or offering support to the qualitative aspects of FEI such as knowledge processes cutting across boundaries or conceptualisation. As a common denominator, we see process models as significantly losing their dominant position when we discuss FEI elements, such as knowledge sharing, ideation and creation of new concepts. The cases indicate that the process models should not be taken on face value, as they do not support the work in FEI with unquestioned recipes. Nonetheless, they contribute to structuring the interviewees’ view of the organisational processes. The process models play a significant role in all three

cases. Process models are an essential reference for the interviewees and part of the vocabulary and way of perceiving innovation processes and product development in practice. At the same time, the process models are problematized but also considered as more or less necessary in reference to innovative activities of the organisation.

THE KNOWLEDGE PERSPECTIVE: FILLING IN THE GAPS

As the process models are problematised and perceived as rather unhelpful in relation to the management of FEI activities, the interviewees are looking elsewhere for inspiration and supplementary guidance for the FEI work. Instead, a number of strategies concerned with the sourcing, sharing and creation of knowledge with involved actors complements the process models. Here, innovation is not seen as a linear process, as indicated by the process models, but rather as an interactive knowledge process, where exchange of knowledge across knowledge domains is key. The knowledge perspective gives voice to an informal response to the limitations of process models but also as something that offers inspiration to fill in the gaps of what the process models cannot support. In the knowledge perspective, knowledge flows and enabling processes of search and dialogue across internal and external sources, departments, specialists, etc. are in focus. In the knowledge perspective, process models are perceived and used as communication devices in managing knowledge across knowledge areas, particularly to management but also across knowledge centres making process models, such as the stage gate model, similar to the role of boundary objects (Star and Griesemer, 1989; Carlile, 2002). Knowledge processes in FEI appear to be highly explorative and less goal-oriented compared to the activities in NPD. In both MedX and HiLite, interviewees describe how search and selection processes are managed through setting up so-called strategic spaces as focusing devices for the exploration of particular ideas. The key difference here is that ideas are not perceived as stable concepts as in NPD, but rather as something to be developed in an interaction and even contestation of taken for granted ideas with strategic management and other actors. In Agro, FEI explorative activities are less spelled out, but the need for knowledge sharing, flow, and creation are still expressed in the interviews. Explorative activities are particularly included in the technology development of Agro, where developers participate in conferences and collaborate with university researchers but without specific goals other than to explore new knowledge in the fields defined by strategic interests. We also see the expressed need for exploration in the concept development of Agro but also the difficulties in sustaining knowledge creation activities due to restrictions and a dominant position of the stage gate process model. As illustrated, the knowledge perspective seems to dominate in the interviewees' concerns, vocabulary and account of their FEI activities and, in particular, the creation of ideas. However, it does not explain how ideas are navigated into good currency (Van de Ven, 1986), and able to enter the NPD gate.

THE TRANSLATION PERSPECTIVE: NAVIGATING IDEAS INTO GOOD CURRENCY

While the knowledge perspective can be seen as a widespread supplement to the process models, the translation perspective seems to be an emerging approach in managing FEI, where process models, knowledge strategies and objects become elements in a navigational strategy. To open up for knowledge sources and enable learning across established 'silos' such as in open innovation (Chesbrough, 2003) is clearly not sufficient when questions arise of where to search, how to open up, how to make organisational actors interested and which established knowledge to be contested. The translation process captures the mutual processes of conceptualisation and network (re)-creating, meaning that the content and intentions of FEI activities become more important than the formalities and forms of collaboration. Translation is illustrated by the strategic considerations of key actors in their navigation of the process of promoting ideas to strategic management or down the NPD line. The change in MedX from a technology-driven orientation of projects with high failure rates to a strategic market direction and commercialisation of their technologies represents a reframing of what counts as innovation. The movement towards a more strategic mindset where networks of individuals, technology applications, production opportunities, and business cases are challenged and then configured or re-configured in a FEI space illustrates how the translation of ideas are catered for in order to increase the chances of developing acceptable concepts ready to enter the NPD process. In this perspective, the process models are perceived and used as a device or boundary object in translation processes. As both experiences from MedX and HiLite show, strategic directions or spaces are aimed at creating a fit between technologies, business cases, and what the organisation is capable of delivering. To make or work with this fit requires a translational process that includes considerations of all variables and elements that can oppose or support the idea.

The table below provides an overview of the perspectives in the three cases. Translation is considered where knowledge from a variety of sources are configured in a purposefully selected setup, for instance in workshops where knowledge, objects and actors are configured in attempts to create actor networks or when they, through a targeted dialogue, aim at creating ideas and concepts. This is also where designers and project managers consider how to organise their work with conceptualisation with the aim of matching or challenging corporate product strategy. FEI activities engage with political processes by configuring and directing workshops and create alliances across the organisational boundaries to convince strong decision-makers and create buy-in from downstream development. Key actors exemplify how they decide whether or not to involve top management and important decision-makers in FEI activities such as in workshops. Another example is how to use early mock-ups or other models on different levels in order to organise an explorative yet directed process. When key actors involve other actors it is not

just a measure of knowledge sharing, the intention is also to create ownership and support to particular concepts. It shows how they use different actors in a purposeful way to configure and stabilise the network around the desired concept output.

Case	Process	Knowledge	Translation
Agro	<p>Functional division of FEI activities are ordered and referred to stage gate model</p> <p>Process models prescribing FEI interfaces and activities</p> <p>Process provides measure of progress</p>	<p>Formation of CoPs and workshops aimed at knowledge sharing and knowledge creation</p> <p>Emphasis on cooperation across process gates</p>	<p>Technology department see themselves 'outside' the process rules</p> <p>Strategies for involving actors around an idea</p> <p>Negotiation of gate passing and work around</p>
MedX	<p>FEI as formal department/unit are separate, preceding, and different from stage gate NPD</p> <p>Stage gate model serves as an ordering coordination mechanism and common reference and understanding</p> <p>FEI as funnel to keep 'the process open and then slowly narrow down'</p> <p>Process as measure of progress</p>	<p>Composition of project teams across knowledge domains according to a holistic perspective in line with direction of FEI space</p> <p>Challenges perceived use practices by placing developers among users</p> <p>Design brief as framing what to make</p>	<p>Reframing of what counts as innovation from technology drive to market drive</p> <p>Involving top management in selected workshops along the process in order to enable early commitment</p> <p>Navigate NPD process and frame concepts to ensure NPD understanding</p>
HiLite	<p>Clear separation of FEI unit from NPD process model</p> <p>Process models/idea funnel as communication tool towards 'linear mindsets'</p>	<p>Exploration of ideas and idea generation in thematic workshops involving external and internal sources</p> <p>Contestation of taken for granted assumptions in NPD</p>	<p>FEI actors define and take responsibility for own process</p> <p>Navigating actors and knowledge domains externally and internally along the NPD process</p>

Table 9 Overview of the process, knowledge, and translation perspective in the three cases

In contrast to ordinary project and stakeholder management within the process perspective, where the main goal is to reduce uncertainty, a translation perspective appears to embrace uncertainties (Garud et al 2013) in FEI and even seek uncertainty to create new opportunities, destabilise the current understanding and networks around product- or business paradigms. As we see in both MedX and

HiLite with their innovation directions and strategic spaces, key actors try to retain the uncertainty instead of eliminating it. It may seem disordered, chaotic and unclear but, as observed in our cases, it appears highly purposeful. Managers or engineering designers reflect on the modes of ordering they are facing and consider how they may mobilise a network in particular ways. Here, the interviewees are concerned with actors, socio-material objects and purposeful transformation on the road to frame or coordinate the use of models, knowledge processes, and technology in a purposeful way in order to perform explorative yet strategic-minded FEI, as this is the way they seek to direct their search for ideas so they can connect with process models such as the stage gate models. Here, the translation perspective has a significant contribution because it can comprehend the complexity of FEI where exploration can exist together with strategic direction.

CONCLUSION

In the present paper, we have identified three dominant perspectives in FEI literature and analysed our three cases accordingly. Our study clearly supports the idea that different perspectives are simultaneously at play in FEI and when we consider the practices accounted for in our cases. To only focus on one perspective would not catch the many facets of managing FEI. We have identified three different perspectives which seem to provide sound coverage of what is going on but also seem useful in providing a holistic understanding of the diversities in managing and organisation of FEI. Compared to the process and the knowledge perspectives, which are broadly recognised in literature and extensively managed in practice, the translation perspective is an emergent perspective in managing FEI. This is not to suggest that translation practices are new in FEI, but that the conceptual understanding and recognition of these processes in FEI literature as well as organisational practice are currently lacking.

We suggest the translation perspective as a third emergent and promising perspective as being useful for managing and organising FEI. It allows us to take into account the objects and artefacts at play. In this way, the process models become a navigational object and something to be put into play. In the cases studied, we see a reflective approach among key actors to process models in how to use them as a purposeful means to achieve something. The same goes for knowledge sharing and creation where a reflective approach confronts, configures, reframes and reconfigures knowledge. The mindsets according to a translational approach are not bound by the understanding embedded in the process- or knowledge perspective. Instead, the focus is on how agency can be created and, while individuals may be embedded in the working of specific process models or understandings of knowledge sharing, the translation perspective points to how actors are able to escape their prescribed roles and take on new responsibilities. The translation perspective is a network perspective that builds upon an idea that the process model can be used actively instead of restricting FEI activities and knowledge processes

can be strategic yet explorative. The study makes us aware that the companies approach FEI using different perspectives and a mix of these according to what makes sense in particular situations, tasks, and processes. Following this, the intention is not to dismiss particular perspectives, but rather to contribute to considerations concerning multiple approaches and the implications of applying them. Clearly, the different perspectives can be competing and conflicting as they also reflect different worldviews and even organisational perspectives. They tell something about the kind of models that form the basis of FEI and its different mindsets, perspectives and models and, hopefully, contribute to a higher level of awareness of the range of possibilities to manage and organise FEI.

As we have highlighted, the process perspective gives a reduced and overly simple understanding of FEI, which is both its strength and its weakness. It provides a reference point but does not support FEI; therefore, it has to be supplemented with other perspectives. The knowledge perspective can thus be said to filling in the gaps where the process perspective does not suffice, because it exceeds the linear understanding of FEI and highlights the exchange of knowledge across borders, both internally and externally. However, the knowledge perspective does not cater for the more political aspects of FEI work, hence the translation perspective helps us explain how ideas are navigated into good currency.

IMPLICATIONS AND FURTHER RESEARCH

The perspectives we have presented in this paper are somewhat analytical and serve as a way of understanding FEI. In order to make the perspectives applicable in a practitioner setting they should be translated into a more operational ‘model’ or mindset. Further research should therefore concern how such a model or mindset can be developed so engineering designers and business developers can become even more aware of how they can make the different perspectives work for them in FEI.

LIMITATIONS

The analysed cases are unique and based in a Danish context. Generalisation from these cases can therefore be difficult. However, elements of FEI in the three cases are likely to also be found in other large industrial companies.

REFERENCES

- Adams, R., Bessant, J., Phelps, R. (2006) Innovation management measurement: A review, *International Journal of Management Reviews*, vol. 8, no. 1, pp. 21-47.
- Akrich, M. (1995) User representations: practices, methods and sociology, in Rip, A., Misa, T., Schot, J. (Eds.), *Managing Technology in Society: The*

- approach of Constructive Technology Assessment. Pinter, London/New York.
- Akrich, M., Callon, M., Latour, B. (2002) The key to success in innovation Part I: The art of interressement & Part II: The art of choosing the good spokespersons, *International Journal of Innovation Management*, vol. 6, no. 2, pp. 187-225.
- Benner, M.J., Tushman, M.L. (2003) Exploitation, exploration, and process management: The productivity dilemma revisited, *Academy of Management Review*, vol. 28, no. 2, pp. 238.
- Boeddrich, H. (2004) Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process, *Creativity and Innovation Management*, vol. 13, no. 4, pp. 274-285.
- Boujut, J. F., Blanco, E. (2003) Intermediary Objects as a Means to Foster Cooperation in Engineering Design, *Computer Supported Cooperative Work*, vol. 12, no. 2, pp. 205-219.
- de Brentani, U., Reid, S. E. (2012) The Fuzzy Front-End of Discontinuous Innovation: Insights for Research and Management, *Journal of Product Innovation Management*, vol. 29, no. 1. pp. 70–87.
- Brown, J. S., Duguid, P. (1991) Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation, *Organization Science*, Vol. 2, No. 1, pp. 40-57.
- Bryman, A. (2001) *Social research methods*, Oxford University Press, Oxford.
- Callon, M. (1986a) Some elements of sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay, in Law, J. (Eds.) *Power, action and belief: a new sociology of knowledge?*, Routledge & Kegan Paul, London.
- Callon, Michel (1986b) The Sociology of an Actor-Network: the Case of the Electric Vehicle, in Callon, M., Law, J., Rip, A. (Eds.) *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World*, Macmillan, London.
- Carlile, P. R. (2002) A pragmatic view of knowledge and boundaries: Boundary objects in new product development, *Organization Science*, vol. 13, no. 4, pp. 442–55.
- Chesbrough, H. 2003. The era of open innovation. *Sloan Management Review*, vol. 44, no. 4.
- Christiansen, J. K., Varnes, C. J. (2007) Making decisions on innovation: Meetings or networks?, *Creativity and Innovation Management*, vol. 16, no. 3, pp. 282-298.

- Clausen, C., Yoshinaka, Y. (2007) Socio-technical spaces: Translating across boundaries in design, *The Journal of Design Research*, vol. 6, no. 1-2, pp. 61-78.
- Clausen, C., Yoshinaka, Y. (2009) The role of devices in staging front end innovation, in proceedings of the First International Conference on Integration of Design, Engineering and Management for Innovation IDEMI09 1-8.
- Cockayne, W. R. (2004) *A Study of Innovation Ideas in Informal Networks*, PhD Dissertation. Stanford University.
- Cooper, R. G. (2008) The Stage-Gate Idea-to-Launch Process-Update, What's New and NexGen Systems, *Journal of Product Innovation Management*, vol. 25, no. 3, pp. 213-232.
- Cross, R., Prusak, L. (2002) The people who make organizations go-or stop, *Harvard Business Review*, vol. 80, no. 6, pp. 104–112.
- van Dijk, C., van den Ende, J. (2002) Suggestion systems: transferring employee creativity into practicable ideas, *R&D Management*, vol. 32, no. 5, pp. 387-395.
- Ebner, W., Leimeister, J. M., Krcmar, H. (2009) Community engineering for innovations: the ideas competition as a method to nurture a virtual community for innovations, *R&D Management*, vol. 39, no. 4, pp. 342-356.
- Eisenhardt, K. (1989). Building Theories from Case Study Research, *Academy of Management Review*, vol. 14, no. 4, pp. 532-550.
- Florén H., Frishammar, J. (2012) From Preliminary Ideas to Corroborated Product Definitions: Managing the Front End of New Product Development, *University of Berkeley*, vol. 54, no. 4, pp. 20-43.
- Garud, R., Gehman, J., Kumaraswamy, A. (2011) Complexity Arrangements for Sustained Innovation: Lessons from 3M Corporation, *Organization Studies*, vol. 32, no. 6, pp. 737–767.
- Garud, R., Karnøe, P. (2001) Path Creation as a Process of Mindful Deviation, in Garud, R., Karnøe, P. (Eds.) *Path Dependence and Creation*, Mahwah, NJ: Lawrence Erlbaum Associates,
- Garud R., Tuertscher P., Van de Ven A. H. (2013) Perspectives on Innovation Processes, *The Academy of Management Annals*, vol. 7, no. 1, pp. 775-819.
- Gassmann, O, Sandmeier, P., Wecht, C.H. (2006) Extreme customer innovation in the front-end: learning from a software paradigm, *International Journal of Technology Management*, vol. 33, no. 1, pp. 42-66.
- Gaubinger, K., Rabl, L. (2014) Structuring the Front End of Innovation, In Gassmann, O., Schweitzer, F. (Eds.) *Management of the Fuzzy Front End of Innovation*, Springer International Publishing, Switzerland.

- Gish, L. (2011) Experiences with idea promoting initiatives: Why they don't always work. In Proceedings of the 18th International Conference on Engineering Design, Design Society 3: 83-92.
- Gish, L., Clausen, C. (2013) The framing of product ideas in the making: A case study of the development of an energy saving pump, *Technology Analysis & Strategic Management*, vol. 25, pp. 1085-1101.
- Green, J. (2000) Epistemology, evidence and experience: evidence based health care in the work of Accident Alliances, *Sociology of Health and Illness*, vol. 22, no. 4, pp. 453–476.
- Howell, J. M. (2005) The right stuff: Identifying and developing effective champions of innovation, *The Academy of Management Executive*, vol. 19, no. 2, pp. 108-119.
- Koen, P. A., Ajamian, G. M., Boyce, S. (2002) Fuzzy Front End: Effective Methods, Tools, and Techniques, in *The PDMA toolbook for new product development*, Wiley, New York.
- Khurana, A., Rosenthal, S.R. (1997) Integrating the Fuzzy Front End of New Product Development, *Sloan Management Review*, vol. 38, no. 2, pp. 103-120.
- Khurana, A., Rosenthal S. R. (1998) Towards Holistic “Front Ends” In New Product Development, *Journal of Product Innovation Management*, vol. 15, no. 1, pp. 57–74.
- Kvale, S., Brinkmann, S. (2009) *Interviews: Learning the craft of qualitative research interviewing*, Sage Publications, Thousand Oaks, London.
- Latour, B., Woolgar, S. (1986) *Laboratory Life*, Princeton University Press, Princeton, New Jersey.
- Legardeur, J., Boujut, J. F., Tiger, H. (2010) Lessons learned from an empirical study of the early design phases of an unfulfilled innovation, *Research in Engineering Design*, vol. 21, no. 4, pp. 249-262.
- Lundberg, N., Sandahl, T. I. (2000) An ANT Perspective on Work Practice Design, in Dieng, R. et al. (Eds.) *Designing Cooperative Systems*, IOS Press.
- McMaster, T., Wastell, D.G. (2005) The Agency of Hybrids: Overcoming the Symmetrophobic Block, *Scandinavian Journal of Information Systems*, vol. 17, pp. 175–182.
- Markham, A., Lindgren, S. (2014) From object to flow: Network sensibilities, symbolic interactionism, and social media, *Studies in Symbolic Interaction*, in press.
- Markham, S. K. (2013) The Impact of Front-End Innovation Activities on Product Performance, *Journal of Product Innovation Management*, vol. 30, no. 1, pp. 77-92.

- Mullins, M. E., Kozlowski, S. W. J., Schmitt, N., Howell, A. W. (2008) The role of the idea champion in innovation: The case of the Internet in the mid-1990s, *Computers in Human Behavior*, vol. 24, no. 2, pp. 451-467.
- Nonaka I., Takeuchi H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press.
- Nonaka, I., Toyama, R. (2003) The knowledge-creating theory revisited: knowledge creation as a synthesizing process, *Knowledge Management Research & Practice*, vol. 1, no. 1, pp. 2-10.
- Pattinson, S., Preece, D. (2014) Communities of practice, knowledge acquisition and innovation: a case study of science-based SMEs, *Journal of Knowledge Management*, vol. 18, no. 1, pp. 107-120.
- Reid S., de Brentani U. (2004) The Fuzzy Front End of New Product Development for Discontinuous Innovations: A theoretical Model, *Journal of Product Innovation Management*, vol. 21, pp. 170-184.
- Smith, P. G., Reinertsen, D. G. (1998) *Developing products in half the time: new rules, new tools*, John Wiley & Sons, Inc., New York.
- Schön, D. A. (1967) *Invention and the evolution of ideas*, London, Tavistock (first published in 1963 as Displacement of Concepts).
- Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York.
- Schweitzer, F., Gabriel, I. (2012) Action at the Front End of Innovation, *International Journal of Innovation Management*, vol. 16, no. 6.
- Star, S. L., Griesemer, J. R. (1989) Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, *Social Studies of Science*, vol. 19, pp. 387-420.
- Takeuchi, H., Nonaka, I. (1986) The New New Product Development Game, *Havard Business Review*.
- Tidd, J., Bessant, J. (2009) *Managing innovation*, John Wiley & Sons, West Sussex.
- Timmermans, S., Tavory, I. (2012) Theory Construction in Qualitative Research: From Grounded Theory to Abductive Analysis, *Sociological Theory*, vol. 30, no. 3, pp. 167-186.
- Vagn, A. R., Clausen, C., Gish, L. (2013) Towards a new perspective of managing ideas in front-end innovation as actor networks, in Proceedings of the 19th International Conference on Engineering Design (ICED13): Design For Harmonies, *Design Society*, pp. 181-190.
- Van de Ven, A. H. (1986) Central Problems in the Management of Innovation, *Management Science*, Vol. 32, No. 5, pp. 590-607.

- Verworn, B., Herstatt, C. (1999) Approaches to the "fuzzy front end" of innovation, Working Papers / Technologie- und Innovationsmanagement, *Technische Universität Hamburg-Harburg*, No. 2.
- Verworn B., Herstatt, C. (2002) The innovation process: an introduction to process models, working paper no. 12, *Technical University of Hamburg*.
- Wastell, D. G. (2006) Information systems and evidence-based policy in multi-agency networks: The micro-politics of situated innovation, *Journal of Strategic Information Systems*, vol.15, pp. 197-217.
- Wenger, E., Snyder, W. (2000) Communities of practice: the organizational frontier, *Harvard Business Review*, pp. 139-145.
- Yin, R. K. (2009) *Case study research: Design and methods*, SAGE Publications.

PAPER 4

The fourth paper is a working paper and relates to my third research question. In comparison to Paper 3, Paper 4 can be considered as a continuation of Paper 3 and makes a structured review of FEI models with the aim of suggesting a complementary model that extends the notion and understanding of FEI modelling. In conceptualising an FEI model, concepts from ANT are used together with concepts of navigation and innovative spaces.

Paper title: Conceptualising a model for FEI: Navigating network and translating processes in innovative spaces

Publication outlet: Intended for submission to Creativity and Innovation Management

Author(s): Anna Rose Vagn Jensen

CONCEPTUALISING A MODEL FOR FEI: NAVIGATING NETWORKS AND TRANSLATING PROCESSES IN INNOVATIVE SPACES

ABSTRACT

Innovation management proposes different models with different perspectives to manage Front End Innovation (FEI). Recent investigations show that it is still challenging to follow prescriptive models in practice. In this paper, I will review a selection of FEI models found in literature. Based upon a case study in three companies of FEI practices and modelling of FEI, I will conceptualise a complementary FEI model using perspectives from Actor Network Theory (ANT). The review of proposed models in literature reveals models that are primarily viewing FEI in a process model perspective, which causes certain limitations to the understanding of FEI. The case study shows models used in practices with a high degree of adaptations of standard FEI models but still models that are not representative of FEI as described in interviews with practitioners. A new model of FEI is proposed that offers a perspective of FEI as a translation process involving heterogeneous elements as human and non-human actors, models, and configurations of innovative spaces.

INTRODUCTION

Innovation is fundamental to the sustained viability of product development companies on the global competitive market. The literature has, for decades, contributed to the increasing knowledge on managing innovation in companies (e.g. Chesbrough, 2003; Tidd and Bessant, 2009; Nonaka, 1991; Reid and de Brentani, 2004; Ulrich and Eppinger, 2004; Benner and Tushman, 2003; Markham et al., 2010; Cooper, 1988). An innovating company brings together several different knowledge domains, from natural sciences to social sciences, all contributing to the existence of an organisation that produces innovative products to current and new prospective markets. In steering, supporting, controlling and organising these different knowledge domains and research and development processes, innovation management has significantly offered many process models and management concepts. One of the most widely used models in companies bringing new products to market is the Stage Gate model by Cooper (2001). The process of the stage gate model is typically very clearly structured, somewhat predictable, and based on a formal organisation of product innovation. Another contribution is also as a process

model but it is extended with an interdisciplinary point of view where functional departments are merged into each phase of the innovation process (Ulrich and Eppinger, 1995). There is still a focus on the structured and formal aspects, but it also reveals some of the complex aspects of innovation processes in organisations that are still challenged by organisational structures that promote functional divisions rather than cross-functional collaborations.

More than twenty years ago, Smith and Reinertsen (1991) claimed that processes before engaging with formal structures of NPD could consume up to half of the entire development time. Furthermore, critical decisions and commitments made in these processes were influencing the entire project and final product. These preceding processes were consuming minimal costs but accounted for major costs in the later processes (Cooper, 1988). Smith and Reinertsen (1991) described these processes as chaotic, unpredictable, and unstructured and were the first to label these processes as the Fuzzy Front End (FFE). The term fuzzy means indistinct, incoherent, unclear, or confused. Nevertheless, it was recommended to include the FFE in the cycle time of New Product Development (NPD) (Smith and Reinertsen, 1991). FFE is also named front end innovation (FEI) and in many product development companies FEI is incorporated in development processes as a Stage 0 or a Pre-Project process that covers FEI (e.g. Khurana and Rosenthal, 1998). However, incorporating FEI in NPD as an extension of the stage gate model (Cooper, 2008) or applying the same sequential linearity of certain activities has been shown to be more difficult than expected because of the complexity of real practices and modes of working with creating and promoting new ideas in an innovating organisation (e.g. Koch and Leitner, 2008; Brown and Eisenhardt, 1997; Robinson and Stern, 1997).

FEI is complex and uncertain when in the making but could perhaps seem rational in retrospect, such as a decision-making process in the Cynefin framework of Snowden (e.g. Snowden, 2002) or as the complex organisation far from certainty and far from agreement by Stacey (1992). Adapting these perspectives allows me to contribute with a conceptualisation of FEI that will offer more understanding and ability to operationalise and manage FEI on its own terms rather than trying to reduce the process into linear activities and thereby lose the complexity that comprises the certain characteristics and dynamics of FEI. I would like to draw on Garud, Tuertscher, and Van de Ven (2013) in presenting a new and complementary model of FEI processes that is able to harness the relational complex processes of FEI as an alternative to the controlling approach. In the controlling approach to innovation processes, innovation management literature primarily works with process models that include certain formalised processes and activities that fit into categories in certain sequences (Garud, Tuertscher, and Van de Ven, 2013). However, these models also exclude significant processes such as knowledge-creation and flow (e.g. Nonaka, 1991; Wenger et al., 2002). In prescriptive process models, it is assumed that, if a professional design engineer follows the prescriptions and is guided by the

relevant checklists, his/her professional experiences will do the rest (Andreasen, 2011). The professional experiences of navigating innovation processes in product innovation companies are frequently informal and contain activities that are performed 'in spite' of formal structures (e.g. Robinson and Stern, 1997).

The objective of this paper is to conceptualise a FEI model that is able to complement and expand current models of FEI reflecting the practices of FEI in innovating companies. I have studied selected FEI models from literature and based on empirical investigations I seek to conceptualise a model for FEI using the analytical perspective of ANT.

METHODOLOGY OF THE STUDY

LITERATURE STUDY

The search for literature has been focused on, and limited to, identifying different models for FEI. I have selected a representation of models that describe and prescribe FEI with different approaches applying different perspectives. The search has been open and explorative but is limited by a concentration of models in literature on innovation management. The focus on the format of a model has limited the broadness of literature but it is done to complement practice where models are widely used because of their ability to perform in organisations.

CASE STUDY

A multiple case study design (Yin, 2009) has been carried out in order to compare and contrast different Danish companies' approaches to modelling FEI. In each of the three case studies, I have investigated the specific models but also practices in the organisation and management of FEI activities that the modelling may not be able to capture (Eisenhardt, 1989). I have selected three large well-established Danish companies with FEI activities to compare across companies. The criteria for selecting the companies were development of physical products, age (> 40 years), size (>500 employees) and having experience with formal and informal processes when organising FEI activities. Background information about the case companies, for example, age, products, markets etc., was primarily acquired from the company webpages and previously published case descriptions. The three companies have each engaged with the amount of time and resources then available. Twelve semi-structured interviews (Bryman, 2008; Kvale and Brinkmann, 2009) across the companies have been carried out, recorded, and transcribed. In the first company I have conducted eight interviews of 30 min. with three managers and five developers working with FEI and concept development. In the second company I have conducted two interviews of 120 min. with an innovation manager and a business developer from a radical innovation department. In the third company I have conducted two interviews of 120 min. apiece with an R&D director and a project

management office manager. For this paper, I will draw on the primary findings in the interviews, based on the deeper analysis in a previous paper (Paper 3). In this paper I will primarily focus on the FEI models of the interviewed companies and use the interviews as elaborations of the models and descriptions of practices in FEI.

THEORETICAL PERSPECTIVE

ANT has provided me with sensitising concepts that make me aware of a certain phenomenon, in this case, how FEI is navigated, carried out, and managed using different FEI models. Besides these sensitising concepts, ANT also provides concepts that inform the conceptualisation of my FEI model. In this paper, the concepts of actors and relations, the translation process, navigation, and innovative spaces are primarily used.

In interviewing practitioners, in addition to a deep focus on human interaction, there is always a link to non-human actors. These could be the technology in question, that forces the translation process in a certain configuration of actors and relations, but also design briefs and reports informing the corporate stage gate process. As described in the review, there is a general understanding in innovation management literature that FEI has a degree of complexity, for instance in the interaction between formal structures and informal practices, but still also a dominating belief that mainstream process models can support FEI sufficiently. It is my intention to show that ANT pointing to the dynamic web of actors and relations, and the process of translation, is better suited to address the complexity of FEI. The intention of drawing on ANT in the analysis of FEI and conceptualising a model of FEI, is not to dismiss the models that can be found in literature but rather to suggest a complementary perspective that could embrace more of the complexity of FEI in order to identify specific managerial implications.

Using the perspective of ANT, I view an idea as a relation. An innovation idea does not exist as an independent object, it only makes sense if it creates value for something else and is relevant for other elements (Cockayne, 2004; Gish and Clausen, 2013). If I view the idea as a relation, then the work with developing innovation concepts is also relational and the same goes for the work in FEI. Instead of a flat view of a process as a standard management tool that may not capture the complexity of ideas as relations, I add a networking perspective to the process where heterogeneous actors and enactment of relations are in focus. I use the theoretical perspective of ANT to inform my conceptualisation of a model of FEI. My focus is on a relational aspect of innovation processes (Bijker, Hughes, and Pinch, 1987; Latour, 1987), a translational aspect of innovation processes that translates the development of early ideas in FEI in a dynamic, enacting, and navigating manner (Akrich, Callon, and Latour, 2002; Van de Ven, 2004), and on situational aspects of innovation processes that situates and makes FEI and inherent activities unique and outstanding (Garud, Tuertscher, and Van de Ven, 2013; Van de Ven, 2004).

FEI MODELS IN LITERATURE

I have selected an indicative sample of different suggestions for theoretical models and models derived from case studies of FEI that together represent the primary contributions in literature. The first model is the Development Funnel model by Wheelwright and Clark (1992).

The model does not distinguish a specific FEI phase and omits one important aspect, namely what happens before the idea is shaped and put into flow in the funnel. The Innovation Funnel model shows some important aspects of how the majority of literature in innovation management views ideas and idea development/processes. Ideas are viewed as relatively stable objects that are sent through a specific set of stages. Many authors have investigated further aspects that surround idea development by extending the model with more detailed and iterative stages (Cooper, 2001), open innovation (Chesbrough, 2003) with inlets on the side, and an earlier stage where the ideas are not yet conceived but rather social networks (Cockayne, 2004). However, the basic concept of how to view ideas as stable objects with intrinsic values still dominates.

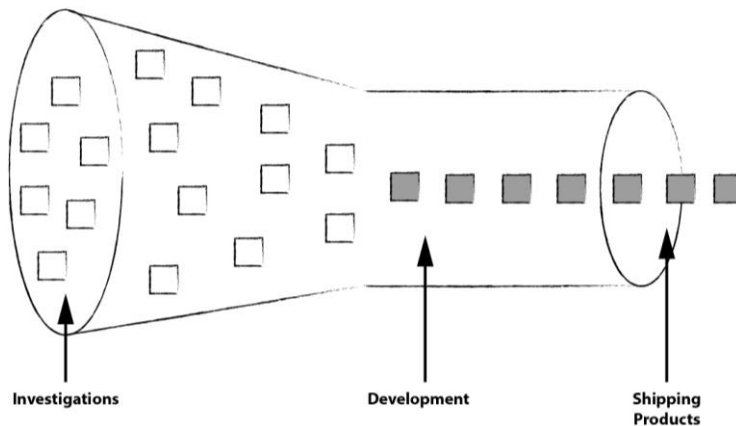


Figure 3 Development funnel (Wheelwright and Clark, 1992))

The next model of FEI is a widely used process model for FEI in industry. The model differs from the standard stage gate model of NPD by applying other types of activities, such as discovery, scoping, and building a business case. However, in principle, the model prescribes the same type of process, namely a linear stage gate process of activities belonging to certain steps in the FEI process. There is an explorative first step, then a selection activity, a refinement of ideas through scoping, another selection in the second gate, a step for developing a business case,

and then a go/no go gate for product development. The model simplifies and structures the activities and places them in a chronological order.

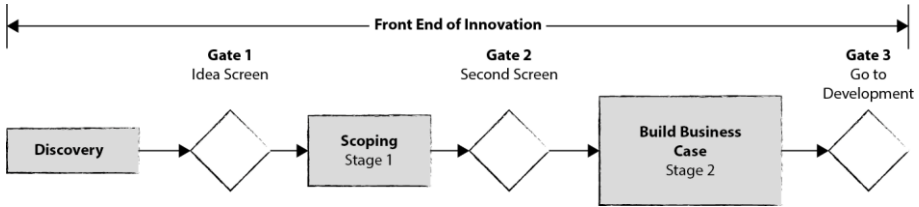


Figure 4 Stage gate process for the front end of innovation (Cooper, 2001)

The model may primarily rely on objects such as checklists and does not account for relevant actors. A critical view may argue that many aspects of FEI processes are omitted and that the model is too generic. Cooper (2008), to some extent, acknowledges the more complex view of innovation processes and discusses how the stage gate model can embrace non-linearity. In the case companies, this model is adapted and refined so it is made specific and relevant for the managing of FEI processes. However, practitioners find difficulties in applying such a linear stage gate process to critical processes in the FEI as this model may not capture the complexities or informal practices that are evidently part of FEI and, in particular, more radical processes. The cases show that the model works more as a management controlling function and not as a support of the work with investigating and promoting new ideas.

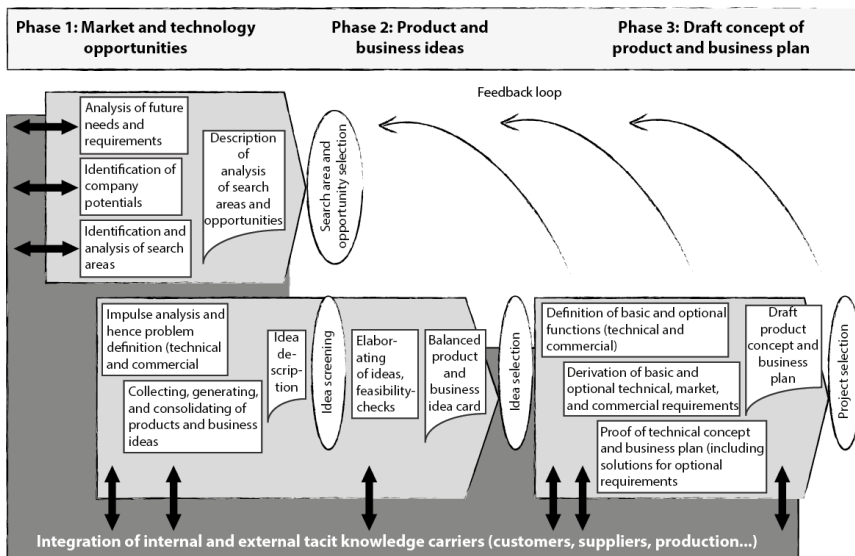


Figure 5 Integrated front end process model (Sandmeier, Jamali, Kobe, Enkel, Gassmann, and Meier, 2004)

The above model of an integrated FEI process is derived from a case study. It is seemingly a more complex model because it illustrates observed activities carried out in an empirical case study but it is primarily through a detail in activities carried out in FEI and a somewhat structured flow of FEI process documents. However, the model is iterative and capable of embracing different dimensions of FEI, such as the integration of customers and suppliers, and feedback learning loops. This may illustrate an example of how a specific company adapts the first model by Cooper (2001). As a consequence, it is also a model that does not have the same level of generalisability (Brem and Voigt, 2009). This model represents models in literature that attempt to describe the complexity of what actually takes place in FEI. The model shows the very iterative and integral characteristics but is still focused on certain activities and outcomes and is limited in the description of the dynamics of actors and knowledge processes that push the whole process of FEI.

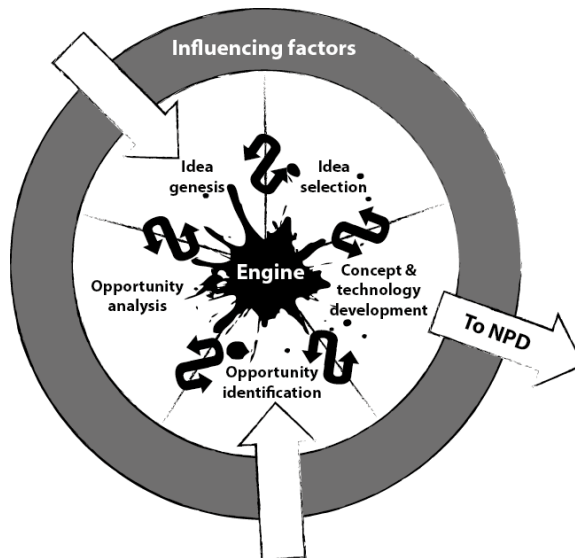


Figure 6 Holistic model of the front end, NCD model (Koen, Bertels, and Kleinschmidt, 2012)

The above NCD model is a generic model but, by illustrating the FEI as a non-linear and holistic process (Koen, Bertels, and Kleinschmidt, 2012), the model apparently distinguishes itself from more linear models such as the previous examples. Another difference is that the model structurally incorporates the associated complexities of leadership, culture, and strategies illustrated by the engine in the middle of the illustration. The engine drives five controllable elements that are specific FEI activities. These activities are iterative and intertwined. The influencing factors, organisational capabilities, regulations, competitors, and customers, etc., are also associated complexities and affect the entire innovation process and are relatively uncontrollable by the company.

The NCD model adds aspects and complexities that are vital to consider for successful innovation processes (Koen, Bertels, and Kleinschmidt, 2012). It is a process more characterised by circular trial and error processes but again relevant actors are left out and a question could be, how this is done in practice? In my contribution in conceptualising a model for FEI I would like to focus on the relational perspective of the FEI in a translational process that captures how, for instance, opportunity analysis is translated into concepts, and how ideas and concepts gain organisational backing. The above models can be considered as a management tool for the standardisation of FEI activities. The models focus on certain activities in sequential, iterative, or circular processes found in case studies or based upon best practice studies of successful FEI. The array as well as the application of such models is manifold because they are heavily dependent on the intention of the practitioner and, as such, no best way exists. If the previous examples of FEI models may be classified as top-down management tools for standardising the processes of FEI, the following examples of FEI models seek to shed some light on bottom-up FEI processes and, more complexly, the interaction between organisational structures and individual culture.

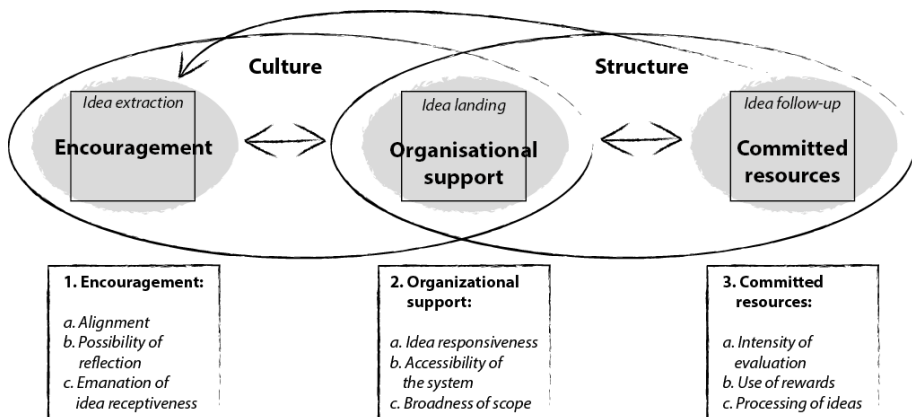


Figure 7 Phases and factors in the transfer of creativity to practicable ideas (van Dijk and van den Ende, 2002)

van Dijk and van den Ende (2002) model the main factors that influence suggestion systems where employee creativity meets with organisational structures. They emphasise the bilateral relation between culture and structure of FEI processes based on individually and organisationally related factors. The next model illustrates the mechanisms that affect the processes of ideation in the interaction between individuals and the organisation (Hellström and Hellström, 2002). In their conceptualisation of the model, the manager is a road builder and rule maker, while the employee is looking for the best routes to push ideas forward. The model primarily focuses on entrepreneurial activities and how the manager creates structures to tackle. In this model, we see an example of including relevant actors

navigating a space of FEI. It is a complex social game that needs to be interpreted for the employee in order to be able to perform in the processes of FEI.

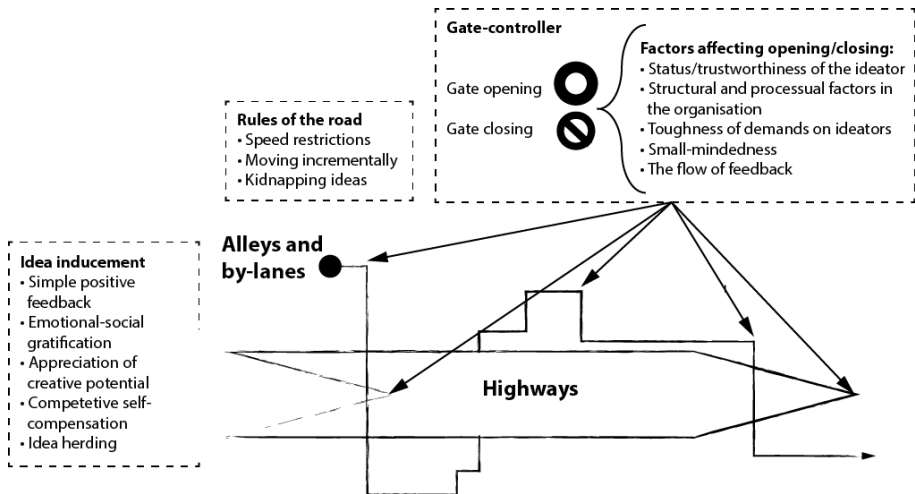


Figure 8 A model of organisational ideation (Hellström and Hellström, 2002)

Scholars of product innovation management also study informality and individual characteristics and roles in FEI. Reid and de Brentani (2004) and Markham, Ward, Aiman-Smith, and Kingon (2010) define certain roles in the processes of informal FEI activities from research to the acceptance in NPD. The gap between research activities and the formal NPD is referred to as the 'valley of death'. This gap between research and acceptance of concepts into the formal NPD is in the lack of resources and expertise and is heavily dependent on the roles of champions, sponsors and gatekeepers. Again, the focus is on entrepreneurial activities in touch with managerial structures.

Koch and Leitner's (2008) model below focuses on motivations and mechanisms for self-organising and interaction with formal NPD processes. The authors do not deal with the non-linearity of FEI that they consider as a complex system and instead primarily focus on how employees act in certain steps of the FEI process. The activities listed in the model run in parallel to, or precede, formal NPD and demonstrate how employees bypass or even ignore formal processes. The model by Hellström and Hellström illustrates the same issues but with a primary focus on the management. Koch and Leitner (2008) illustrate the possibilities for employees to act autonomously but in the structure of the NPD process in their modelling of FEI.

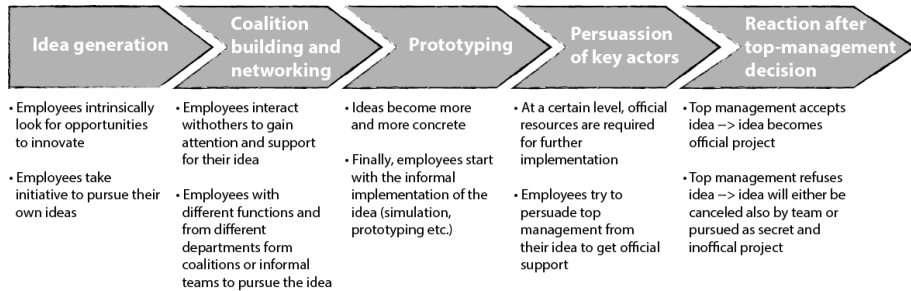


Figure 9 The evolution of a self-organised innovation (Koch and Leitner, 2008)

In conceptualising FEI models, the various authors choose to include some elements and exclude others. Common for the selection of FEI modelling is the inclusion of certain activities that are frequently related to FEI processes, such as ideation, selection, and acceptance of innovation concepts. Besides this, the models focus on including formal structures and some of the models also include informal social interaction. These informal processes are frequently activities but of a more entrepreneurial kind. In the models, there are also degrees of freedom that allow free adaptation of the models in practice. In case studies, the strongest statement when discussing the processes of FEI is that the modelling does not, to a greater or lesser extent, capture the reality of their practices, some even state that they can be obstacles in the dynamics of FEI.

FEI MODELS IN CASE STUDIES

My development of a model for FEI is partly based on my empirical findings and analysis of how companies organise FEI and partly on theoretical knowledge. The empirical findings suggest a complex and situational character of how the companies organise FEI. It is also a space consisting of knowledge creation and translation processes (Paper 3). The three case companies have developed their own FEI models that structure their work to some extent. The interviews suggest a more complex process and practice that the models are not able to account for. These processes are, in particular, the creation and enactment of relations in a heterogeneous network across many different practices in- and outside the company. The models from my case companies can be considered as management tools that visualise and systematise FEI activities. The models are created by the company and reflect the intentional formal process of FEI.

The first example of a FEI model is from the first case company and is derived from their stage gate process model. The model unfolds the first step of *identify opportunity* just before Gate 1 in their stage gate process. The model is restricted to include the kind of elements that I also see in the general stage gate model in literature but adapted to the specific company. It is a process of tasks and activities to be done and, in the final step of their FEI, there is an approval of the outcome in

the form of a gate. When I was presented with this model, one director reminded me that the models do not always account for their real practices in FEI.

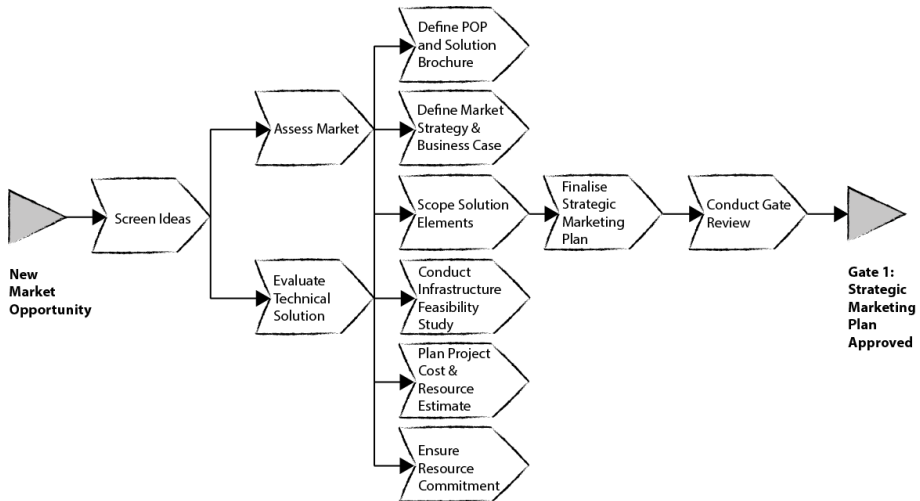


Figure 10 A FEI model from Agro

I came across another model elaborating stage 1 that caught my attention from the same company. The model illustrates their specific *process* but also specific *roles* placed according to the timeline of the process, much like a Gantt chart. The process steps are simple framings of types of activity such as *explore*, *create*, *validate* etc. However, more interesting is the placement of roles and the responsibilities connected with the roles. A role such as *concept driver* that is responsible for certain activities such as *concept space*, *concepts catalogue*, *mock-ups*, and *concept development report* etc. In this model, the employees have developed a shared model that places emphasis on human actors in the process that makes sense for them and the way they work with FEI. The model includes actors together with the activities and tasks that will move the process forward. The modelling of FEI by this company raises a specific question about what happens before there is any defined idea. Through the interviews and my analysis, I have accounts of several processes that make room for fostering and implementing new ideas but the model does not account for these processes that are primarily informal but well established in FEI across different departments of FEI. From my discovery of the model of roles attached to process steps in development of concepts, I may assume that there could be modelling of processes including more elements in other places of FEI such as the *new market opportunity* step or gate 1 in their formal model of FEI.

In the next model, there is a *value proposition* stage before entering FEI. Hughes and Chafin (1996) take a learning process perspective on FEI and focus on adding value to customers and end-user. My case company has users and customers at its

core and they aim at framing their FEI process in accordance to this. From being a very technology-driven company they have gone through a massive change towards a market-driven focus in creating new business. Based upon an innovation roadmap aiming at creating value for customers and end-users, the company proposes an innovation challenge. The innovation challenge is proposed to a broad range across organisational boundaries and competences that includes contributors from technology development to sales representatives. The company wants to focus more on spaces of innovative activities than a structured process that dictates activities in a certain sequence for a certain department of the organisation. The company speaks of a backbone rather than a dictating process. As with the other empirical examples, this company has adapted the stage gate model, so it makes sense for their processes of FEI but it is still a formal illustration of the FEI process. They informed me that, in practice, the process is much more complicated. The space of the innovation challenge proposes innovation briefs and later iterative processes of divergence and convergence of the concept space, where top managers are involved in assessing the propositions, a direction for the concept is chosen. It is interesting that they use the term ‘direction’ this indicates a navigational perspective.

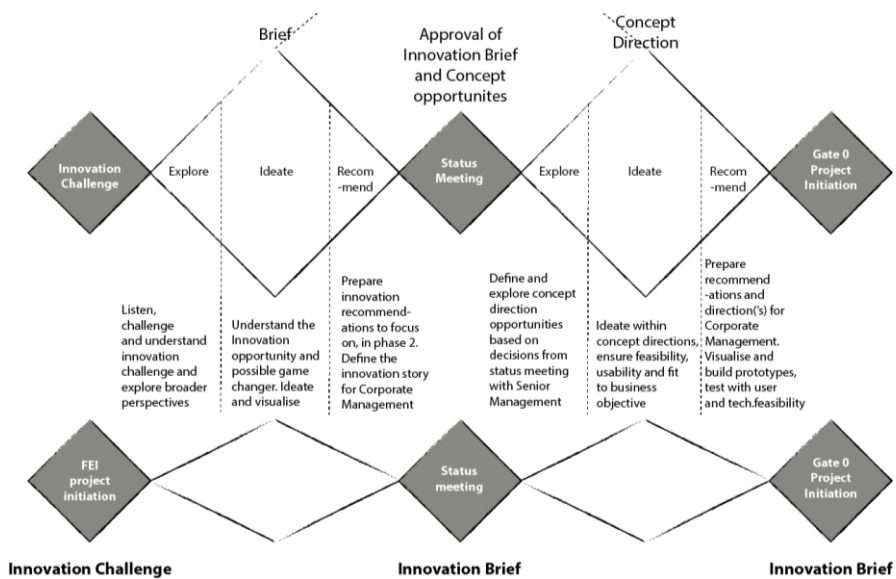


Figure 11 FEI process model from MedX

The following example below is, according to the interviewees, still a linear simplification of the real practices, where informal enactment of relations dominate their practices in FEI. The model is also an example of how the practices of FEI interact with formal structures. The interviewees explain how the model is designed in order that a linear mind can understand the process, such as a steering committee and top managers. The model is more illustrative than the standard models and also

allowed me to obtain an insight into the process before any specific ideas can be placed in lists and catalogues. The model is from a radical innovation department where there is full integration of business development and concept development functions in contrast to my two other companies. Here I get a look into the process of opportunity identification and analysis in the *world/company* step and the *strategic spaces* step. These steps question what is out there in the world? And what can we do, as the company we are, and what do we want to do?

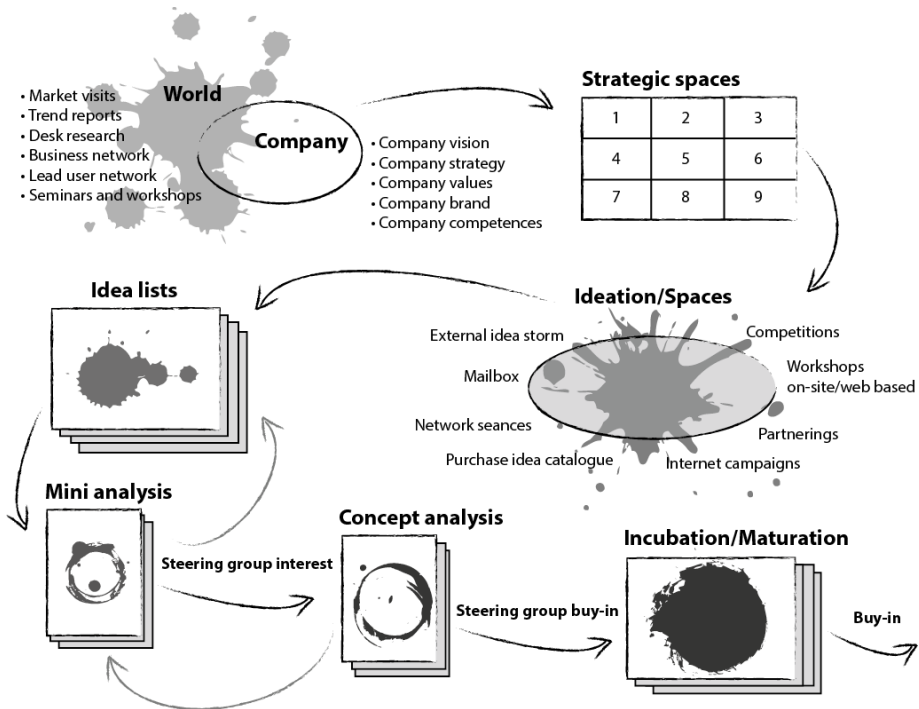


Figure 12 Model of radical FEI from HiLite

While developers follow the formal routines structured by management models they also invest efforts in investigating and promoting new ideas, and this involves the ability to move around in the organisation from technology development to sales and marketing departments in order to sharpen and sell the concepts and gain support for the concepts. Moreover, while these practices are for employees who have a natural entrepreneurial approach to work with new ideas these are fragile practices relying on specific individuals and sometimes unmanageable for management. Therefore, management may only be in touch with processes through the simplifying management models and thereby missing the processes that are more informal. Idea champions and entrepreneurial behaviour can be difficult in large well-established companies because daily operations and barriers of gaining budgetary and managerial support are hindering these informal activities (Dougherty and Hardy,

1996). Even though many of these models of management processes are iterative and thereby acknowledge some kind of dynamic complexity, they still leave entrepreneurial behaviour to its own destiny and do not support the informal processes of FEI. I do not, however, intend to dismiss the stage gate model but instead only argue that there are elements of innovation processes with which the model does not engage.

When discussing the models with the companies there are indications that these models are not capable of illustrating the reality. When practitioners are confronted with their models of FEI their responses are frequently ‘this is our model but we don’t do it like that in practice’. This does not, however, mean that the models are useless and without matter; the companies invest resources in adapting, creating models, and teaching the models to employees. It is, nonetheless, a management tool that simplifies reality and does not account for how the real processes of FEI are played out, but the models serve as intentional structures and communicative devices. Another aspect to consider is the arrows that are always part of modelling FEI. The elements between the arrows are frequently described by activities or tasks, but the arrows are disregarded. I believe that the arrows account for important processes that are essential for moving the process forward successfully. When using the perspective of ANT, I will argue that each arrow indicates a translation of something from something to something else, and this translation process involves actors on different levels and of different kinds, enactment of formal and informal relations, and situated practices. For example, how do I get from discovering the world to a matrix of categorised opportunity spaces? In the process of FEI in the companies, something makes itself relevant when related to other things, e.g. new legislation in the market of dairy products, a new technology for adhesives in attaching medical devices to the human body, or a rearrangement of the construction industry allowing new competitor parameters in the market. The companies discover these things and translate them into opportunities and concepts and so on by involving the relevant technologies, business partners, and employees. I believe that arrows do not justify these translating processes. These processes are much more complicated and difficult to comprehend with standard theories but also offer great potential for understanding the mechanisms of successful FEI and manipulating these on a more explicit managerial level.

CONCEPTUALISING THE FEI MODEL

In creating my model, I particularly want to capture the relational processes in the interaction between formal structures and informality using the perspective of ANT. Through the interviews, I can see that the central topic in FEI processes is the creation and enactment of social relations across multiple knowledge domains but also the enactment of relations with non-humans, for instance formal structures of procedures or technologies related to market opportunities. When interviewees explain how they network across departments it is also through media and relating

with non-human actors that influence the process and decisions made. In this way, I want to pay attention to the agency of heterogeneous actors in a dynamic network that undergoes a translational process.

I would like to discuss a few criteria before conceptualising the model in order to turn the identified limitations of current models to possible solutions. These criteria may work as points of needs to which the model should be a suggestion of solutions. The model is not, however, absolute and will be a suggestion open for discussion. The criteria are as follows: 1) Embracing the social but still recognising the value of processes and structures. 2) Replacing the traditional process model perspective with a perspective that is capable of representing innovation as a forward-moving process that stabilises a network around an innovation concept. When taking up new innovation possibilities, the network will reconfigure, such that meaning will change, along with the replacement or transferal of technologies and redefining business strategies; this process is essential to be able to embrace in a FEI model. 3) Room for a new understanding of what creates actors and options for actions. The structure and actor should be able to be in an interactive state where agency can be ascribed to heterogeneous elements in the network around an innovative concept. 4) Being a mutual reference for both managers and employees, such as learning devices or game that are able to account for the factors of innovation as situated. In the following, I will explain the conceptualisation of my FEI model by describing the configuring elements of the model made up by the concepts of *translation*, *network*, and *space*.

PROCESS AS TRANSLATION

In my paper, I introduce several examples of modelling FEI through a process model perspective. Two different perspectives emerge in the review: 1) structural models and 2) social perspectives. They are both examples of standardised management tools of process models that illustrate different activities of FEI in an ordered sequence and also examples of how individuals and groups acts and interacts in the organisation of FEI. The examples of process models that illustrate a sequence of activities rely foremost on formality. The attention is on the formal and what formal structures the management can implement in FEI with the expectation that employees work with and around the structures and informally fill out the gaps of the formal processes and structures where needed. Here, management is creating structures and the informal is secondary and somewhat left to chance. In the examples of how individuals and groups act and interact in processes of FEI, the focus is on the entrepreneurial and self-organising perspective of innovation in organisations. For instance, Reid and de Brentani (2004) contribute with a role theory perspective and place key individuals with certain abilities in the FEI process. At this point, the individual has a crucial role where agency is attached to specific roles that change over time according to the types of task in the process of making innovative ideas into concepts ready for the NPD process (Markham, Ward, Aiman-

Smith, and Kingon, 2010). The roles are more structural elements that do not point to where agency comes from but merely that different roles inhabit different types of agency. Hellström and Hellström (2002) models how ideation in an organisation relies on certain mechanisms in the interaction between individuals and organisational structures. Hellström and Hellström (2002) extend the understanding of the interaction between agency and organisational structure but solely with a social perspective. From this perspective, the formal structures are instruments in the informal activities of the individuals.

The two perspectives seem to have a different underlying theoretical framing of either a rational problem-solving perspective or a stakeholder- and project management perspective (Dorst and Dijkhuis, 1995). My concern is to take notice of both perspectives, the agency of actors and the forward-going process of FEI. In my conceptualisation of a process concept, I include this focus in applying the translation process from ANT. The translation process allows for engaging with a process of translating meaning, technologies, strategies etc. while, at the same time, incorporating the agency of both human and non-human actors. The empirical findings show me how standard process models are used as management tools or as actors more strategically to enhance agency of key actors rather than determining the real process of FEI. For instance, I see examples of how the funnel model, which is a process of idea selection and screening, is used as a non-human actor in translating results of idea development as an enrolling mechanism for important decision makers that has better understanding for linearity. I also see several examples both in my empirical data but also in other studies where the stage gate model is subject to the real processes of FEI and used more as an important actor than a determining process (e.g. Christiansen and Varnes, 2007). The process models are played out as actors and not as a vital process for FEI. I seek to understand the complex nature of FEI and apply an actor network theory perspective and the process of translating a network. From this perspective, a wide variety of objects in the network have meaning and influence the process in either a stabilising or destabilising modus.

NAVIGATING NETWORKS

In my conceptualisation of a FEI model, the focus is not on networks as a structure because it does not lead to action. Instead, the network is a dynamic element that can be navigated in enacting relations in order to build agency. The navigation takes account of the current position in the network and where to move from there (Broberg and Hermund, 2004). If I perceive the network as dynamic and I perceive actors as heterogeneous entities, I add new, interesting dimensions to the modelling of FEI. The theory of actor networks has been used as an analytical perspective in studies of FEI and innovation processes (e.g. Christiansen and Varnes, 2007; Legardeur, Boujut, and Tiger, 2010; Wastell, 2006). In framing FEI, the non-human objects are, in some cases, included as activities or checklists but never with the agency that ANT might direct my attention towards. Human actors extend their

agency by relating to objects (Law, 2002). In this way, it makes a difference for the management of FEI when choosing one process model over another, and if choosing one technology over another. These considerations are part of the navigational and agency perspective with which I conceptualise the framing of FEI. The objects are part of defining the actor network and the translation process. When creating an actor network, a specific content is also created, and from a specific content a network is created. For example, I see how companies either create content in a process through placing actors in innovative workshops or how entrepreneurs from a specific content of, for instance, an idea or opportunity, create a network. Instead of either choosing the one over the other, the navigational concept points to taking account of the options and then choosing between them as strategies in navigating the network. Garud, Tuertscher, and Van de Ven (2013) highlight the importance of considering the subtext (context) of agency as well as the context when studying innovation processes with the complexities it inherits. I draw on these thoughts when conceptualising my FEI model from the perspective of ANT. The heterogeneity of actors and relations lies in the attention to the specific content and context of the network. Meaning, experiences, agendas, possibilities of actors and relations are part of configuring the translation process of the network. ANT helps me to focus on the action, the proactivity that moves the process of FEI. I am interested in the network when it moves and changes, not only how the network is outlined. I am interested in the enactment of relations, not only the relation as a link between two individuals. Enactment means to bring structures into existence and set them in action (Weick, 1988). In enacting relations in FEI, I am especially interested in the navigating the actors and models of FEI, not just the planning and structuring of FEI. In conceptualising this, I describe it as agency.

In the cases, one example refers to the structuring of FEI as giving agency to actors. Before structuring and formalising FEI, developers in one company were complaining about lacking the ability to navigate in the informal setting of FEI. At the same time, they claim that too much structure will hinder creativity/agency. Agency is not placed with the social actors nor with the structure but rather as the outcome of their interactions. I would like to highlight the interaction between the two extremes and where the agency is played out. In the example, the organising of FEI tries to accommodate the productive role of structures and the importance of freedom. In innovation processes, there is frequently a focus on the result instead of the process (Gunn and Clausen, 2013). There thus needs to be a focus on innovation both as a result and on the process as experimentation in navigating FEI. Managers manage by using objects and structures as auxiliary devices. Leaders lead while supported by material objects. I do not intend to understand the non-human actors as limited objects but I do intend to understand the enactment of relations with both human and non-human actors. I see the agency coming out of enacting the relations to other actors such as non-human actors.

INNOVATIVE SPACES

I have reduced mainstream process models of FEI to being important actors that act in relation to other actors in a network that is undergoing a translational process of destabilisation and stabilisation. The translation processes, though more complex and dynamic than standardised process models, are also subject to a larger concept of FEI. I apply the concept of innovative spaces to describe an overall concept of the processes of FEI. I distinguish FEI from the standard process of decision-making to an innovative space. A branch of science and technology studies (STS) termed social shaping of technology (SST) inspires the concept of innovative spaces. Clausen and Koch (1999) view 'technological change as the outcome of social processes of negotiation through a complicated and heterogeneous network of diverse players'. Technological change is shaped by the creation of *spaces and occasions* by different actors. For example, a production planning system is shaped by its developers, shaped through the adaptation in a company, and also by the employees using the system. Through the identification of these spaces and occasions potential outcomes and risk can be addressed.

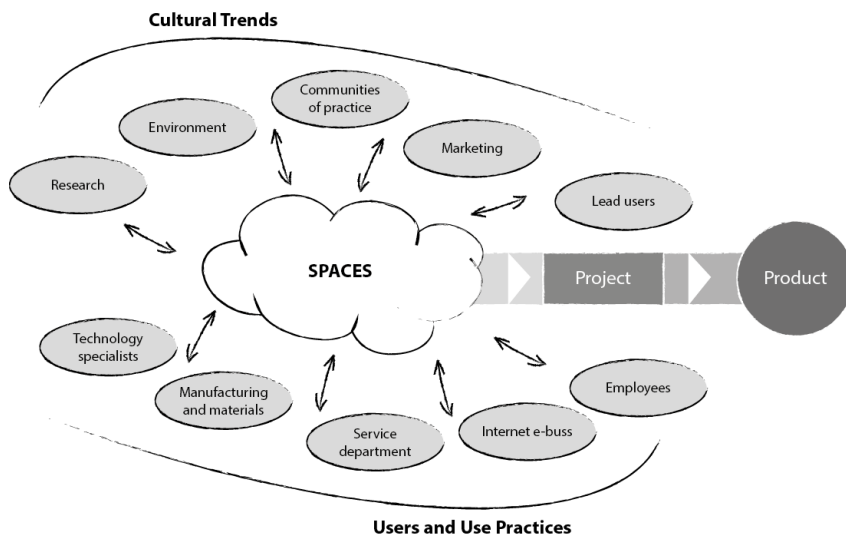


Figure 13 Staging of early phases in product design (Clausen and Yoshinaka, 2007)

According to Jorgensen and Sorensen (1999), the innovative space is not physically manifested, but is rather a cognitive concept. Jorgensen and Sorensen (1999) contribute to the discussion of management of technology development and innovation processes and use a term of spaces of innovation in introducing their perspective of arenas of development. Arenas of development are defined as cognitive spaces of actors, references to specific objects and situations with locality and material references, knowledge and visions, and a set of translations that

stabilise and destabilise relations and actors. Clausen and Yoshinaka (2007) also develop the space metaphor through *sociotechnical spaces*. In the above figure it is illustrated 'how socio-technical spaces may be constituted through a mindful selection of translators of diverse knowledge domains'. I take notice of this modelling of FEI as it captures some of the issues I invite in the framing of FEI that embraces the complexity but, in particular, it illustrates the notion of innovative spaces. In my study of empirical examples and literature of FEI modelling, I come across a similar recognition of FEI processes as being configured according to what the innovative space includes, such as specific human and non-human actors, contexts defined by development trajectories, culture, and environments, and content defined by knowledge, visionary strategies, and technologies, and translation processes of destabilisation and stabilisation.

In my understanding, the process of FEI and the network of FEI of which heterogeneity and agency form part create, and are created by, an innovative space. This innovative space is part of the managing of FEI where decisions include and/or exclude specifics, for instance certain processes, models, ideas, technologies, and individuals. The innovative space is configured by deliberate and intentional choices and calls for a certain process and network of actors and relations. The space brings together different knowledge domains and is configured by these different knowledge domains. The many different objects included in the innovative space involve meaning and established understandings and good management will know what is included and excluded in their FEI processes and how it is possible to navigate in a concrete FEI innovative space. It is part of the management's task to frame the innovative space according to strategy and visions, while all the time taking action on decisions and being aware of what is included and not included in configuring the innovative space. Bronnum and Clausen (2013) also engage with the space metaphor as a *sociotechnical development space* in conceptualisation processes in product innovation. They argue that both the official and the negotiated configurations of the development space are interesting when desiring specific outcomes of the conceptualisation process. In their study, they find that issues occur and hinder the desired outcome when configurations of development spaces are not explicit or not considered to be influencing the conceptualisation process, such as dominant design paradigms or project models.

When applying the perspective of ANT, it allows for a consideration of the innovative space on the micro, meso, and macro levels. The innovative space can also map different networks that can lead the FEI processes in certain directions, for instance, mapping a situation of competition that the company seeks. In this way, they can map a future scenario and contemplate how to reach that situation where actors enrol and mobilise which kinds of innovation concepts to search for, etc. In the empirical studies I see an example of creating *strategic spaces* in search for new opportunities of innovation. The theoretical model of FEI incorporating an innovative space, suggests a sensible managing of FEI by strategically including

specific actors creating content in their relation to each other. The managerial perspective is the sensitivity towards changes, possibilities, or opportunities in the innovative space and the enactment of relevant relations that move the process in a certain direction. It is also the reactions to signals from the innovative space that indicates the time and process for strategically inputting or framing the space to support or challenge the process of the innovative space.

I have drawn a simple model to illustrate my framing of FEI that may work as a mindset for the practitioners and a contribution to academia that pinpoints other dimensions as having an important significance in the dynamics of FEI. I have used concepts from ANT in conceptualising my FEI model. In so doing, three operational dimensions emerge: *actors*, *relations*, and *process*. The dimensions are interdependent so that changes in one will cause changes in the other. For instance, if a certain technology is changed it can cause changes in the development process and changes in the network that carries the process. In my illustration below, small circles connected to the bigger centralised circle illustrate the spatial dimension with different human and non-human actors and their relations. The actors have specific abilities, competencies, potentials, and locations that define the relations creating the network and define the space and configuration of the network. The process is illustrated by the arrows between the three evolving networks and the bigger arrow across the evolving network and symbolises the translation process of the network over time through the processes of *creative destabilisation* and *constructive stabilisation*.

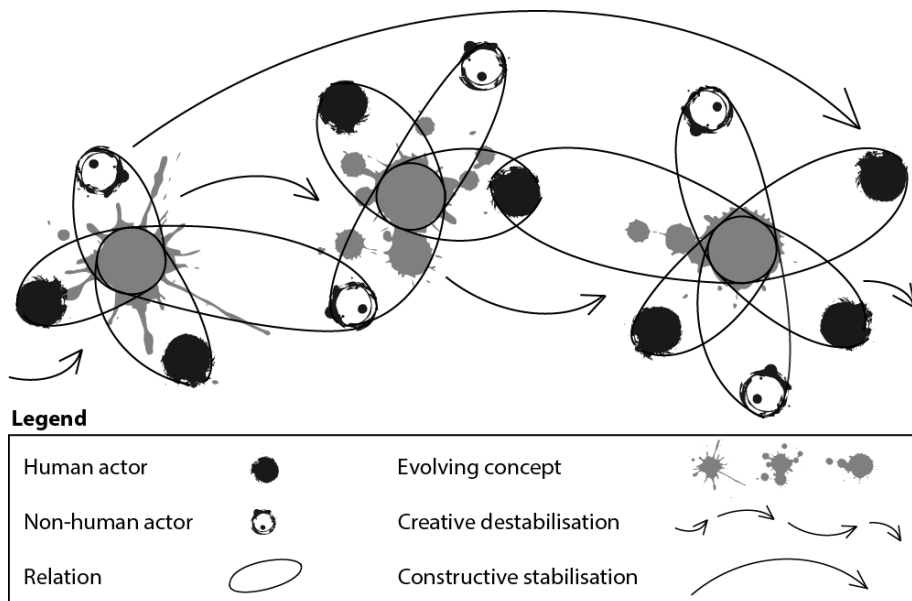


Figure 14 FEI model

DISCUSSION

The proposed model of FEI should be perceived on an abstract level. In order to meet and embrace the complexity of the actor networking, translational and situational aspects of FEI, there needs to be a degree of abstraction. However, I also want to operationalise my FEI model. The conceptualisation of different dimensions is a way to avoid dealing with all the complexity at once. In operationalising the model, I can take a starting point in actors, relations, network, or process depending on the situation. If I have an idea, then I take a starting point in the relation dimension and, from there, configure my network and process. I can also take a starting point in an actor and review what possibilities it can give me. I can also consider the process and ask if it can bring me where I want to go. The model requires that, if you take a starting point in one dimension, you have to include the other dimensions from that starting point because they are interrelated and dependent. The dimensions configure each other.

The dimensions of actors and relations are spatial and illustrated by circles that are connected by lines. The circles indicate different actors that can be of both the human and non-human kind. The centre circle symbolises the emerging and conceptualised idea. The actors form relations and configure the innovative space. The actors describe characteristics such as resources, abilities, knowledge, competences, potential, and their location. The lines that connect the small circles with the big circle in the middle illustrate the relations between actors. These relations are heterogeneous and, together with the actors, they create a dynamic network. Inclusion and exclusion – what and who are in and what and who are defined outside of the innovative space – also define the dimension of network. To find out which actors to include or exclude in the network, I can turn to the other dimensions. I can look at the process dimension and see if it points to specific actors to include or exclude. As Clausen and Yoshinaka (2007) explain, a mindful selection of translators of diverse knowledge may be integrated in configuring the innovative space to support desired outcomes (Bronnum and Clausen, 2013). A mindful selection of actors requires a look into what the actors are, what they can do, and how they do it. This takes me to the next dimension of my model.

The configuration of the innovative space describes characteristics of relations and actors. In operationalising the model, I go further than categorising actors as human and non-humans. Actors and their relations are unfolded and the specific actors and their kinds of relations are considered in order to understand the situational significance of actors in navigating actors and models in innovative spaces. According to ANT, actors are defined through relations and relations define actors. As explained in my view of ideas, the idea is dependent on who relates and how they relate. As an example, a dominant design in a company can influence the work in FEI but it is also subject to different meanings and how different actors relate in different ways. If a company would like to be radical in their new design of a

medical device, they could, for instance, configure a team by designers without strong relations to the design and that have dominated the previous conceptualisation of new products. Actors and relations are heterogeneous and the ideas are produced or adopted in the space of a specific organisation, environment, past, and culture. Heterogeneity may be described through characteristics such as requirements, quality parameters, competences and abilities, etc. These characteristics contain formal aspects such as management endorsement, business plans, project definitions, requirements, standards, job titles and responsibilities as well as informal aspects such as experiences, engagement, framing, meaning, and agendas. In parallel, context may be described as the culture within a company, the competing environment in which the company makes its business, and the path dependency that has its presence in how companies innovate. Again, these can be informal or be manifested formally, for instance through procedural obligations. The creation and configuration of an innovative space can also have its starting point in defining these heterogeneous elements, e.g. a specific technology that creates a possible business opportunity. From there, the other dimensions can be configured.

Process describes how the innovative space undergoes a translation process through the modes of creative destabilisation and constructive stabilisation. The process is illustrated by the arrows between the three evolving networks that demonstrate the creative destabilisation and a larger arrow illustrating the general evolution towards constructive stabilisation. The focus is not on activities and tasks but rather on how to translate knowledge in order to move the process. A starting point for navigating actors and models in the FEI space may be the translation of new knowledge, as previously described. Researching and translating new knowledge regarding technologies, market aspects, or manufacturing processes, for instance, is a destabilising process that is fundamental for innovative capability. Nonaka and Takeuchi (1995) refer to the notion of *dynamic capability* in their work on the knowledge creating company and how companies are able to create and extend knowledge resources. Teece (2007) explicates the model of dynamic capability, the ability of an innovating company to sensing and seizing innovation opportunities in a drifting and competitive environment. However, instead of relating such entrepreneurial activities to the individual, it is suggested as entrepreneurial management. As such, the dynamic capability can reside in the organisational structures driven by social behaviour. In my view, the creative destabilisation can relate to the sensing of opportunities or even the creation of opportunities, and the constructive stabilisation can relate to the seizing of these opportunities. The dimension of process is defined by the real movements between human and non-human actors and includes measurable achievements of knowledge creation and, informally, I can talk of the sense of learning and movement, i.e. 'whether we are getting somewhere'.

BRINGING THE FEI MODEL INTO PRACTICE

In my view, one challenge in particular arises when I suggest this FEI model that draws on a more inclusive and holistic approach to comprehend FEI compared to more traditional approaches. The main challenge is how to operationalise and put the FEI model into practice. How would it make sense to and support practitioners in product innovation industry? Through the perspectives I use in conceptualising my FEI model, the process of implementing and turning such a model into practice may be considered as a translation process. As such, I need to consider the moments of problematisation, interestment, enrolment, and mobilisation. In my preceding processes of studying the modelling and practices of FEI, analysing my data, and synthesising emergent results, I have involved different actors that are both positive and somewhat sceptical towards my suggestions. These actors are employees and managers in product innovation organisations working with FEI that I have included in my gathering of data for my study, it is practitioners and other researchers I meet on conferences, and it is discussants I engage with in published research. Accordingly, how can I move on in my translation process of strengthening a network that supports my FEI model? In the academic environment, I use the devices connected with researching, theorising, and publishing in gaining interest for my agenda. However, if I turn my attention to the practitioners and the industrial environment, the users of my FEI framing, they can become strong allies or spokespersons and support my agenda.

In the participatory design literature, I find concepts of collaboration and co-creation that make sense to the propositions I put forward through my framing of managing FEI. This is especially true in my expectations of how the model and its concepts could be practiced in product innovation companies. In participatory design, concepts such as co-creation, enactment, spaces, and staging are describing processes of participatory design. Design games have been widely studied in the area of participatory design with the aim of supporting collaboration between different stakeholders in design. The primary focus has been on the collaboration between designers or developers and users or customers. Iversen and Buur (2002) use design games in action research to support design competence, collaborative design processes and improvements of design practices. Brandt (2006) describes design games working as a metaphor for design collaboration between different stakeholders and describes, for instance, exploratory design games as a framework for accommodating participation in participatory design. In seeking to bring the FEI model into practice, I would like to draw on the design game approach (e.g. Brandt, 2006) that may help overcome the challenge of making practitioners interested in testing or using my FEI model. Design games encompass tangibles, roles, rules, and a staging space/facilitation. Design games are about giving the ability of all the participants for actual participation but also to understand each other's stakes. Brandt (2006) gives examples of different exploratory design games and suggests a basis for creating one's own outline of an exploratory design game that could frame

an application of my model. As a direct reflection of this, my model for FEI envisages the importance for managing FEI as the staging of an innovative space involving people in participating through the constitution and translation of an actor network. Staging an innovative space of human actors with different competencies and interests, and non-human materiality with different abilities and inscriptions, can be challenging. Therefore, a framework such as the design game approach could turn out to be useful in staging this collaboration and practicing my model of FEI. In my opinion, some interesting tools are at hand in the method of design games. The perspective of design games that could operationalise the FEI model and turn it into practice is an exploratory adventure and could define a follow-up study. Managers and employees of FEI are not only my users that I need to understand when developing a new model, they are also actors that I aim to adapt and practice my model. Through the design game I want to stage the meeting between me, as researcher and developer of a model of FEI, and practitioners in industry (Brobjerg, 2010). There are different types of design games, all focused on receiving knowledge and participation from the user and user scenario. A design game that I perceive as having a potential in translating my FEI model and put it into practice is the scenario-oriented design game. According to Schön (1983), the scenario is to reconstruct the current situation to gain new insights. The enacted scenario construction is an exploratory design game that is able to be specific and flexible at the same time (Brandt, 2006). Schön (1983) describes the 'reflective practitioner'. Models do not lead to action but are rather put in play by the practitioner through improvisation, learning and practice. My model is a reflective approach. It equally asks about formal structures and informal practices, and is a translation process and not just a process of activities and tasks, and it is a model that asks about actors as heterogeneous elements and what is important for actors to be activated.

CONCLUSION

With this paper, I have conducted a review of FEI models found in literature. The models represent different perspectives and approaches to understand and model FEI. Furthermore, the paper contributes with an empirical case study of three product innovation companies that have provided their own FEI models, which have also been reviewed in the paper. Based upon findings in the literature and case studies, I have proposed an alternative FEI model framed by concepts from the analytical perspective of ANT. The proposed FEI model introduces a new approach to FEI by including actors without excluding process models but rather turning them into navigational objects. Furthermore, the proposed model indicates the situational aspect of FEI processes by considering configurations and innovative spaces. The translation process describes the conceptualisation of new concepts where current understandings are challenged and new products are developed. Finally, I have indicated a way to turn the abstract model into practice using a design game approach.

LIMITATIONS AND FURTHER RESEARCH

Besides the contributions in the paper, the paper also has some limitations. The study could benefit from a deeper and more structured investigation of FEI models in literature where comparison and categorisation could develop generic dimensions and elements of significance for the development of a new FEI model. The same could be relevant for the empirical part of the study. A broader investigation of how models, both adapted from literature and emerging in practice, are used in practice could hone the categorisation of central elements in the modelling of FEI. Finally, an interactive approach of testing FEI models and actively involve practitioners in the development of a FEI model could also benefit the study.

REFERENCES

- Akrich, M., Callon, M., Latour, B. (2002) The key to success in innovation Part I: The art of interressement & Part II: The art of choosing the good spokespersons, *International Journal of Innovation Management*, vol. 6, no. 2, pp. 187-225.
- Andreasen, M. M. (2011) 45 Years with design methodology, *Journal of Engineering Design*, vol. 22, no. 5, pp. 293-332.
- Benner, M.J., Tushman, M.L. (2003) Exploitation, exploration, and process management: The productivity dilemma revisited, *Academy of Management Review*, vol. 28, no. 2, pp. 238.
- Bijker, W. E., Hughes, T. P., Pinch, T. J. (1987) *The social construction of technological systems: New directions in the sociology and history of technology*, MIT Press, Cambridge.
- Brandt, E. (2006) Designing Exploratory Design Games - a framework for participatory design? *Proceedings of Participatory Design Conference*, pp. 57-66.
- Brem, A., Voigt, K. I. (2009) Integration of market pull and technology push in the corporate front end and innovation management - Insights from the German software industry, *Technovation*, vol. 29, pp. 351-367.
- Broberg, O. (2010) Workspace design: a case study applying participatory design principles of healthy workplaces in an industrial setting, *International Journal of Technology Management*, vol. 51, no. 1, pp. 39-56.
- Broberg, O., Hermund, I. (2004) The OHS consultant as a 'political reflective navigator' in technological change processes, *International Journal of Industrial Ergonomics*, vol. 33, pp. 315-326.
- Bronnum, L., Clausen, C. (2013) Configuring the development space for conceptualization, *Proceedings of the 19th International Conference on engineering Design*, vol. 3, pp. 171-180.

- Brown, S. L., Eisenhardt, K. M. (1997) The Art of Continuous Change: Linking Complexity Theory and Time-Paced Evolution in Relentlessly Shifting Organizations, *Administrative Science Quarterly*, vol. 42, no. 1, pp. 1-34.
- Bryman, A. (2008) *Social Research Methods*, Oxford University Press.
- Chesbrough, H. (2003) The era of open innovation, *Sloan Management Review*, vol. 44, no. 4.
- Christiansen, J. K., Varnes, C. J. (2007) Making decisions on innovation: Meetings or networks?, *Creativity and Innovation Management*, vol. 16, no. 3, pp. 282-298.
- Clausen, C., Koch, C. (1999) The role of spaces and occasions in the transformation of information technologies - lessons from the social shaping of IT systems for manufacturing in a Danish context, *Technology Analysis & Strategic Management*, vol. 11, no. 3, pp. 463-482.
- Clausen, C., Yoshinaka Y. (2007) Socio-technical spaces: Translating across boundaries in design, *The Journal of Design Research*, vol. 6, no. 1-2, pp. 61-78.
- Cockayne, W. R. (2004) *A Study of Innovation Ideas in Informal Networks*, PhD Dissertation. Stanford University.
- Cooper, R. G. (1988) Predevelopment activities determine new product success, *Industrial Marketing Management*, vol. 17, no. 2, pp. 237-248.
- Cooper, R. G. (2001) *Winning at new products - accelerating the process from idea to launch*, Basic Books, New York.
- Cooper, R. G. (2008) The Stage-Gate Idea-to-Launch Process-Update, What's New and NexGen Systems, *Journal of Product Innovation Management*, vol. 25, no. 3, pp. 213-232.
- van Dijk, C., van den Ende, J. (2002) Suggestion systems: transferring employee creativity into practicable ideas, *R&D Management*, vol. 32, no. 5, pp. 387-395.
- Dougherty, D., Hardy, C. (1996) Sustained Product Innovation in Large, Mature Organizations: Overcoming Innovation-to-Organization Problems, *The Academy of Management Journal*, vol. 39, no. 5, pp. 1120-1153.
- Dorst, K., Dijkhuis, J. (1995) Comparing paradigms for describing design activities, *Design Studies*, vol. 16, pp. 261-274.
- Eisenhardt, K. (1989) Building Theories from Case Study Research, *Academy of Management Review*, vol. 14, no. 4, pp. 532-550.
- Garud R., Tuertscher P., Van de Ven A. H. (2013) Perspectives on Innovation Processes, *The Academy of Management Annals*, vol. 7, no. 1, pp. 775-819.

- Gish, L., Clausen, C. (2013) The framing of product ideas in the making: A case study of the development of an energy saving pump, *Technology Analysis & Strategic Management*, vol. 25, pp. 1085-1101.
- Gunn, W., Clausen, C. (2013) Conceptions of Innovation and Practice: Designing Indoor Climate, in Gunn, W., Otto, T., Smith, R. C. (Eds.) *Design Anthropology: Theory and Practice*, Bloomsbury Academy, London.
- Hellström, C., Hellström, T. (2002) Highways, Alleys and By-lanes: Charting the Pathways for Ideas and Innovation in Organizations, *Creativity and Innovation Management*, vol. 11, no. 2, pp. 107-114.
- Hughes, C. D., Chafin, D. C. (1996) Turning new product development into a continuous learning process, *The Journal of Product Innovation Management*, vol. 13, pp. 89-104.
- Iversen, O. S., Buur, J. (2002) Design is a Game: Developing Design Competencies in a Game Setting, *Proceedings of the Participatory Design Conference*, CPSR, pp. 22-28.
- Jorgensen, U., Sorensen, O. H. (1999) Arenas of Development - A Space Populated by Actor-worlds, Artefacts, and Surprises, *Technology Analysis & Strategic Management*, vol. 11, no. 3, pp. 409-429.
- Khurana, A., Rosenthal, S. R. (1998) Towards Holistic “Front Ends” In New Product Development, *Journal of Product Innovation Management*, vol. 15, no. 1, pp. 57-74.
- Koch, R., Leitner, K. H. (2008) The Dynamics and Functions of Self-organization in the Fuzzy Front End: Empirical Evidence from the Austrian Semiconductor Industry, *Creativity and Innovation Management*, vol. 17, no. 3, pp. 216-226.
- Koen, P. A., Bertels, H. M. J., Kleinschmidt, E. (2012) Effective Practices in the Front End of Innovation, in Kahn, K. B. (Eds.) *PDMA Handbook of New Product Development*, John Wiley & Sons, Somerset, NJ, USA.
- Kvale, S., Brinkmann, S. (2009) *Interviews: Learning the craft of qualitative research interviewing*, Sage Publications, Thousand Oaks, London.
- Latour, B. (1987) *Science in action: How to follow scientists and engineers through society*, Harvard University Press, Cambridge.
- Legardeur, J., Boujut, J. F., Tiger, H. (2010) Lessons learned from an empirical study of the early design phases of an unfulfilled innovation, *Research in Engineering Design*, vol. 21, no. 4, pp. 249-262.
- Law, J. (2002), *Aircraft Stories: Decentering the Object in Technoscience*, Duke University Press, Durham, N. Ca.
- Markham, S. K., Ward, S. J, Aiman-Smith, L. Kingon, A. I. (2010) The Valley of Death as Context for Role Theory in Product Innovation *Journal of Product Innovation Management*, vol. 27, pp. 402-417.

- Nonaka, I. (1991) The Knowledge-Creating Company, *Harvard Business Review*.
- Nonaka, I., Takeuchi, H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press.
- Reid, S., de Brentani, U. (2004) The Fuzzy Front End of New Product Development for Discontinuous Innovations: A theoretical Model, *Journal of Product Innovation Management*, vol. 21, pp. 170-184.
- Robinson, S., Stern, B. (1997) *Corporate Creativity: How Innovation and Improvement Actually Happen*, Berrett-Koehler, San Francisco, CA.
- Sandmeier, P., Jamali, N., Kobe, C., Enkel, E., Gassmann, O., Meier, M. (2004) Towards a Structured and Integrative Front-End of Product Innovation, *R&D Management Conference*, Lisbon.
- Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York.
- Smith, P. G., Reinertsen, D. (1991) *Developing Products in Half the Time*, Van Nostrand, New York.
- Snowden, D. (2002) Complex acts of knowing: paradox and descriptive self-awareness, *Journal of Knowledge Management*, vol. 6, no. 2, pp. 100-111.
- Stacey, R. D. (1992) *Managing the Unknowable: Strategic Boundaries Between Order and Chaos in Organizations*, John Wiley & Sons, Inc. San Francisco.
- Teece, D. J. (2007) Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance, *Strategic Management Journal*, vol. 28, no. 13, pp. 1319-1350.
- Tidd, J., Bessant, J. (2009) *Managing innovation*, John Wiley & Sons, West Sussex.
- Ulrich, K. T., Eppinger, S. D. (1995) *Product design and development*, McGraw-Hill, New York.
- Van de Ven, A. H. (2004) The context-specific nature of competence and corporate development, *Asia Pacific Journal of Management*, vol. 21, pp. 123-147.
- Wastell, D. G. (2006) Information systems and evidence-based policy in multi-agency networks: The micro-politics of situated innovation, *Journal of Strategic Information Systems*, vol.15, pp. 197-217.
- Weick, K. E. (1988) Enacted sensemaking in crisis situations, *Journal of Management Studies*. vol. 25, no. 4, pp. 305-17.
- Wenger, E. C., McDermott, R., Snyder, W. (2002) *Cultivating Communities of Practice*, Boston, MA, Harvard Business School Press.
- Wheelwright, S. C., Clark, K. B. (1992) *Revolutionizing product development: Quantum leaps in speed, efficiency, and quality*, Free Press, New York.
- Yin, R. K. (2009) *Case study research: Design and methods*, SAGE Publications.

CHAPTER 6. DISCUSSION

The main goal of this study has been to reframe the approach to obtain new understandings and interpretations of FEI. My intention is to encourage scholars and practitioners to view FEI through a more holistic perspective that opens up for new interpretations of how FEI can be organised and managed. In this way, I mean to take the structural, social and political concerns into consideration, as they all form the interactions and perspectives in FEI. In my introduction, I asked the following questions:

- *How is FEI viewed and understood in literature and which perspectives and models frame the approach to FEI?*
- *How is FEI organised and managed in practice in product innovation companies and which perspectives and models frame the approach to FEI?*
- *How could a new conceptual model reframe the understanding of FEI to support the practices of FEI?*

In this chapter, I will go through the contributions of the dissertation and discuss the different findings.

6.1. UNDERSTANDINGS IN LITERATURE

The literature review relates to my first research question. In reviewing literature throughout my dissertation, I found that the literature is somewhat pointing in different directions and applying different frameworks that sometimes exclude other, but valid and important, perspectives on how to approach FEI. I found that main views in literature apply either social-oriented approaches that focus on social interactions or structure-oriented approaches focused on process models or social structures. From these approaches, different theories and models emerge, such as models concerning knowledge creation, social networks, organisational roles, CoPs, stage gate models, or idea management. The main limitations in the majority of reviewed literature that offer different approaches, as I see it, are how each of these approaches have their limitations in describing FEI as a holistic phenomenon. Important elements taking place in the practices of product innovation companies, such as the dependency of social interaction and culture or the use of models as navigational devices and structural understandings, are being left out and thereby important insight in understanding FEI is omitted. Some literature experiments with crossing social-oriented views with structure-oriented views of FEI, for instance van Dijk and van den Ende (2002) and Hellström and Hellström (2002). They contribute with studies that try to consider both social-oriented elements and structural elements in FEI activities in innovation organisations. In this discussion, I want to take a step further beyond dividing literature into structure- or social-focused. In my

papers, I have also described a lack of recognising or of ability to incorporate complexity in the way FEI is framed in literature, which also forces descriptions to leave out significant elements of FEI. Elements that contribute to the complexity are, for instance, technology, legislation, or design paradigms as powerful non-human actors in shaping the space of FEI in product innovation companies. Other elements are political processes. Bakker et al. (2006) bring up the concepts of a crea-political process, significantly related to entrepreneurial activities in an organisation. Here, selling ideas and gaining funding opportunities from the surrounding organisation becomes a key focus in FEI. From being largely lacking in many kinds of process models of FEI to becoming in focus in literature on organisational roles, knowledge creation, and social networks, I see actors and how they interact with other actors and with models. The question of actors, and how actors are perceived beyond human individuals, also adds to the complexity of FEI. The complexity of FEI is obvious and is recognised in literature, but I do not see approaches in literature that have the ability to paint a holistic picture of FEI. As a whole, literature dealing with FEI applies many different and valuable approaches but, in my view, practitioners are left without an approach that is able to gather these central different elements comprising FEI. These limitations of approaching FEI that I find in literature become more evident in my interactions with practitioners.

6.2. PRACTICES OF MANAGING FEI

6.2.1. PRACTITIONER STUDY

The practitioner study relates to the second research question. From this study, I found how practitioners handle very different perspectives at the same time in describing how they work with FEI. The different elements that comprise the requirements and challenges of FEI found in my practitioner workshops and survey appear quite varied and cover very different aspects of how FEI is handled in an organisational context. For practitioners, it is vital to consider FEI in a holistic view including very different elements from structuring process models and creating spaces for innovative behaviour to awareness of company visions and strategies and feelings of togetherness. In categorising the findings in my practitioner study, I divided the different elements into structure, people, process, and content. In relation to my literature study, these findings did not correspond with the simplicity in literature describing FEI, even though the applied framing of the workshop activities was a generic FEI process model. Practitioners were asked to fill out the phases of a generic FEI process model and did not only limit themselves in types of suggestion by, for instance, only focusing on a sequence of activities (e.g. Cooper, 2001). The suggestions covered items such as culture, social interactions, models, tools, strategic considerations, etc. In interacting with practitioners, it was evident that FEI was not perceived as just a sequence of activities such as from opportunity identification to concept development (e.g. Koen et al., 2002). The practitioners seemed concerned about how to go from one phase to the other and were providing

the dynamics that they perceived as having the ability to move the process from one phase to the next.

By bringing in a new perspective based on ANT, I have contributed to the understanding of the practices of FEI and particularly the role of the process models. ANT is able to comprehend heterogeneity, complex networks and dynamics, and therefore became the analytical perspective of choice in the further studies of my project. The analytical perspective of ANT provided me, as a researcher, with the ability to include different elements offering different perspectives illuminating the complexity of FEI practices. The models used in the innovation processes of companies are shown to be important devices for communication across horizontal and vertical levels. They function as reference points and as boundary objects (Carlile, 2002). However, they are limited to what they are able to transfer of the available knowledge. The process models of FEI are able to communicate certain activities in certain phases, the functions within an organisation that are supposed to be active in certain phases and, furthermore, they can serve as a measurement of progress. However, the process models are not very good at showing the iterative processes, the dynamics of progress, and, indeed, not the more explorative modes of, in particular, FEI (e.g. Nonaka and Takeuchi, 1995; Benner and Tushman, 2003; Reid and de Brentani, 2004; Markham et al., 2010). When applying ANT as an analytical perspective, the process models go from being a structure that people work within to become devices that people navigate with.

6.2.2. CASE STUDY

The case study also relates to my second research question. In my case study, I not only found confirmation of the practitioner insights from the workshops and survey, but also practitioners in the case study were very aware of the limitations of linear process models and the importance of social-oriented interactions and spaces of knowledge creation interactions. They were, however, less explicit about how they use process models as devices more than dictating structures in understanding and managing FEI, but one example was HiLite that intentionally used process models to describe their progress to upper-level managers. In the view of ANT, organising and managing FEI (to be successful) requires providing a frame for a networking process among heterogeneous actors so they can qualify their interactions and relations. Framing conditions for translating networks around emerging product ideas cannot rely on a linear set of sequential decisions, even if they are aimed at leading an idea to acceptance in the organisation (McMaster and Wastell, 2005). From the perspective of ANT, a successful FEI process – being able to create an innovation opportunity and lead it into a promising concept that is accepted and taken up into the corporate structures – would be described as an actor network going through a translation process (Akrich et al., 2002). In the case study, managers as well as designers try to navigate and make sense of different configurations of the FEI space (Clausen and Yoshinaka, 2007). This navigation takes into consideration

how to relate to or how to include or exclude human and nonhuman actors, such as stakeholders from different parts of the corporate organisation and users or customers from outside the company, new and old technologies, roadmaps and design briefs, and structures such as the stage gate process. Instead of taking the structural processes and gates at face value as coordinating instruments, the navigators refer to spatial metaphors, such as creating a “space for dialogue with developers down the chain” (MedX), or a “space for knowledge sharing and dialogue” (Agro), or a “strategic space” (HiLite) for aligning concepts to strategy. These spatial metaphors can be seen as a new orientation device for key players concerned with addressing and managing emergent configurations in navigating actors and models in a FEI space. They concern FEI configurations and reflect attempts to create FEI spaces that may support the formation of new actor networks or reconfigure existing ones by enabling specific dynamic relations between actors.

What is at stake here is the alignment between, for example, new technologies, the organisational network of different actors, and external actors around an emerging concept (Wastell, 2006). Concepts may be resisted or even rejected if the network is not capable of gaining support and strength. In a successful translation process, weak relations of loose ideas are turned into a stable actor network with strong relations where the actors reinforce their shared programme of a product concept. In this case, a product concept is accepted in the formal corporate structures through an alignment with the prior order while, at the same time, adjusting that order (Wastell, 2006). One might ask if only specific individuals are capable of navigating actors and models in FEI on an organisational level (Mullins et al., 2008) and if these navigational and translational processes only belong to the shadow side of the organisation and therefore out of reach for managers. It is my opinion that this can be changed if an understanding and a vocabulary for the complexity of FEI was adequate. In this way, the link between shadow and the legitimate system of the organisation would be stronger and more effective. From the perspective of ANT, to divide between the shadow and legitimate system is not useful in an analysis as they are mutually defined. Instead, the task could be to be aware of the dynamic relations between the systems in order to support the utilisation of the resources and opportunities that the interactions between the systems offer in practice (Stacey, 1992).

6.3. REFRAMING THE MODELLING OF FEI

In the following, the discussion relates to my third research question. Through my approach to FEI, my investigations and findings contribute to a more holistic view of managing and organising FEI, but how can I also propose a way to bring my findings into practice? The development and suggestion of a conceptual FEI model is motivated by the aim of operationalising the overall findings of the PhD study and to reframe the understanding of FEI primarily found in current literature. One of the concerns found in my study of FEI is the challenge around the coordination and

collaboration between different innovation employees that come from different areas of the organisation with different professional backgrounds (Dougherty, 1992). These employees frequently represent different views on the conceptualisation of new products and, in the interaction across organisational boundaries, opportunities as well as challenges arise in this collaborating effort (e.g. Dougherty 1992). Nevertheless, the integration of different areas or functions of a product innovation company is essential to FEI, both for creating new innovative directions, navigating different actors and models in the innovative space, and for creating the necessary support in the organisation. With my dissertation I do not refrain from structure or models, they are strong actors and important navigational devices but they have to be adequate in order to be structures that support innovation (e.g. Dougherty, 2008). My FEI model and views gleaned on FEI in product innovation companies also involve technologies and designs as meaningful and sometimes powerful actors that influence and shape the translation process of FEI. I have suggested a conceptual FEI model based on my theoretical and empirical studies with the aim of meeting the complexity and dynamics of FEI found. To make another model can seem contradictory when I am simultaneously pointing to the limitations of current models of FEI in literature. Models are frequently didactic, simplistic, and one dimensional, which is a general constraint of models (e.g. Verwonn and Herstatt, 2002; Florén and Frishammar 2012).

Throughout my dissertation, and especially indicated in Paper 3, I see models and the use of models in a different view. They work as devices actively used in navigating FEI and not determining FEI. I thus suggest a different type of model that characterises a translation process where existing actor networks are destabilised, reconfigured, and stabilised towards the conceptualisation of new innovations. The translation process is different from the standard processes frequently illustrated as process models. The majority of process descriptions in literature perceives the process as reducing uncertainty and dictating a certain order and sequence of activities. The translation process extends these views by involving a disorder perspective or destabilisation, as described. This is very much related to innovation and especially FEI as it concerns change and the development of new technologies, business and use. As Benner and Tushman (2003) points out, standard process and management models are good at supporting exploitative activities, but are not useful for supporting explorative activities, which is an essential part of FEI.

6.3.1. BRINGING THE FEI MODEL INTO PRACTICE

In Paper 4, I elaborate on the difference between my FEI model and current FEI models found in primary literature. To take a step closer to practice, I would like to suggest how to operationalise the FEI model and bring it into practice. In doing so, I imagine a reflective learning and change process where a new reality of how to manage FEI projects is created and situated (Clarke, 2005). Hence, operationalising the FEI model is focused on an explorative process of learning and co-creating the

conceptions of how FEI is managed (Brandt et al., 2008). My model proposes several elementary concepts. These are heterogeneous actors, enacted relations, a translational process of creative destabilisation and constructive stabilisation, which entails network configurations and reconfigurations in a situated innovative space. These elements are created from my analytical application of ANT and empirical findings. I would like the practitioners to work with these elements in a collaborative effort in order that they gain a shared understanding of the elements across departments. Seidel and O'Mahony (2014) describes representations in obtaining coherence in concept development in cross-functional teams. Through case studies of different teams, they found that it is necessary to engage in three different practices of representations: Collective scrutiny of representations, linking representations to design constraints, and actively editing representations. In so doing, the team gain a shared understanding of the innovation challenge. In a similar manner, I want to create a shared understanding of managing the innovation process with my proposed model of FEI. Other authors have also dealt with collaboration through shared understanding and through using or creating representations in design processes (e.g. Bogers and Sproedt, 2012; Buur and Matthews, 2008; Brandt et al. 2008). From the participatory design literature, I have found design games, which can stage a setting with rules, materials, and participants from different domains in the product innovation company. In this setting, a design dialogue is created that enables the participant to contribute to the design of prototypes or mock-ups (Sanders, Brandt, and Binder, 2010). In the design game, the participants act, enact, and play with material in designing products and layouts, in this case it would be the strategic navigation of the FEI space.

6.3.1.1 FEI model as a design game

In a design game approach, a workshop setting and capable facilitators could stage the design game. The elements of the FEI model could be materialised by transforming them into tangible game pieces using different kinds of materials such as cardboard, pens, a game board, post-its, etc. The game pieces are used in a setup with game rules, players, and a game structure that affords specific input such as questions or challenges and specific output such as mappings, designs, lists, drawings, etc. (e.g. Brandt, 2006). The design game of navigating an innovative space of actors and models can open up for a dialogue of how to push conceptualisation and gain support from the organisation. To make every participant aware of the shared aim and the elements to be navigated, the game pieces are used to facilitate a dialogue and creation of a shared understanding.

When making a decision to start an FEI process, involved actors begin to shape an innovative space where new thoughts and ideas are considered. It is a destabilisation of how things are now and new applications, technologies, and business approaches etc. are explored. The design game questions and challenges the stabilised by bringing together different worlds with different perceptions and opinions to create

new insights and understandings not only from a larger perspective but also extending the participants' understanding of each other's perspectives. The design game challenges and questions how things are perceived in a mutual learning process using the tangibles of the design game (Béguin, 2003). The destabilisation is focused around a specific area or perceived goal, a point of view or a point of departure. It is connected to a larger perspective and linked to strategic thoughts. It can be the problematisation of a network of human and non-human actors of what is known or being done now or something to investigate. The focus of the innovative space could be the point of view of a user or a market. It could be an actor like a technology or a business case. Let us say that the focus of the innovative space created is an exploration of potential new business areas for known technologies such as in the case of HiLite. The FEI model pays attention to the localised and the situated. It considers the specific technologies and perceptions of designers to be important determinants of the innovative space and the relations enacted, along with the context in which the innovative space is created. All three case companies are well aware of their history, culture, and development trajectory and stories of technologies and markets play a significant role in their explorative activities, strategic thinking and navigational processes. The focus of the space points to the awareness of how we think and navigate in the innovative space. In this consideration, rules, roles, and representations that are part of the design game are created or chosen.

In the case studies, what are the stakes of the designers, the managers, the strategic decision makers, the technology, and the innovation process? The FEI model design game could frame the game pieces and board in different colours and shapes to represent different actors, relations, understandings, and processes. The participants could play with the pieces while discussing, understanding, creating knowledge, and laying out strategies of the concrete FEI translation process. The design game could be played repeatedly during FEI, as we see in agile processes like the Scrum framework of development (e.g. Takeuchi and Nonaka, 1986) but with a focus on configuring actors that are, or will be, part of the FEI space, the specific actors and relations, the overall strategic goals, organisational limits or path dependencies, innovation trajectories, and adjusting and reflection of the process.

In many respects, the FEI model resembles the constitution, configuration and translation of a heterogeneous network of relevant human and non-human actors in the development of new product innovations in an organisation. The heterogeneity not only describes the different actors as being humans and non-humans, it also describes actors located in different organisational structures and with different approaches and ideas in the work with seeking and developing new business and technology opportunities. Relations between different actors included in the space can also be of a different kind. This can be physical or mental relations as connected by organisational structures or connected by shared interests, e.g. CoPs. The heterogeneity is something that creates opportunities for exploring and

experimenting with new ideas but, at the same time, a challenge in a collaborative space where stakeholders have different perspectives and agendas. The design game stages a space where such heterogeneity has the opportunity to question normativity because you are confronted with something or someone that has a different perspective and goals and opportunity to create a shared understanding.

The case companies in the study come from a technology driven trajectory/path dependency. They have all recognised and strategised the need for business, customers, and/or user-driven innovation, but this seems to be a change process that is quite difficult to push and overcome on many levels. The design game has the ability to consider different stakeholders and incorporate objects that support these stakeholders but also gives them the ability to see and understand other stakeholders and their visions, goals, and needs. Brandt and Messeter (2004) describe how to empower stakeholders with design game pieces as props. They refer both to Ehn and Sjögren (1992) that describe mock-ups as a reminder of design reflections and Star (1989) who describes boundary objects as artefacts carrying and sharing meaning between different domains of knowledge. For the case companies, the new paradigm of incorporating a business drive and combining this with complex technologies also brings challenges of collaborating across knowledge domains and stakeholders. In FEI, it is not viable to just hand over specifications, design and business cases at the gate to the next stage of NPD, it requires close collaboration and support from many parts of the organisation.

CHAPTER 7. CONCLUSION

Based on my literature review, I have pointed to the lack of consensus and development concerning how to manage and model FEI. Rather, there seems to be a division between social-oriented approaches and structure-oriented approaches to the management of FEI. Furthermore, I found that this division between the structure-oriented approaches, with their emphasis on process models, and the social-oriented models, with an emphasis on knowledge sharing and learning, left a gap pointing to the need for more holistic approaches.

In interaction with practitioners, I found that they handled many different perspectives and approaches residing in both the structural and social perspectives. According to the practitioners, a multiplicity of approaches are applied and used depending on how they make sense of the situation. Nonetheless, I also found that there is a difference in how advanced the companies are in their vocabulary and perhaps ability in navigating actors and models in FEI. At one end, FEI outside the stage gate process seemed implicit and typically performed by informal internal entrepreneurs with special abilities and personal characteristics, while at the other, an explicit, corporate, and strategic choice of establishing a formal FEI department resulted in successful radical innovation. However, as a common denominator, the practitioners studied across the cases seemed highly reflective, applying a number of different approaches to handle the FEI challenges. Nonetheless, this reflexivity was hardly explicated and seemingly not supported by the offered FEI models.

By applying ANT on the management of FEI, the dissertation offers a novel approach where process models and knowledge strategies are perceived as particular objects and communication devices to be navigated in the creation of heterogeneous networks around product ideas and concepts. With this approach, ANT has supported the ability to reflect on the front end work carried out and to include and make sense of the complexity of the different approaches and perspectives that practitioners apply in the navigation of FEI. These insights have led to the conceptualisation of a FEI model, which is meant to extend the kinds of model that can frame the approach to FEI. The PhD project is based on a limited number of cases and calls for further development of theoretical thoughts and interactions with practitioners. A further study could entail a dedicated design game approach to co-create a more concrete and operational FEI model.

In my view, FEI is not necessarily chaotic or unmanageable, it is just not yet well understood but residing in a landscape consisting of both implicit and explicit understanding and dialogue, formal and informal structures and behaviour, and shifts between situational and general possibilities. As such, it is in a situation of still undergoing development in the middle of a translation process seeking stability and thereby still on the way to reaching the full potential of optimisation and efficiency.

Through my dissertation I have tried to illuminate different perspectives of FEI, both from other studies and from practice. I would like to encourage reflection and inspire a more holistic approach to the understanding and modelling of FEI providing the support practitioners would find useful and beneficial in the work carried out in FEI.

REFERENCES

- Akrich, M., Callon, M., Latour, B. (2002) The key to success in innovation Part I: The art of intersement & Part II: The art of choosing the good spokespersons, *International Journal of Innovation Management*, vol. 6, no. 2, pp. 187-225.
- Allen, J., James, A. D., Gamlen, P. (2007) Formal versus informal knowledge networks in R&D: a case study using social network analysis, *R&D Management*, vol. 37, no. 3, pp. 179-196.
- Bakker, H., Boersma, K., Oreel, S. (2006) Creativity (Ideas) Management in Industrial R&D Organizations: A Crea-Political Process Model and an Empirical Illustration of Corus RD&T, *Creativity and Innovation Management*, vol. 15, no. 3, pp. 296-309.
- Béguin, P. (2003) Design as a mutual learning process between users and designers, *Interacting With Computers*, vol. 15, no. 5, pp. 709-730.
- Benner, M.J., Tushman, M.L. (2003) Exploitation, exploration, and process management: The productivity dilemma revisited, *Academy of Management Review*, vol. 28, no. 2, pp. 238.
- Bessant, J. (2003) *High-Involvement Innovation*, John Wiley and Sons, Chichester.
- Bertels, H. M. J., Kleinschmidt, E. J., Koen, P. A. (2011) Communities of practice versus organizational climate: Which one matters more to dispersed collaboration in the front end of innovation?, *Journal of Product Innovation Management*, vol. 28, no. 5, pp. 757-772.
- Björk, J., Magnusson, M. (2009) Where Do Good Innovation Ideas Come From? Exploring the Influence of Network Connectivity on Innovation Idea Quality, *Journal of Product Innovation Management*, vol. 26, no. 6, pp. 662-670.
- Blessing, L. T. M., Chakrabarti, A. (2009) *DRM, a Design Research Methodology*, Springer-Verlag, London.
- Boeddlich, H. (2004) Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process, *Creativity and Innovation Management*, vol. 13, no. 4, pp. 274-285.
- Bogers, M., Sproedt, H. (2012) Playful Collaboration (Or Not): Using a Game to Grasp the Social Dynamics of Open Innovation in Innovation and Business Education, *Journal of Teaching in International Business*, vol. 23, no. 2.
- Brandt, E. (2006) Designing Exploratory Design Games - a framework for participatory design? *Proceedings of Participatory Design Conference*, pp. 57-66.

- Brandt, E., Messeter, J. (2004) Facilitating Collaboration through Design Games, *Proceedings of the eighth conference on Participatory Design: Artful integration: interweaving media, materials and practices*, vol. 1, ACM Press, s. 121-131.
- Brandt, E., Messeter, J., Binder, T. (2008) Formatting design dialogues - games and participation, *CoDesign: International Journal of CoCreation in Design and the Arts*, vol. 4, no. 1, pp. 51-64.
- Brem, A., Voigt, K. (2007) Innovation management in emerging technology ventures - The concept of an integrated idea management, *International Journal of Technology, Policy and Management*, vol. 7, no. 3, pp. 304-321.
- de Brentani, U., Reid, S. E. (2012) The Fuzzy Front-End of Discontinuous Innovation: Insights for Research and Management, *Journal of Product Innovation Management*, vol. 29, no. 1. pp. 70–87.
- Böhle, F., Bürgermeister, M., Porschen, S. (2012) *Innovation Management by Promoting the Informal*, Springer-Verlag, Berlin Heidelberg.
- Brown, J. S., Duguid, P. (1991) Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation, *Organization Science*, Vol. 2, No. 1, pp. 40-57.
- Brown, S. L., Eisenhardt, K. M. (1997) The Art of Continuous Change: Linking Complexity Theory and Time-Paced Evolution in Relentlessly Shifting Organizations, *Administrative Science Quarterly*, vol. 42, no. 1, pp. 1-34.
- Brunetto, Y., Xerri, M. J., Nelson, S., Farr-Wharton, B. (2016) The role of informal and formal networks: how professionals can be innovative in a constrained fiscal environment, *International Journal of Innovation Management*, vol. 20, no. 3.
- Bryman, A. (2008) *Social Research Methods*, Oxford University Press.
- Buur, J., Matthews, B. (2008), Participatory Innovation, *International Journal of Innovation Management*, vol. 12, no. 3.
- Callon, M. (1986) Some elements of sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay, in Law, J. (1986) *Power, action and belief: a new sociology of knowledge?* Routledge & Kegan Paul, London.
- Carlile, P. R. (2002) A pragmatic view of knowledge and boundaries: Boundary objects in new product development, *Organization Science*, vol. 13, no. 4, pp. 442–55.
- Chesbrough, H. 2003. The era of open innovation. *Sloan Management Review*, vol. 44, no. 4.
- Christiansen, J. K., Varnes, C. J. (2007) Making decisions on innovation: Meetings or networks?, *Creativity and Innovation Management*, vol. 16, no. 3, pp. 282-298.

- Clarke, A. (2005) *Situational Analysis: Grounded Theory After the Postmodern Turn*, Sage Publications, Inc.
- Clausen, C., Yoshinaka, Y. (2007) Staging socio-technical spaces: translating across boundaries in design, *Journal of Design Research*, vol.6, no.1/2, pp.61-78.
- Cooper, R. G. (1988) Predevelopment activities determine new product success, *Industrial Marketing Management*, vol. 17, no. 2, pp. 237-248.
- Cooper, R. G. (2001) *Winning at New Products: Accelerating the process from idea to launch*, 3rd ed. Cambridge, MA: Perseus.
- Cooper, R. G. (2008) The Stage-Gate Idea-to-Launch Process-Update, What's New and NexGen Systems, *Journal of Product Innovation Management*, vol. 25, no. 3, pp. 213-232.
- Cross, R., Prusak, L. (2002) The people who make organizations go-or stop, *Harvard Business Review*, vol. 80, no. 6, pp. 104–112.
- van Dijk, C., van den Ende, J. (2002) Suggestion systems: transferring employee creativity into practicable ideas, *R&D Management*, vol. 32, no. 5, pp. 387-395.
- Dougherty, D. (1992) Interpretive Barriers to Successful Product Innovation in Large Firms, *Organization Science*, vol. 3, no. 2, pp. 179-202.
- Dougherty, D. (2008) Bridging Social Constraint and Social Action to Design Organizations for Innovation, *Organization Studies*, vol. 29, no. 3, pp. 415-434.
- Eisenhardt, K. (1989). Building Theories from Case Study Research, *Academy of Management Review*, vol. 14, no. 4, pp. 532-550.
- Ehn, P., Sjögren, D. (1992) From system descriptions to scripts for action, in *Design at work*, L. Erlbaum Associates Inc. Hillsdale, NJ, USA, pp. 241-268.
- Eklund, J., Petterson, J., Elg, M., Bolling, A. (2008) Interactive research for production and work development, *Proceedings of the Nordic Ergonomics Society Annual Conference NES*, Reykjavik, Iceland.
- Ferlie, E., Fitzgerald, L., Wood, M., Hawkins, C. (2005) The Nonspread of Innovation: The Mediating Role of Professionals, *The Academy of Management Journal*, vol. 48, no. 1, pp. 117-134.
- Florén H., Frishammar, J. (2012) From Preliminary Ideas to Corroborated Product Definitions: Managing the Front End of New Product Development, *University of Berkeley*, vol. 54, no. 4, pp. 20-43.
- Garcia, R., Calantone, R. (2002) A critical look at technological innovation typology and innovativeness terminology: A literature review, *Journal of Product Innovation Management*, vol. 19, no. 2, pp. 110–32.
- Garud R., Tuertscher P., van de Ven A. H. (2013) Perspectives on Innovation Processes, *The Academy of Management Annals*, vol. 7, no. 1, pp. 775-819.

- Gassmann, O., Schweitzer, F. (2014) *Management of the Fuzzy Front End of Innovation*, Springer International Publishing, Switzerland.
- Giddens, A. (1984) *The Constitution of Society: Outline of a Theory of Structuration*, Polity Press, Cambridge, U.K.
- Gish, L., Clausen, C. (2013) The framing of product ideas in the making: A case study of the development of an energy saving pump, *Technology Analysis & Strategic Management*, vol. 25, pp. 1085-1101.
- Glaser, B. G., Strauss, A. L. (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*. London: Weidenfeld and Nicholson.
- Gupta, S., Maltz, E. (2015) Interdependency, dynamism, and variety (IDV) network modeling to explain knowledge diffusion at the fuzzy front-end of innovation, *Journal of Business Research*, vol. 68, pp. 2434-2442.
- Green, J. (2000) Epistemology, evidence and experience: evidence based health care in the work of Accident Alliances, *Sociology of Health and Illness*, vol. 22, no. 4, pp. 453-476.
- Hallgren, E. W., Clausen, C., Hansen, C. T. (2008) *Employee driven innovation; A case of implementing high-involvement innovation*. Ph.D. thesis.
- Herstatt, C., Verworn, B., Nagahira, A. (2004) Reducing project related uncertainty in the "fuzzy front end" of innovation: a comparison of German and Japanese product innovation projects, *International Journal of Product Development*, vol. 1, no. 1, pp. 43-65.
- Holahan, P. J., Sullivan, Z. Z., Markham, S. K. (2014) Product development as core competence: How formal product development practices differ for radical, more innovative, and incremental product innovations, *Journal of Product Innovation Management*, vol. 31, no. 2, pp. 329-345.
- Kesting, P., Ulhøi, J. (2010) Employee-driven innovation: Extending the license to foster innovation, *Management Decision*, vol. 48, no. 1, pp. 66.
- Koch, R., Leitner, K. H. (2008) The Dynamics and Functions of Self-organization in the Fuzzy Front End: Empirical Evidence from the Austrian Semiconductor Industry, *Creativity and Innovation Management*, vol. 17, no. 3, pp. 216-226.
- Koen, P. A., Ajamian, G. M., Boyce, S. (2002) Fuzzy Front End: Effective Methods, Tools, and Techniques, in *The PDMA toolbook for new product development*, Wiley, New York.
- Koen, P. A., Bertels, H. J., Kleinschmidt, E. J. (2014) Managing the front end of innovation – Part I and Part II, *Research Technology Management*, vol. 57, no. 1, pp. 25-35.
- Kvale, S., Brinkmann, S. (2009) *Interviews: Learning the craft of qualitative research interviewing*, Sage Publications, Thousand Oaks, London.

- Law, J. (2002), *Aircraft Stories: Decentering the Object in Technoscience*, Duke University Press, Durham, N. Ca.
- Lawson, B., Petersen, K. J., Cousins, P. D., Handfield, R. B (2009) Knowledge sharing in interorganizational product development teams: The effect of formal and informal socialization mechanisms, *Journal of Product Innovation Management*, vol. 26, pp. 156-172.
- Markham, S. K. (2013) The Impact of Front-End Innovation Activities on Product Performance, *Journal of Product Innovation Management*, vol. 30, no. 1, pp. 77-92.
- Markham, S. K., Ward, S. J, Aiman-Smith, L. Kingon, A. I. (2010) The Valley of Death as Context for Role Theory in Product Innovation *Journal of Product Innovation Management*, vol. 27, pp. 402-417.
- Mathar, Tom (2008). Making a Mess with Situational Analysis? Review Essay: Adele Clarke (2005). Situational Analysis: Grounded Theory After the Postmodern Turn, *Forum: Qualitative Social Research*, vol. 9, no. 2, art. 4.
- McMaster, T., Wastell, D.G. (2005) The Agency of Hybrids: Overcoming the Symmetrophobic Block, *Scandinavian Journal of Information Systems*, vol. 17, pp. 175–182.
- Mullins, M. E., Kozlowski, S. W. J., Schmitt, N., Howell, A. W. (2008) The role of the idea champion in innovation: The case of the Internet in the mid-1990s, *Computers in Human Behavior*, vol. 24, no. 2, pp. 451-467.
- Nonaka, I. (1991) The Knowledge-Creating Company, *Harvard Business Review*.
- Nonaka I., Takeuchi H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press.
- Nonaka, I., Toyama, R. (2003) The knowledge-creating theory revisited: knowledge creation as a synthesizing process, *Knowledge Management Research & Practice*, vol. 1, no. 1, pp. 2-10.
- Otte, E. Rousseau, R. (2002) Social network analysis: a powerful strategy, also for the information sciences, *Journal of Information Science*, vol. 28, no. 6, pp. 441-453.
- Pattinson, S., Preece, D. (2014) Communities of practice, knowledge acquisition and innovation: a case study of science-based SMEs, *Journal of Knowledge Management*, vol. 18, no. 1, pp. 107-120.
- Pattinson, S., Preece, D., Dawson, P. (2016) In search of innovative capabilities of communities of practice: A systematic review and typology for future research, *Management Learning*, pp. 1-19.
- Rank, O. N. (2008) Formal structures and informal networks: Structural analysis in organizations, *Scandinavian Journal of Management*, vol. 24, pp. 145-161.

- Reid, S. E., de Brentani U. (2004) The Fuzzy Front End of New Product Development for discontinuous Innovation: A Theoretical Model, *Product Innovation Management*, no. 21, pp. 170-184.
- Sage, D. J., Dainty, A.R.J., Brookes, N. J. (2010) Who reads the project file? Exploring the power effects of knowledge tools in construction project management, *Construction Management and Economics*, vol. 28, no. 6, pp. 629–640.
- Sanders, E. B-N., Brandt, E., Binder, T. (2010) A Framework for Organizing the Tools and Techniques of Participatory Design, *Proceedings of the Participatory Design Conference 2010: PDC 2010 Participation :: the Challenge*, Sydney, pp. 195-198
- Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York.
- Seidel, V. P., O'Mahony, S. (2014) Managing the Repertoire: Stories, Metaphors, Prototype, and Concepts Coherence in Product Innovation, *Organization Science*, vol. 25, no. 3, pp. 691-712.
- Seim, R., Broberg, O., Andersen, V. (2014) Ergonomics in Design Processes: The Journey from Ergonomist toward Workspace Designer, *Human Factors and Ergonomics in Manufacturing & Service Industries*, vol. 24, no. 6, pp. 656-670.
- Sergeva, N. (2014) Employees and the innovative idea contribution process: Clarifying individual and contextual characteristics, *International Journal of Innovation Management*, vol. 18, no. 5.
- Smith, P. G., Reinertsen, D. G. (1998) *Developing products in half the time: new rules, new tools*, John Wiley & Sons, New York.
- Stacey, R. D. (1992) *Managing the Unknowable: Strategic Boundaries Between Order and Chaos in Organizations*, John Wiley & Sons, Inc. San Francisco.
- Star, S. L., Griesemer, J. R. (1989) Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, *Social Studies of Science*, vol. 19, pp. 387-420.
- Svensson, L., Nielsen, K. A. (2006) Action research and Interactive research: A framework for the book, in Aagaard Nielsen, K., Svensson, L. (Ed.), *Action research and interactive research: Beyond practice and theory*, pp. 13-44. Maastricht: Shaker Publishing.
- Takeuchi, H., Nonaka, I. (1986) The New New Product Development Game, *Harvard Business Review*.
- Verworn B., Herstatt, C. (2002) The innovation process: an introduction to process models, working paper no. 12, *Technical University of Hamburg*.

REFERENCES

- Wastell, D. G. (2006) Information systems and evidence-based policy in multi-agency networks: The micro-politics of situated innovation, *Journal of Strategic Information Systems*, vol.15, pp. 197-217.
- Wenger, E., Snyder, W. (2000) Communities of practice: the organizational frontier, *Harvard Business Review*, pp. 139-145.
- Wenger, E. C., McDermott, R., Snyder, W. (2002) *Cultivating Communities of Practice*, Boston, MA, Harvard Business School Press.
- Wheelwright, S. C., Clark, K. B. (1992) *Revolutionizing product development: Quantum leaps in speed, efficiency, and quality*, Free Press, New York.
- Yin, R. K. (2009) *Case study research: Design and methods*, SAGE Publications.

ISSN (online): 2446-1628
ISBN (online): 978-87-7112-901-4

AALBORG UNIVERSITY PRESS