Creating knowledge in firms and collaborations

A case study of knowledge creation in innovation

Wenche Bakkebråten
University of Oslo
Globalisation, Innovation and Policy
01.10.2001

Word count: 23575
Preface

Doing independent research for the first time has been a real learning experience. The amount of hours that has gone into the preparations for this paper you now hold in your hands has far exceeded what I would have imagined before I started. So have the pleasures and discomforts that accompany working so intensely on one single project.

Acknowledgements:

I would like to thank the informants of this thesis, who made the collecting of empirical material a real learning experience.

I am indebted to my supervisor Finn Ørstavik for excellent guidance throughout the work of this thesis, as well as for access to the STEP Cotech-database and for helping me get access to interviewees.

Ivan,

I am truly grateful for your unconditional support.
Synopsis

This thesis takes the approach of the knowledge-based view of organisations, as it argues that learning potential influences firm competitiveness. The connection between knowledge and innovation may seem self-evident, but is at the same time difficult to specify. Common sense will tell us that creation of new knowledge must be at the core of every innovation. To be able to make something new, existing knowledge must be creatively re-combined, or new insights must emerge. For actors to launch a product innovation on the market, some learning must have occurred. The process of learning that is inherent in the innovation process is at the core of this thesis.

This master thesis endeavours to explore what conditions must be present for knowledge creation and knowledge transfer to occur, both inside a firm and in an innovation collaboration. As a means to accomplish this task, a case study of fifteen Oslo-based companies in a wide variety of sectors was carried out. The main purpose of the empirical work was to test some basic theoretical assumptions of what the typical learning and innovating organisation looks like.

The problem concerns what factors that must be present in firms, and innovation collaborations, for significant learning to be generated.

Four different but related perspectives were chosen to explore this problem:

1: The relationship between organisational form and learning potential
2: Interaction forms suited for knowledge creation and transfer
3: The strategies firms should use, and are using, to ensure knowledge transfer
4: The relationship between learning and innovation and connection to knowledge infrastructure.

The firms included in this study far exceed the categories theory assumes are coherent with learning and innovating organisations. One tentative conclusion that can be drawn from this limited empirical basis is that these theoretical claims are overly assertive and that theory should be revised on the basis of more case studies of learning and innovation at the micro level.

Keywords: knowledge, learning, innovation, collaboration, organisational type, interaction forms, strategies, innovation system.
Table of contents

Preface.................................................................i
Synopsis ......................................................................ii
Table of contents..................................................1
List of tables and figures.........................................4

Chapter 1: Introduction........................................5
  1.1 Societal and scientific background....................5
  1.2: The ESST program:........................................6
  1.3: Aim ..........................................................6
  1.4: Problem formulation ....................................7
  1.5: Research questions .....................................7
  1.6: Contributions .............................................8
  1.7: Thesis outline:............................................8
  1.8: Core concepts ...........................................8
  1.8.1: What is knowledge? ................................8
  1.8.2: Knowledge is something more than and different from information ....8
  1.8.3: Knowledge is social ................................10
  1.8.4: Tacit knowledge is not easily transferred .......10
  1.8.5: What is learning? ...................................12
  1.8.6: What is innovation? .................................12
  1.8.7: What is collaboration? ..............................13
  1.9: The K-L-I-C concepts and their connections ....13

Chapter 2: Research design and methods...............15
  2.1: Design .....................................................15
  2.2: Selection criteria and relation to previous studies .16
  2.3: Explorative objective ................................17
  2.3.1: Comparative research .............................18
  2.3.2: Interview as a method ............................18
  2.3.2: Questionnaire as a method ......................19
  2.4: Time as a methodological challenge ..............20

Chapter 3: Analytical framework..........................21
  3.0.1: Individual and organisational learning ........21
  3.0.2: The knowledge based view of the firm ..........22
  3.1: What type of organisation is best suited learning? 24
    3.1.1. Lam: Professional bureaucracy, Machine bureaucracy, Operating
      Adhocacy and J-form organisation ......................24
    3.1.2. Nonaka: SECI ........................................29
    3.1.3: Nonaka: The hypertext organisation ............31
    3.1.4: Combining SECI and LAMs typology ..........33
    3.1.5: Criticism of SECI ..................................34
    3.1.6: Answer: Operating Adhocacy and Hypertext organisation ..........35
  3.2: What type of interaction form is better for knowledge creation and transfer? 36
    3.2.1: Practical co-operation and dispositional knowledge ....36
    3.2.2: What is a "Community of Practice"? .............37
    3.2.3: Criticism of COP ..................................39
3.2.4: Two different organisations finding common ground: the concept of grounding ................................................................. 40
3.2.5: Answer: close social interaction over time ............................................ 41
3.3: What strategies ought firms use to ensure knowledge transfer? ........... 42
  3.3.1: Top-down, bottom-up and middle-up-down management of learning ..... 42
  3.3.2: Synthesis; middle-up-down management for knowledge creation ...... 43
  3.3.3: Nonakian strategies for knowledge creation ....................................... 45
  3.3.4: Strategies from the theory of “communities of practice” .................... 45
  3.3.5: Limitations of theory: What about hierarchies and learning? .......... 46
  3.3.6: General search procedures .............................................................. 47
  3.3.7: Collaborating as a strategy for knowledge creation and transfer ....... 47
  3.3.8: The age of the relationships; new networks new learning and old systems deeper learning? ........................................ 48
  3.3.9: Dyads or networks ........................................................................... 49
  3.3.10: Summing up strategies .................................................................. 50
3.4.1: Defining national systems of innovation ............................................ 52
3.4.2: The Norwegian National System of Innovation in the European context 53
3.4.3: the supply side of national systems of innovation .............................. 54
3.4.4: Science and technology infrastructure institutions in Norway .......... 55
3.4.5: Answer: good access to knowledge infrastructure ............................ 56
3.5: Theoretically based conclusions ............................................................ 56

Chapter 4: Empirical analysis .................................................................... 57
4.0: Presenting the cases ............................................................................. 57
  4.1.1: Organisational types revisited ............................................................ 59
  4.1.2: Combining Lam’s typology with SECI and COP ................................. 63
  4.1.3: Organisational structure; hierarchy vs. flat organisation .................. 66
  4.1.4: The hypertext organisation revisited ................................................ 66
  4.1.5: Summing up; unambiguous correlation between organisational type and innovation .......................................................... 67
  4.2.1: Communities of practice revisited .................................................... 68
  4.2.2: No dominant interaction form .......................................................... 70
  4.2.3: “Trust” ............................................................................................. 71
  4.2.4: Grounding ....................................................................................... 72
  4.2.5: Physical proximity as beneficial for knowledge transfer .................. 74
  Average score .......................................................................................... 75
  4.2.6: Actual proximity to collaboration partner .......................................... 75
  4.2.7: Summing up; the relationship between interaction form and learning potential ........................................................................ 77
4.3: Strategies for knowledge creation ......................................................... 78
  4.3.1: Top down strategies for knowledge creation and transfer inside the firm .... 78
  4.3.2: A Master-apprentice model ............................................................... 78
  4.3.3: “Cloning programs” ......................................................................... 79
  4.3.4: Is strategies for knowledge transfer unimportant? ............................. 80
  4.3.5: A database for CVs and professional meetings .................................... 80
  4.3.6: The performance appraisal process .................................................. 82
  4.3.7: Courses ............................................................................................. 83
  4.3.8: The importance of training/education for learning in firms: ............... 83
  4.3.9: Bottom-up strategies for knowledge creation and transfer inside the firm .... 84
  4.3.10: Space for exploration .................................................................. 84
Chapter 4: Knowledge creation

4.3.11: An open corporate culture that encourages learning ............................................85
4.3.12: The dilemma between deepening existing knowledge and distributing knowledge widely ........................................................................................................86
4.3.13: Collaboration as a strategy for knowledge creation ..................................................87
4.3.14: Innovation as a mean to an end: profit .................................................................87
4.3.15: Exceptions; knowledge transfer as motivation for collaborating ..............88
4.3.16: Dyads or networks revisited .................................................................................89
4.3.17: Long term strategies and relationships, the age of the dyads .................91
4.3.18: Summing up; strategies .......................................................................................91

4.4: How embedded are these firms to the Norwegian NSI? .............................................93
4.4.1: Knowledge infrastructure as information sources .................................................93
4.4.2: Same nationality facilitates interaction .................................................................93
4.4.3: Financial support ....................................................................................................94
4.4.4: Position in the value chain influences partner choice ...........................................96
4.4.5: Educational levels ..................................................................................................97
4.4.6: Geographical proximity to partners is less important? .........................................98
4.4.7: NSIs and MNEs – a contradiction? ........................................................................98
4.4.8: Is there a connection between organisational type and NSI connection? ...99
4.4.9: Summing up; what is the connection between these firms and NIS support structure? .................................................................................................................99

Chapter 5: Preliminary conclusions ................................................................................101
5.0: Main objective revisited ..........................................................................................101
5.0.1: General conclusions .............................................................................................101
5.0.2: Knowledge is socially constructed ......................................................................101
5.1: Is there a connection between organisational form and learning potential? ..........102
5.2: Is there a connection between interaction form and learning potential? .............102
5.3: Strategies for knowledge creation and transfer .......................................................104
5.4: Connection to NSI knowledge infrastructure ...........................................................105
5.5: Main conclusion .......................................................................................................105
5.6: Suggestions for further research .............................................................................106

Appendix ........................................................................................................................107
Bibliography .................................................................................................................107
Interview guide .............................................................................................................109
Questionnaire ...............................................................................................................112
Brief presentation of the sample ..................................................................................115
List of tables and figures

Page

Table 1: characteristics of knowledge  11
Table 2: Combining Lam and Nonaka      33
Table 3: Presenting the firms and their product innovation  57
Table 4: Categorising the firms        67
Table 5: Innovativeness and organisational type   68
Table 6: The importance of shared values and visions  70
Table 7: The importance of different interaction forms for knowledge transfer  75
Table 8: The importance of education and training for learning  83
Table 9: Motivation for collaboration     88

Figure 1: Dyads and networks          89
Chapter 1: Introduction

The topic of this thesis is learning and innovation in the private sector.

1.1 Societal and scientific background

Why does the phenomenon of innovation intrigue scientists? The usual legitimisation for studies is that innovation provides the basis for rising standards of living through technological changes, providing growth in productivity. Innovations thus have a major impact on society. It is equally important, however, to understand that innovations are not created in a vacuum, but are inherently a social process influenced and negotiated by stakeholders with political, social and economical objectives.

Previous theoretical frameworks regarded innovation as a result of the heroic acts of geniuses and spectacular entrepreneurs, whose creativity and visions drove the economy further ahead. Innovation was regarded as a relatively straight-forward process from invention to launch on the market, and the common view held was that innovations were based in advances in science.

In the last decades, theories have surfaced which take an entirely different view on innovation. Without ignoring the contributions of inventors and entrepreneurs, these theories look into the wider societal context in which innovations are constructed. The many actors involved in building new knowledge, and their combining efforts lead to the actual innovation. The interactive models on innovation also emphasize how the innovation process is a complex and dynamic process in which efforts is constantly redefined and redirected. The interactive model of innovation emerged in parallel with post-industrial production, where a new kind of competition was recognised. This kind of competition was more based on the companies’ ability to learn than on their tangible assets. It is argued that companies’ ability to learn is reflected in their innovativeness. Thus is the reciprocity between learning and innovation established.
The interactive model of innovation is actively advocated within the traditions of science and technology studies that lay the ground for ESST\(^1\).

1.2: The ESST program:
ESST is part of a research tradition that focuses on social, cultural, political and economic dimensions of science or technology (www.esst.uio.no/orginfo.html). This thesis focuses on cases where firms have embedded some of their and their partners’ knowledge into innovations. I will show how social, cultural and political dimensions inside firms and in collaborations between firms are inherent in the innovation process.

1.3: Aim
The aim of this thesis is to shed light on enabling and constraining conditions for knowledge creation and transfer within a firm and between firms collaborating in order to develop a product innovation. The objective is two-sided. I want to explore conditions for learning in private organisations, as well as to explore what conditions for learning a collaborative innovation project can provide.

In order to do this, I will discuss the nature of knowledge creation, inherent in the innovation process, from the point of view of various theoretical disciplines and then test propositions in the literature with a live case study on learning in innovation collaboration in 15 Oslo based firms. I will look closer into how knowledge creation and knowledge transfer between the partners was an inherent part of the process that finally led to the launch of a product innovation, thus linking the interactive model of innovation to the knowledge based view of the firm.

\(^1\) ESST is an abbreviation for European studies of Society, Science and Technology.
1.4: Problem formulation
The main problem of this discussion can be formulated as a question:

* Which factors must be present in firms, and innovation collaborations, for significant learning to be generated?

This problem is broad, and can be answered from different perspectives. I have chosen to break down the overarching question above into smaller ones, thus also choosing look out posts, which influence the focus of the thesis. These look out posts are: organisational type, interaction form, strategies for knowledge transfer and connection to knowledge infrastructure.

1.5: Research questions

1. What type of organisation is best suited for learning? Is there a connection between organisational form and learning potential?

2. What type of interaction form is best suited for learning? What type of interaction is most common in the collaborations and what are its implications for learning?

3. What strategies do the firms use to ensure internal knowledge transfer in general, and what strategies do they use to ensure knowledge transfer between themselves and their partners?

4. How embedded are these Oslo-based firms to the knowledge infrastructure of the Norwegian national innovation system? What does this implicate for learning?

---

2 The analytical framework and the empirical analysis, chapter 3 and 4, are structured around these four questions. The heading 3.4, for instance, implies that it is a review of question number four above, in the third chapter.
1.6: Contributions

My theoretical contribution is to combine organisation theory, economical and sociological perspectives on learning, and on the firm. Using a pragmatic approach, I will select aspects from various theories to build a framework from which I will analyze the case studies of 15 firms. The empirical contribution is to bring voice to 15 Oslo-based firms. What do they regard as important factors for learning and innovation?

1.7: Thesis outline:

The next section provides a conceptual framework, outlining the key concepts and perspectives adopted in the study. Next is research design and methods discussed in chapter two. The four research questions introduced above form the focus of the theoretical discussion in chapter three, and the empirical analysis in chapter four. Finally, the theoretical and empirical findings are discussed in chapter five, where main conclusions are drawn.

1.8: Core concepts

In this section, I will introduce the most important concepts of this thesis, namely knowledge, learning, innovation and collaboration. The main problem of this thesis is:

*Which factors must be present in firms, and in innovation collaborations, for significant learning to be generated?*

1.8.1: What is knowledge?

1.8.2: Knowledge is something more than and different from information

Information can be described as a set of general codes, data. For information to become knowledge, the actor has to interpret and give the information meaning, and each actor continuously do this by drawing on her/his experience, existing knowledge...
base and other contexts. This subjectivity results in a relativistic and relational view on knowledge; knowledge will always be closely linked to the individual and his/hers groups (Hildrum lecture 16.10). Unlike information, knowledge is about commitment and beliefs; it is a function of a perspective or intention that exists prior to the gathering process (Nonaka & Teece 2001:322). Following Plato, who defined knowledge as “justified true belief”, Nonaka & Teece views knowledge as “a dynamic process of justifying personal belief toward the “truth” “ (Nonaka & Teece 2001:15).

This definition opens up for a more political and conflict perspective on knowledge, in that knowledge is a process in which we try to justify our personal beliefs. It also opens for focus on how value- laden knowledge is, depending on the prevailing norms of the community.

---

1.8.3: Knowledge is social

Knowledge is inherently dynamic, as it is created in social interactions. Knowledge is also more or less context-specific, depending on a particular time and space. This context is what differentiates knowledge from information (Nonaka & Teece 2001:14). According to Nonaka, knowledge is essentially more social than individual: “Knowledge is created by means of the interactions among individuals or between individuals and their environments, rather than by an individual operating alone” (Nonaka & Teece 2001:22). The social context in which knowledge is created is active in this process. Working environment, social aspects, legislation, educational levels etc does matter. These factors influence the way knowledge is created.

1.8.4: Tacit knowledge is not easily transferred

In addition to the distinction between information and knowledge there is the distinction between tacit and codified knowledge. First and foremost, the distinction between tacit and codified knowledge is important because it sheds light on the difficulties inherent in communicating knowledge, both at the individual and organisational level. Tacit knowledge can be defined as “knowledge that is intuitive, unarticulated and that cannot be easily codified and transferred” (Lam 1999:5). Polanyi was the first philosopher who coined the term “tacit knowledge”, stating how we sometimes “can know more than we can tell”. Tacit knowledge entails both an operational and a cognitive aspect. The operational aspect is evident in know-how (embodied, tacit, operational knowledge), whereas the cognitive dimension entails “beliefs, perceptions, ideals, values, emotions and mental models so ingrained in us that we take them for granted” (Nonaka & Teece 2001:319), factors that actively shape our perception of the world. The insight is that what we know is part of our
identity, and what we know shapes our outlook of the world, for instance what appear to be possibilities to some, appear as obstacles to other people.

Codified knowledge can be defined as knowledge that “can be stored or put down into writing without incurring undue losses of information” (Boisot 1995, Hildrum lecture 16.10).

Table 1: Characteristics of knowledge


<table>
<thead>
<tr>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Always involves a person who knows</td>
</tr>
<tr>
<td>*Comes from experience we have reflected upon, made sense of and tested against others’ experiences</td>
</tr>
<tr>
<td>*Invisible, often comes to mind only when a problem must be solved or a question answered</td>
</tr>
<tr>
<td>*Flows through communities, between generations, organisations, cultures</td>
</tr>
<tr>
<td>*Circulates via informal, undocumented practices; stories and hallway meetings over a cup of coffee, and circulates more formally through artefacts; documents and products</td>
</tr>
<tr>
<td>*New knowledge is created at the boundaries of old knowledge</td>
</tr>
<tr>
<td>*Is an asset meaning different things to different people</td>
</tr>
<tr>
<td>*Can become outdated/obsolete instantaneously</td>
</tr>
<tr>
<td>*Is initially tacit/not codified</td>
</tr>
</tbody>
</table>
1.8.5: What is learning?

I choose to define learning as a process in which we acquire knowledge. Teece et al (1997) define learning as “a process by which repetition and experimentation enable tasks to be performed better and quicker, and/or enables new production opportunities to be identified” (Teece et al 1997:520). They emphasize how learning processes are social and collective, ranging from imitation to joint problem solving. In their view, learning requires search procedures and common codes of communication. The aspect of improvement, knowledge as partially cumulating, is also evident in Dodgson’s view. He defines learning in an organisational setting as “The way firms build, supplement and organize knowledge and routines around their competences and within their cultures, and adapt and develop organizational efficiency through improving the use of these competences”. Competences are “the focused combination of resources within a firm which define its business activities and comparative advantages” (Dodgson 1996:55).

1.8.6: What is innovation?

The concept of innovation comes from the term “innovare” which means “to make something new”. All firms that are included in this study have in some way or another made something new. They have all launched a new product on their markets. The novelty aspect varies greatly across the different cases; some products are truly new to the whole world, while others are merely a change in existing products. In a fundamental way innovation is “enabling people to do things which have never been done before” (Freeman & Soete 1997:2). A definition of “innovation” involves this aspect of novelty: “a process of turning opportunities into new ideas, and of

---

4 The concepts “learning” and “knowledge creation” are used interchangeably throughout the thesis.
putting these into widely used practices” (Tidd et al, 1997: 24). Innovation is often categorized as product (offering something new) or process (changing the way a product is produced). This definition points to how innovation requires that actors have identified a opportunity they want to capitalize on, and have brought forward a new idea that suits stakeholder interests and developed this idea into a tangible innovation. The interactive models of innovation view innovation as a systemic activity, that involves a multiplicity of actors: “(...) innovation is not the activity of a single company, rather an active search process to tap into new resources of knowledge and technology and apply them to products and production processes” (Hauknes 1999:13). Then it becomes important to look at how firms collaborate in creating innovations.

1.8.7: What is collaboration?

Collaboration can be defined as “any activity where two or more partners contribute differential resources and know-how to agreed complementary aims” (Dodgson 1993:13). Collaboration was in the STEP study of 1998 restricted to "to real interaction between partners that jointly contribute to the innovation" (Ørstavik & Näs1998:8). Neither of these definitions point out the amount and quality that is required for joint contribution to be termed a “collaboration”.

1.9:The K-L-I-C concepts and their connections

In this chapter, I have introduced the core concepts in this thesis. Important debates were introduced on the tacitness of knowledge, organisations as knowledge creators and the importance of collaboration for innovation.
The connections between the concepts that were discussed here, is intricate and tightly knit. Learning is a process in which knowledge is created. Knowledge is sometimes made tangible in new products or processes that become part of economic transactions, and this process in which innovations are developed sometimes involve collaborations between different organisations.

In the next chapter, I will present a research design that enables a close look at how the above concepts are linked. The research is designed as to provide answers to the question of what factors must be present in firms, and in collaborations, for significant learning to be generated.
Chapter 2: Research design and methods

This chapter outlines the general plan for the research work that provides the foundation for this thesis.

2.1: Design

The aim of this thesis is to shed light on enabling and constraining conditions for knowledge creation and transfer within a firm, and between firms that are collaborating in order to launch a new product on the market. The exploration of the main question, *which factors must be present in firms, and innovation collaborations, for significant learning to be generated*, will be done using both theories on organisations, learning and innovation, and by collecting empirical material from 15 Oslo-based firms that have been innovative. The rationale for collecting empirical material is to be able to hold the theoretical assumptions up against “real-life” experiences, and thus test the validity of these assumptions in an empirical setting.

What is the rationale for investigating learning through innovation projects? Learning is intrinsically linked to innovation. This link becomes less vague if we think of a new product that appears on the market. It is not hard to imagine that some efforts in creating and transferring must lie behind its existence. To be able to create something new, new knowledge has to become tangible through a new product, some kind of learning must have occurred. Therefore, after looking for predictions in theory about what conditions must be present in a firms’ environment for learning to occur, I turn to 15 firms that have successfully launched a product innovation. Their stories of innovation will be used as an empirical basis from which the theory can be assessed. The discrepancy or accordance between “theory and practice” is the leverage of this thesis.
2.2: Selection criteria and relation to previous studies

Studies that employ a qualitative approach often draw the sample strategically. This means that the informants are chosen in a purposive way in relation to the problem that is studied (Thagaard 1998:51). As is evident from the problem formulation, the relationship between learning and innovation is at the very core of this thesis. Therefore, the research sample is drawn from the respondents of a study of successful innovations conducted by the STEP group\(^5\) in 2000 (Ørstavik 2000). This ensures that the firms have recently launched a successful product innovation\(^6\), and that they have collaborated during the innovation process of these products. These firms have also rated the projects’ significance for their technological competence as positive, and they are all located in the Oslo region. 17 of the 120 firms with success stories was asked to contribute to this study\(^7\).

2.2.1: Getting access:

To get access to these informants, I developed an inquiry together with one of the researchers from the STEP group that had been engaged in both the 1998 and 2000 study. STEP used the opportunity to thank the firm for its prior cooperation, and asked them once more to contribute to a study. In addition, a sketch of this project was presented. A couple of days later, I contacted these firms by phone, introduced the study once more and asked for an interview. The response rate was overwhelming,

---

\(^5\) STEP is an abbreviation for Studies in technology, innovation and economic policy, a Norwegian research group.

\(^6\) The study of innovation was in this study restricted to product innovation, defined as "When a firm has introduced a new product, or a new service related to products sold by the firm, over the last 3 years, or when a product is presently being developed that has not yet been launched on the market" (Ørstavik & Nås, 1998:8).

\(^7\) Using these special cases as empirical basis for this study implies that data cannot be used for generalisations. The sample is biased and thus not appropriate for determining the question of how typical or atypical these cases are for the Norwegian, European or international industrial innovativeness.
well beyond what I had hoped for. I was not able to reach one of the firms, since they
either have changed address or name, or both; I was not able to track them down on
the Internet or through phone operators. Of all the 16 firms I contacted, only 1 was not
able to contribute. They were currently in a large lawsuit regarding their “success-
product” and did not want to distribute more information about the collaboration due
to these conflicts. 14 of the 15 interviews revolved around the collaborations that
resulted in product innovations. One firm that were not able to talk about their
innovation project wanted instead to give information on a marketing alliance they
were engaged in. I nevertheless chose to include this interviewee’s insights on
learning and innovation.

I conducted the 15 interviews in the period from the 18th of June to the 16th of
August. All interviews except one (in English) was conducted in Norwegian, due to
the availability of Norwegian as the mother tongue both for the researcher and the
informants. Each interview lasted 1-2 hours and all were taped and transcribed.

All firms and interviewees that contributed to this study are anonymous throughout
the thesis. The firms are therefore differentiated in wide categories, and the
interviewees are not mentioned by name\(^8\).

2.3: Explorative objective

The objective of this study is explorative, and the study makes use of a qualitative
approach. The multiplicity of factors involved in these cases makes the explorative
approach suitable. Explorative research is often seen as a precondition to development
of subsequent hypothesis about causality.

One of the advantages of a qualitative approach is the flexibility it implies for the
researcher in developing and specifying the problem formulation and focus, as new

\(^8\) For more information on the interviewee and their firms, see brief firm presentations in appendix.
findings emerge as relevant during the research (Thagaard, T 1998:45). Following this tradition, I validated the quality of my research design as I went along. Experiences accumulated from doing the interviews and explorations into the literature on this subject have been actively used in the interview guide, and are also evident in how questions are phrased.

2.3.1: Comparative research
To be able to say something more general about conditions for knowledge creation and transfer in firms, and within collaborations, I found it necessary to study more than a couple of cases. 15 interviewees, one from each firm, were asked the same set of questions. The same interview guide and questionnaire have been used throughout the collection of the empirical material.

2.3.2: Interview as a method
One major weakness of interview as a research method is that the researcher only gets access to what the informant says s/he does, which can be very different from what s/he actually does. However, having an explorative objective and wanting to draw as much as possible on the experiences of business people, with no time for direct observation, interview was the best viable option. In order to be able to compare answers, the interview was semi-structured, structured because of the pre-developed questions, semi because of the varying succession of questions. Employing this flexible strategy implies a risk to pose leading questions, influencing the informants to answer questions in a way that reflects how I ask them. However, the topics of this study is somewhat sensitive and personal, e.g. required that the informant were

---

9 Inline with a flexible, qualitative approach, I did two pilot interviews on the 5th of June, with two different informants working for one of Norway’s largest corporations. The primary objective of these was to use this experience to be able to develop more accurate and relevant questions, and limiting the interview guide so that the conversation would not last much over one hour.
willing to also reveal some individual and organisational imperfections. Hence, questions had to be asked accordingly, getting the informants to open up by encouraging them. The interview guide was developed to explore some of the most important basic assumptions in the literature on organisational knowledge creation and innovation.

All interviews were typed and transcribed, to ensure accuracy.

2.3.2: Questionnaire as a method

The questionnaire was developed as a supplement to the interview guide, aimed at increasing the reliability of data. \(^{10}\) The questionnaire\(^{11}\) was e-mailed to the interviewees 1-2 days after the interview, in order for them to have the project fresh in mind. 14 out of the 15 informants responded to the questionnaire. The questionnaire material will be used to provide illustrations of broad tendencies in the empirical material, as the sample is too small to provide a basis for quantitative generalisations. Pre-developed categories in questionnaires have a major limitation regarding informant validity. The researcher decides to what extent the indicators and variables represent reality, and the informant is not able to discuss the categories with the researcher, as an interview session allows room for. However, it makes the task of comparison easier to the researcher, and is as such a useful additional method to interviews.

---

\(^{10}\) Reliability refers to what extent the same indicators would produce similar results on repeated trials.

\(^{11}\) See the questionnaire in the appendix.


2.4: *Time as a methodological challenge*

The time that had elapsed since the other surveys sometimes implied either that the former STEP informants had quit their jobs, the firm had been acquired by another firm, or simply that the person available for me now, could not exactly remember the stories surrounding the success-product, and insisted instead of telling me about another cooperation project that seemed more immediately accessible and easier to talk about. The time that had elapsed since these projects were finished, or the products were launched is a threat to the reliability, or the extent of accuracy, that remains in stories of innovation that are a few years old. ¹²

---

¹² Psychological research indicates that memory is constructive.
Chapter 3: Analytical framework

In this chapter, I will present and discuss different but related frameworks for learning and innovation: the theoretical framework of Lam, the theoretical framework of Nonaka, “Communities of Practice” and the theories of National innovation systems, in order to build an analytical framework from which the empirical material can be analysed. The interview guide is also drawing heavily on insights from these frameworks.

3.0.1: Individual and organisational learning

Social science often discusses the link between the individual and a larger organisation, or even society at a higher level. This problem, referred to as “the micro-macro link”, is also evident in the case of learning. We experience the world as individuals. From this perspective, all learning is individual, since it is only individuals who act.

Having this in mind, how can organisations learn?13 The presence of an individual possessing the required knowledge for a task does not mean that the organisation at large is able to use this knowledge. Often knowledge will be kept inside the members of the organisation forcing the organisation to operate in unnecessary ignorance.

How is knowledge inherent in organisations? Organisations are obviously “holding environments” for knowledge, as knowledge is inscribed for instance in the archives and accounting systems, making the organisation less dependent on each individual working for it. But in a more direct sense, organisations represents knowledge, that is,

13 Throughout this thesis, I refer to organisational learning as learning and knowledge creation in a general sense, which take place within an organisational setting. I consider it difficult to distinguish between single-loop and double-loop learning based on the limited empirical material. Hence, I do not take a stand to whether learning is of a single- or double loop character. The focus is instead on what Argyris & Schon call “deutero” learning, which is learning how to learn. This is more important than deciding whether a specific incidence of learning should be termed single loop (changed action without changing parameters for action) or double loop (large discrepancies between present situation and goal requiring changes of parameters of action).
it knows how to do certain things, it has strategies for performing complex tasks, and
opinions about what goals are valuable, and norms about how one should go about to
attain those goals. An organisation has a certain type of collective knowledge.
Collective knowledge can be defined as “Ways in which knowledge is distributed and
shared among members of the organisation (...) the accumulated knowledge of the
organisations stored in its rules, procedures, routines and shared norms (....) (Lam
1999). Firms thus embed knowledge in documents, archives, and in the minds and
bodies of their employees. Sometimes, as was the case for the sample in this study,
firms also embed knowledge in a new product, termed a product innovation.
Organisations are the main vehicle for technological change, as they carry through
innovations.

3.0.2: The knowledge based view of the firm

In the social sciences, evolutionary economists and innovation researchers talk of how
the new “learning economy” is totally changing the way firms operate, how they
produce and how they innovate. In the learning economy, learning is the most
important process and knowledge the most important resource (Lundvall & Johnson
1994). Lundvall emphasizes how the learning economy introduces a new kind of
competition, not as much based on knowledge, as on the firms’ ability to learn.
Indirect learning, which is seen as a by-product of economic activities by traditional
economists, is in the learning economy regarded as equally important to direct
learning that takes place within the educational system. The perspective of the
learning economy presupposes a vision of firms as knowledge creating entities.
This thesis draws on insights from this research tradition that focuses on firm’s
resources. This research tradition argues that competitiveness is the result of lower
costs; higher quality and product performance stemming from how well the firm manages or controls its scarce resources. Its competitiveness is not so much due to strategic moves/countermoves (as the strategic conflict approach would assume, for instance Shapiro) or to defensive actions against competitive forces (the structure-conduct performance paradigm, e.g. Porter 1980) (Teece, Pisano & Shuen 1997:511). Learning, skill acquisition, accumulating intangible assets and management of knowledge and know-how then become strategic issues for every firm that wants to survive and possibly prosper. This theoretical strand may be termed the knowledge-based view of the firm.¹⁴

These theorists emphasize how organisations are support structures in which knowledge can be created: “An organization cannot create knowledge by itself. What the organization can do is support creative individuals or provide the contexts for them to create knowledge” (Takeuchi, in Nonaka & Teece 2001:322)

What then is the applicability of the knowledge-based view of the firm? Is the term “a knowledge creating company” only applicable to so-called “high-tech” companies, or in sectors where the scientific content of innovation is increasing or large? Brown & Duguid (1998) argue that models portraying the competitiveness of firms, as knowledge-dependent, are applicable relatively independent of sector: “all firms are in essence knowledge organizations. Their ability to outperform the marketplace rests on the continuous generation and synthesis of collective, organizational knowledge” (Brown & Duguid 1998:91). The central question here concerns what firms should do to generate valuable knowledge. What does theory prescribe that organisations should do in order to create knowledge? The four dimensions of the question of what factors must be present in firms, and in collaborations, for significant learning to be

¹⁴ I believe that all theories used in this thesis can be included in the category of “knowledge-based view of the firm”.
is investigated in this succession: organisational type, interaction form, strategy and NSI-connection. In the following section, I will show that the type of knowledge the firm depends upon varies across organisations.

3.1: What type of organisation is best suited learning?

This section is about different organisational types and their suitability for learning and innovation. The theorists used in this discussion are Lam and Nonaka.

3.1.1. Lam: Professional bureaucracy, Machine bureaucracy, Operating Adhocracy and J-form organisation.

In this section, I will discuss different organisational types, presenting a framework developed by Lam. The perspective developed by Lam in 1998 is based on various theoretical insights, ranging from to Mintzberg to Nonaka. Lams’ ambition is to combine and synthesize these theories into one framework in order to analyse the knowledge activities within different firms. Her framework is intended to explain how knowledge, societal institutions and organisational forms interact to shape learning and innovation (Lam1999: 3). I interpret Lams’ typology as a Weberian ideal typology or an archetype. This implies that there is nothing normative about this model; it merely brings forward some characteristics of organisational forms and its accompanying types of knowledge.

Two dimensions lay the ground in Lam’s framework; knowledge as tacit/explicit (the epistemological dimension), and the individual /the collective as “knowledge sites” or knowledge agents (the ontological dimension). Combining these two dimension result

---

15 The problem formulation on page 3 chapter one.
in a four-fold typology of organisational forms: “Professional Bureaucracy”, “Operating Adhocacry”, “Machine bureaucracy” and “J-form organisation”\textsuperscript{16}.

In a “Professional Bureaucracy” the most important knowledge form is explicit and individual. This type of organisation “derives its capability from embrained knowledge of trained experts” (Lam 1998a: 13). Embrained knowledge is formal, abstract knowledge that is acquired individually through formal studies, a general and transferable knowledge acquired by the process of “learning by studying”. The individual is given autonomy, but the structure remains bureaucratic. In a PB, general principles and well-defined knowledge are used in problem solving, thus restricting use of tacit knowledge. In PB-organisations, the transfer of knowledge is weak because of strict status boundaries. PBs are also likely to host an elitist corporate culture based on “professionalism”, that could impede innovation.

Lam’s second organisational form is called “Machine Bureaucracy”, and this organisation is most dependent on encoded knowledge (explicit and collective knowledge). This type of organisation is constantly working to reduce the tacitness of the knowledge base, engaging in continuous codification/externalisation. Codified knowledge in procedures and written rules reduces the organisational dependence upon its individuals. The hierarchy itself, the structures and the procedures are the knowledge agent. Specialisation, standardisation and control enhance its efficiency, and routine tasks require minimal formal knowledge from the individual. The MB type of organisations accumulates knowledge slowly, and is not equipped to tackle fast changes. I believe that the relevance of Argyris & Schons’ distinction between theory about use and theory in use to be greatest in this type of organisation. The organisation simplifies the tasks to a large extent in job descriptions and manuals, and

\textsuperscript{16} The abbreviations PB, MB, OA and J-form are used throughout the thesis.
thus its “theory about use” is diverging from the actual practices of the organisation (theory in use)\(^{17}\). This discrepancy is unhealthy for information and knowledge transfer, making the gap between top management and frontline workers more visible.

In both PBs and MBs knowledge is highly standardised. In the next two categories, knowledge is much less standardised, and thus harder to transfer.

Drawing mainly upon tacit and individual knowledge, the third organisational category “Operating Adhocracy” “draws its capability from the diverse know-how competencies and practical problem solving skills embodied in the individual experts” (Lam 1998a: 15). OA relies on tacit, individual, embodied, context-specific knowledge, and the main knowledge agent is the individual within a project group. In this organisation type, tacit knowledge is generated, but not accumulated because of the context-specificity of the knowledge.

Lam’s fourth category is called the “J-form organisation”, and is modelled after Japanese organisations. An J-form organisation is “an organisation which derives its capability from knowledge that is ‘embedded’ in its operating routines, team relationships and shared culture” (Lam 1998a: 15). The most prevalent knowledge form in a “J-form organisation” is tacit, collective knowledge embedded in a social community, inherent in organisational routines and shared norms. Knowledge is specific to the relationship and distributed across the community, through cross functional groups, facilitating broad based learning, centred on the firm.

Responsibility for product planning lies in the hands of the product development groups, a multi-functional project team comprising members of diverse backgrounds. The J-form organisation combines a hierarchical leader structure with ad-hoc teams, glued together by a strong corporate culture. In a J-form organisation, the hierarchy

\(^{17}\) The difference between theory about use and theory in use stems from the works of Argyris, see for instance Argyris & Schon (1996).
integrates more than it controls the individuals. Using various ad hoc teams implies a large degree of job rotation, facilitating broad learning. The J-form organisation generates and accumulates tacit knowledge through continuous “learning by doing” and thus learning inside a J-form organisation is potentially conservative, and the organisation is best suited for incremental innovation.

The connection between these organisational types and learning is expanded upon in Lam 1999. The key to differential learning potential according to Lam is tacit knowledge: “The key factor that differentiates their learning capability is their ability to create organisational relationships for harnessing tacit knowledge” (Lam 1999:29).

The PB and MB are regarded as the least learning supportive organisational types. PBs is rooted in an open labour market based on high levels of specialisation. The PBs is geared towards generation of explicit knowledge, and is characterised by “narrow learning, inhibits innovation” (Lam 1999: 26, figure 4). MB presupposes a bureaucratic model that seeks to eliminate and control tacit knowledge, and is rooted in an internal labour market. The learning here is superficial, and the innovation limited.

The OA is perhaps the “most appropriate structure for firms engaging in an innovative, dynamic and unpredictable environment”(Lam 1999:27), and the most “knowledge intensive, focusing on the strategic advantage of continuous change, adaptation and entrepreneurship” (Lam 1999:29). This requires, however, that a localised inter- firm career network, a la Silicon Valley, support it. Otherwise, the OA would meet pressures to bureaucratise, and the individuals would loose their incentives for tacit knowledge accumulation. In the OA, individuals enjoy the greatest degree of autonomy. The organisation encourages entrepreneurial behaviour and
experimentation, thus having potential for achieving radical innovations (Lam 1999:29).

Both the OA and the J-form organisation are "non-hierarchical organisations based on decentralised problem solving and multi-disciplinary team working" (Lam 1999:29).

As mentioned above, the J-form organisations is in accordance with incremental learning and smaller, continuous change. It requires a stable internal labour market and a broad based educational system. Because of the internal labour market, learning in a J-form organisation is conservative, which inhibits radical innovation. The J-form organisation is distributing knowledge widely, and depends on the collective competence of its members. Tacit knowledge is accumulated and core competences are cultivated within a J-form organisation.

Lam does not seem to prescribe accurately what firms should do to create knowledge. The next theory provides an answer to the how- question by a model of knowledge creation called SECI. It is more micro- oriented, drawing on organisational theory, psychology and sociology. Moreover, it attempts to synthesize western and Japanese insights on organisational learning. The epistemological and ontological dimensions evident in the works of Lam are also at the core of Nonaka’s theory of knowledge creation. The focus of Nonaka is both on how knowledge is created (SECI) and a theory of what kind of organisation that would provide the better breeding grounds for knowledge creation (Hypertext).
3.1.2. Nonaka: SECI

Nonaka and colleagues argue that it is the activities within the continuum between tacit and explicit that create knowledge. Knowledge creation can be defined as “a continuous, self-transcending process by means of which one transcends the boundary of the old self into a new self by acquiring a new context, a new view of the world and new knowledge. In short, it is a journey ‘from being to becoming’ “ (Nonaka & Teece 2001:16). They have developed a model of a knowledge spiral that moves upwards from the micro to the macro level. It starts with shared tacit knowledge, through making tacit knowledge explicit, through combining explicit knowledge, and the final stage of one spiral sequence is a process where explicit knowledge is internalised within individuals (again made tacit). One sequence of spiralling follows the other, moving constantly upwards from the individual to the organisational level.

Four different learning types are involved in the spiral, and these must be combined in an organisation for it to reach its knowledge potential. These are externalisation, internalisation, socialisation and combination (Nonaka 1994:19). These four modes must be organisationally managed to form a continual cycle. Nonakas’ spiral model of knowledge accumulation starts with socialisation, followed by externalisation, combination and internalisation18. “Socialization” is the process of creating tacit knowledge through shared experiences. One common tool for socialisation is the master-apprentice model used i.e. in “on-the –job-training”. “Externalisation” is the process of converting tacit knowledge into explicit knowledge. These codifications typically result in concept creation. This conversion is the most powerful one, enabling transfer of knowledge across organisations. “Combination” is the process of combining and reconfiguring existing explicit knowledge through social processes.

18 The abbreviation SECI is used throughout the thesis.
Organisational databases and communication networks are examples of facilitating tools for this mode of knowledge conversion. “Internalisation” is the type that resembles common-sense notions of learning, which is the process where one converts (somebody else’s) explicit knowledge into (one’s own) tacit knowledge. Typically, explicit knowledge is shared/distributed throughout the organisation and then converted into tacit knowledge by the individuals. Such shared mental models become a valuable asset to the organisation.

This pattern also fits into how knowledge is created through the innovation process. Nonaka’s answer to the question of how to coordinate the knowledge of individuals and embed this knowledge in a new product is that socialisation, externalisation, combination and internalisation must occur in order to successfully create innovations. One can imagine the starting point being a certain community that is committed to developing a particular technology. This community shares its knowledge tacitly, through active membership. Next it starts to conceptualise and put words and numbers to its insights, thus codifying the once tacit knowledge. Then it can combine information from both within and outside the community in order to for instance create a product. The explicit and combined knowledge will be internalised, thus once again made tacit and embodied to individuals. The community, i.e. an innovation project team, might break up and the cycle can begin; now involving different individuals at different places.

One potential reason why organisations fail to use the experience from one project to another is that they don’t take the time to internalise the experience of the innovation process after the product has been launched, and don’t take the time to immediately start the socialisation process, in which tacit insights from prior projects are shared within the community.
One major shortcoming of the SECI theory is that it does not specify how the spiral is gradually involving more people, moving upwards on the ontological dimension. It seems likely that the spiral cannot grow endlessly. Is it possible that there is a threshold over which the spiral starts to subtract?

The question of how the knowledge spiral should be managed is resolved by the theory of the hypertext organisation as an ideal setting for all four knowledge conversion modes.

3.1.3: Nonaka: The hypertext organisation

Nonaka argues that the hypertext organisational design facilitates the cyclical knowledge conversion (SECI). The hypertext organisation is both a formal hierarchical structure (business system) and a self-organizing structure (task force or project team). This hybrid organisational form is called hypertext organisation, because, just as in using hypertext, individuals interact with different layers, and switch between different parts of the whole. As surfers of the Internet can switch between different layers, the surfers of the hypertext organisation can readily switch between different contexts; the business system, the project team and the knowledge base.

The middle layer of the hypertext organisation is the hierarchical business system, built for efficient routine work. The project-team layer is at the top, consisting of various teams, in which members come from different business system units. The hierarchical nature of the business system makes the knowledge conversion forms internalisation and combination most prevalent. Complementing these conversion forms are the project teams that generate externalisation and socialisation.
Organisational knowledge generated in these two layers is recategorised and recontextualised (Nonaka & Takeuchi 1995:167) in the bottom – layer called the “knowledge- base layer. This layer is of course not a concrete entity, or organisational unit, but is embedded in the technology, culture and vision of the company.

Nonaka’s notion of the hypertext organisation is similar to what Tidd et. al call “project execution teams”, “a full-time project team where functional staff leave their areas to work on the project, under project leader direction” (Tidd, Bessant & Pavitt 1997:257)

I regard the theoretical construct of the hypertext organisation to be an ideal typical learning organisation. Thus it is interesting to look more into what part of the knowledge spiral other organisational types than the hypertext organisation is adept at. I believe it is interesting to combine the insights of Nonaka and Lam to look at what organisational types are more likely to generate what sort of knowledge.
Combining SECI and LAMs typology

Combining the theoretical contributions of Nonaka and Lam would imply that externalisation/codification is a precondition for MBs and the most common knowledge conversion form in this type of organisation. In MBs, much of the interaction is through documents and orders, thus reducing uncertainty in a movement towards routine tasks, thus, optimising efficiency. In PBs, combination of explicit knowledge is the dominant knowledge conversion, and a common type of interaction revolves around research articles and other forms of documentation. In a J-form organisation, the most common form of interaction is often close physical interaction over a problem that must be solved, in projects, and thus socialisation is the more common knowledge conversion form in this type of organisation. In OAs interaction take place in distinct projects that relay more on individual competence than common/shared competence, making internalisation a precondition.¹⁹

Table 2: Combining Lam and Nonaka

<table>
<thead>
<tr>
<th></th>
<th>Tacit knowledge</th>
<th>Explicit knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>OA - internalisation</td>
<td>PB - combination</td>
</tr>
<tr>
<td>Organisational</td>
<td>J-form - socialisation</td>
<td>MB - externalisation</td>
</tr>
</tbody>
</table>

¹⁹ Potential problems concerning this combination of theories are picked up in more depth in chapter four page 64, where the sample are categorised according to this four-fold typology.
3.1.5: Criticism of SECI
Recently, theorists have started to criticize the well-renowned framework developed by Nonaka and colleagues. The criticism focuses on how the theory fails to answer one very fundamental question: What is the force that drives the knowledge spiral? How does the spiral get started? Scharmer, in Nonaka & Teece 2001, develops the concept of self-transcending knowledge as a reply. "Self-transcending knowledge" is "tacit knowledge prior to the embodiment in day-to-day practices" (Scharmer, in Nonaka & Teece 2001:70). Applied to/on the innovation process, the focus should be on how a vision is crystallised and materialised. Having a concrete idea about how to materialise various knowledge bases is the actual starting point for the entire innovation process. Scharmers’ answer to what drives the knowledge spiral is true motivation, shared will and communities of commitment. In order for knowledge creation to occur within one organisation, employees must move from “thou shalt” to “I will”; the origin of action must be internally based. The aspect of autonomy that is brought forward here is generally agreed upon in the literature of the knowledge-based view of the firm, and is intimately linked to the discussion on flat structures over hierarchies. The common argument is that decision-making must take place where the relevant knowledge is located, because some knowledge is tacit. Following this rule of thumb will ensure the quality of decisions (Grant 2001, in Nonaka & Teece 2001:156).
3.1.6: Answer: Operating Adhocacry and Hypertext organisation
The theoretical answer to the question of what kind of organisation is best suited for learning is for Lam the Operating Adhocacry and for Nonaka the hypertext organisation. One major difference between the OA and the hypertext organisation is that while the OA is most dependent upon the tacit, embodied knowledge of the employees, the entire knowledge spiral is organisationally managed in the hypertext organisation. Another difference is that the OA work mostly on projects, while in the hypertext organisation, the project teams co-exist with a hierarchical structure.

Above, we saw that the SECI knowledge spiral had to be organisationally managed to become continuous. The following section focuses on which interaction forms that encourage knowledge creation. The theories that are reviewed here have a high opinion of close social interaction, and practical co-operation. I believe this focus agrees mostly with the socialisation mode of the SECI knowledge spiral.
3.2: What type of interaction form is better for knowledge creation and transfer?

The second research question concerns which interaction forms firms should encourage in order to enhance learning within their organisation. Main theorists in this section are Wenger and Brown & Duguid, who view observation and practical co-operation as interaction forms for knowledge transfer.

3.2.1: Practical co-operation and dispositional knowledge

Senge is one of the pioneers advocating “the learning organisation”. In his famous 1990 book he reviews common obstacles for organisational learning. Learning by trial-and error, he argues, is the most important and common/usual form of learning, but not suited for innovation. Strategic business choices, choices concerning research and investments, are of such a type that the actor who chooses the action will not immediately experience the consequences, and therefore will not learn. In situations where the consequences are not evident and visible in the near future, the failure to learn is great.

At the contrary, Brown and Duguid argue, the type of knowledge most relevant for an organisation is “Know-how”, or dispositional knowledge, the ability to utilize “know-what” in various situations. Nonakas’ framework also place great importance on on-the-job training resulting in dispositional, tacit knowledge. Brown and Duguid (in Nonaka & Teece 2001:50) argue that dispositional knowledge, the technical component of tacit knowledge, do not often lie within individuals but are distributed among an ensemble of people working together. Dispositional knowledge entail an ability to respond to actual situations and get things done rather than only talk about them in the abstract” (Nonaka & Teece 2001:50), and this ability is distributed in a

---

20 Senge 1990 is the English version, while I refer to the Norwegian translation of 1999.
social group through social practice. Brown and Duguids’ primary example is the 1996 study of Xerox repairmen by Orr. This study indicated that the reps daily activities differ from their job descriptions. Their dispositional knowledge was distributed, collective, partial and improvisational, and this was not reflected in the job manuals. The argument is that dispositional knowledge is socially embedded in daily practices, and the accumulation of dispositional knowledge thrives best in “communities of practice”.

3.2.2: What is a "Community of Practice"?

Etienne Wenger introduced the concept of Communities of practice. “Communities of practice” can be defined as “groups of people informally bound together by shared expertise and passion for a joint enterprise (...) share their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems” (Wenger & Snyder 2000: pp 139-140). A COP is a group of people who work together and shares knowledge, with a large potential for knowledge creation.

The theory of COP can be viewed in at least two different ways. One is to regard it as a general sociological theory about how work communities emerge wherever people come together to perform specific tasks. In this view, COP exist in all companies, although they are seldom acknowledged as important learning sites/societies by the management and are thus often neglected or repressed by the organisation. Another interpretation is to define COP more narrowly, as institutionalised COP that is actively supported by the organisation. The former view opens up for conflicts between COP and the organisation, whereas their interests have merged in the latter interpretation of the theory.

---

21 The abbreviation COP is used throughout the thesis.
COP emerges spontaneously as members select themselves, and thus the boundaries are flexible\textsuperscript{22}. COP emerge as shared practice over time enables individuals to develop a common outlook on their work, and they will eventually share judgments about what to do, when to do it and what constitutes a job well done (Nonaka & Teece 2001:52)\textsuperscript{23}

They are based on personal transfer of knowledge, where groups of “apprentices” learning together are more efficient than master-apprentice one-way transfer. Their primary output is knowledge, which they share in creative ways, for instance by passing on work experience as stories. They have a strong commitment to a common goal and continuously assess their own behaviour, and this evaluation is more successful than top-down initiated evaluation. Within COP, learning is viewed as inseparable from practice/work, and individual learning is viewed as inseparable from collective learning: “learners are acquiring not explicit, formal “expert knowledge”, but the embodied ability to behave as community members” (Brown and Duguid 1991:48)\textsuperscript{24}. Workplace learning entails building “communities”, negotiating tacit frames for interpretation. People (and organisations) who want to learn something must have contact with those who do what they want to learn: co presence makes learning possible and absence excludes learning.

Peripherally participating in a COP is the best position for learning. It is argued that being on the periphery of competent practitioners doing their “business as usual” is a

\textsuperscript{22} The size of COP varies considerably, from 10 to 400 people. One criticism can be raised, based on empirical insights in social psychology that indicate that large groups over 20-30 people will tend to develop diverging interests. It seems unlikely that communities are so large.

\textsuperscript{23} This aspect of COP resembles Nonakas’ theory about the cognitive and operational aspects of tacit knowledge (believes, perceptions)- does this imply that COP only support tacit knowledge? The aspects of codification and internalisation are not mentioned at all.

\textsuperscript{24} Questions that can be raised against the COP-theory are: do COP only convert tacit into tacit knowledge, that is, does it only create socialisation?
good opportunity for picking up invaluable know-how, manner and technique in addition to information.

Brown and Duguid (1998) claim groups from different firms having something in common (for instance overlapping competences) are more suitable for knowledge transfer than heterogeneous groups within one firm. Informal relations, built on established social links may be more effective for knowledge transfer than formal links (Brown & Duguid 1998:102).

3.2.3: Criticism of COP

Nonaka criticizes theories that see COP as the ultimate learning environments. Nonaka argue that COP are constrained by history, and thus cannot learn easily and fast. Because COP is important for identity, it is constrained by history, and consistency and continuity is important. Membership in COP are fairly stable, becoming a full participant takes time, and results in a feeling of belonging for the participants. The only change that occurs within COP is when newcomers are socialised into the community, and learn to be full participants (Nonaka & Teece 2001:24). Nonakas writings implies that he regards his theory to encompass several more knowledge forms than the theory of COP. COP’ relevance is reduced to apply to socialisation, as the learning that occurs in COP are limited to how new members learn what is currently going on within their community, mainly a process of socialization.

It remains unclear how managers can exploit the learning potential of the COP of their organisation. What are the criteria that can help researchers and managers identify a COP? What strategies should managers implement to nurture existing COP and how
should they go about in order to institutionalise them? These questions remain unanswered by the COP theory.

During the discussion of the concept of knowledge in chapter one, it was argued that knowledge is social and collective. Some sort of interaction is a prerequisite for knowledge creation. The next theory looks into what type of interaction forms that ought to be used in collaborations in order to increase the potential for learning.

3.2.4: Two different organisations finding common ground: the concept of grounding

The concept of grounding originates from the disciplines of cognitive psychology and educational science, and is usually used in a context concerning direct learning, situations with educational purposes. However, I will argue that the concept is also to some extent applicable to situations where two business partners are collaborating for innovative purposes. Interaction between multiple participants requires some degree of mutual understanding, and the process by which this is accomplished, is termed “grounding”. Mutual understanding, knowledge, beliefs, assumptions, presuppositions are necessary for communication and collaboration, and are dependent upon continuous efforts, “grounding work” such as feedbacks acknowledging that one is listening and comprehending. Or, if one actor realises her/his assumptions are unwarranted, s/he will attempt to repair and re-establish common ground (Dillenbourg 1999:34).

The assumption is that different interaction forms not only bring different constraints to learning directly, but also indirectly, by restraining the grounding process.

25 Following the perspective of Innovation systems, these situations call for “indirect learning” (Gregersen lecture, ESST 20.11.2000).
Different interaction forms give different opportunities for grounding. For instance, face-to-face interaction is very different from videoconferencing when it comes to the ability to see the same things (co-presence), receive messages at the same time it is sent (co-temporality) and whether both parties can send messages simultaneously, or have to take turns. Hence, face-to-face interaction requires less grounding efforts from the participants than videoconferencing (Dillenbourg 1999). Taking this argument further would imply to view the cases that included frequent face-to-face interaction as better environments for transfer of knowledge than the cases where interaction was restricted to exchanging e-mails. This assumption will be picked up in chapter four, where the empirical findings are presented.

3.2.5: Answer: close social interaction over time
The theory of COP and grounding presented above focus on close social interaction forms, shared practice over time, and the learning inherent in the activities of ordinary working life. Because of the context-specifics of valuable knowledge, interaction forms that enable physical co-presence are preferred over e-mails and teleconferences.

Choosing how to transfer knowledge inside own firm can be strategic decision. Who makes the decisions on how knowledge should be created and transferred is important, as well as what the strategy implies. The next section will focus on the third research question.
3.3: What strategies ought firms use to ensure knowledge transfer?

In chapter one page four, the third research question concerned what strategies firms use in order to ensure knowledge transfer. Below I review theoretical insights on what firms ought to do to ensure knowledge transfer inside own firm. Then I proceed to discuss collaborating as a strategy for creating and transferring knowledge. The literature does not point to any simple solutions, and different theories provide different solutions. The main question is to what extent it is possible for organisations to learn by design.

3.3.1: Top-down, bottom-up and middle-up-down management of learning

Tidd et al (1997) argue that strategic, top-down processes are necessary for the management of the innovation process. It is absolutely vital for every organisation to be able to plan how and when to learn and innovate within the present learning economy. As the title “Managing Innovation” suggests, Tidd et al argue how innovation can be managed. However, one shortcoming of this book is that it does not specify explicitly who should manage what during the innovation process. This does not imply that only top-management responsibility for learning and innovation is considered. On the contrary, they argue that organisations characterised by top-down communication with little integration between functions are incompatible with requirements for successful innovation (Tidd et al 1997:309).

Arguing for the importance of a bottom-up approach, Brown and Duguid (1991) focus on actual, everyday working groups as learning and innovating “communities of practice”. They warn about how top-down initiated processes can force learning, for

---

26 What strategies firms typically employ for knowledge creation and transfer are expanded upon in chapter four, where findings from the 15 case studies are presented.
instance assigned task forces may destroy the “naturally “ emerged communities of practice, and thereby prove to be a strategy with unintentional outcomes/effects. Disrupting existing COPs implies disruption of potentially innovating and learning groups that through their daily activities uphold the organisation (Brown and Duguid 1991:53). The traditional gap between leaders and COPs is negative for learning and innovating, and the gap may be bridged as leaders recognise the many COPs the organisation consists of. In this perspective, top management responsibility must change from handing out specific and detailed orders to preparing the conditions for bottom-up initiated knowledge creation. They may do this for instance by relying on “organisational translators”. This is people with extensive experience from different communities, peripherally embedded in both, that may act as a mediator between the communities, as “organizational translators are individuals who can frame the interests of one community in terms of another community’s perspective” (Brown and Duguid 1998:103).

3.3.2: Synthesis; middle-up-down management for knowledge creation
Nonaka & Takeuchi 1995 reviews limitations of the top-down and bottom up management models for knowledge creation. Organisations with a top down management strategy are often hierarchies depending on top management communicating through orders, and storing knowledge in databases. Only two of the four knowledge conversion modes are put into action, namely internalisation and combination and thus organisations with top-down strategies deals primarily with explicit knowledge.

At the other extreme of the continuum is bottom up strategies for knowledge creation. Here, the main knowledge agent is an entrepreneurial-minded individual, who use the
knowledge conversion modes socialization and externalisation in order to create tacit knowledge. Project teams are common in organisations dominated by a bottom-up strategy, where great autonomy is given to each individual. However, these projects may be too time consuming because of difficulties in coordinating many autonomous individuals.

Nonakas’ attempt for synthesis is called middle-up-down strategies for knowledge creation. In this model, the main knowledge agents are the teams, and their project leaders/middle managers. Both tacit and explicit knowledge is created through management of the continuous knowledge conversion cycle of SECI (socialization, externalisation, combination and internalisation). A hypertext organisation, communicating through dialogues and the use of analogy, that stores knowledge in organisational knowledge bases exemplify the middle-up-down management process for knowledge creation. In the hypertext organisation, with middle-up-down management, all employees are involved in knowledge creation with the following labour of division; front line workers as knowledge practitioners, middle managers as knowledge engineers and top managers as knowledge officers (Nonaka & Takeuchi 1995:151). The knowledge officers set broad guidelines, which is interpreted and conceptualised by knowledge engineers. The middle managers/knowledge engineers set up multidisciplinary task forces where broad competences are represented. The task forces openly brainstorm and debate, and allow room for conflicts and seek creative solutions. Middle managers inhabit the more important role among the three groups as they start and engineer the knowledge spiral of SECI at both the epistemological and ontological dimension. It is the main responsibility of middle
managers to reduce the discrepancy between theory in and about use, translating vision into practice.  

3.3.3: Nonakian strategies for knowledge creation

According to Nonaka, knowledge develops relationally, that is, the knowledge spiral continues because of the “contacting surface” between people. For the SECI spiral to move upwards at the ontological dimension, individuals must share and transfer their knowledge to a group or the organisation. Each person must place efforts into articulating their own thinking, and take part in other peoples’ tacit knowledge. This can be done by imitation, dialogue, brainstorming sessions, setting goals, conceptualisation or gathering information from different contexts. Nonaka encourages organisations to use task forces consisting of people with varied educational backgrounds, and strategic rotation of personnel (Nonaka & Takeuchi 1995:81).

3.3.4: Strategies from the theory of “communities of practice”

The theory of COP emphasizes the importance of sharing work experience through stories as the main strategy for knowledge creation at the group level (Wenger & Snyder 2000:145). This is exemplified by nurses sharing their bedside manners in chance hallway meetings, and by Xerox repairmen sharing details about sophisticated machines.

---

27 The distinction of theory in use and theory about use was discussed under the heading of Machine Bureaucracy, earlier this chapter, page 24.
3.3.5: Limitations of theory: What about hierarchies and learning?

The learning organisation is in accordance with a decentralised control structure. Mandate to everyone to independently reach own decisions, and to take responsibility for these decisions, is a precondition for true “learning organisations”. Both Nonaka’s, Lam’s and Senge’s portrayals of the hierarchical organisation leave little hope for this organisational structure to create and transfer knowledge. Tidd et al. 1997 refer to studies which show how traditional hierarchical structures are weakest correlated with success in innovation (Tidd et al 1997: 257). Are there no available options for these organisations to develop learning capabilities? Hierarchical organisations, however, do exist and prosper. How is that possible in the “learning economy”? There also seem to exist many organisations with a hybrid structure, with quasi integration rather than pure vertical integration or networks based types of organisations. The dichotomised view on organisational structure and learning has too few nuances, and is not very helpful. I believe the debate about hierarchies and flat organisations are not the real issue at stake here. There is no single best kind of organisation. What is important is the aspect of fit, or how to get the most appropriate structural form for each firm given particular circumstances. The contingency model argues that the most successful organisations are those who develop the most suitable fit between structure and operating contingencies (Tidd et al 1997:312). It seems unlikely that these organisations with a strict hierarchical structure do not change and learn, although they might learn and change in a different manner, and perhaps more slowly and seldom.
3.3.6: General search procedures
Teece et. al (1997) point out that organisational learning requires active search procedures in the environment surrounding the firm, and how these search procedures should be an organisational routine for all firms who aspire to become learning organisations. The search for relevant knowledge on an everyday basis can take place for instance in branch exhibitions, publications or publicly available databases. Firms also search for knowledge in their collaborations with other firms, and this is the focus of the next section.

3.3.7: Collaborating as a strategy for knowledge creation and transfer
Teece, Pisano & Schuen (1997) argue that collaborations may be helpful both for learning and transformation and thereby be beneficial for firm competitiveness: “Extensive outside contact can help firms recognize dysfunctional routines and prevent blind spots” (Teece et al1997: 520). Similarly, Dodgson (1993) argues that collaboration in combination with in-house efforts can speed up the learning process in firms. He also believes collaborations provide possibilities of learning about new technologies, and also learning about methods of creating future technologies (Dodgson 1993:161).

The importance of each collaborating partners intention to learn, the transparency of the partners and their ability to learn for learning to occur during collaborations are emphasized (Tidd et al 1997:232). These factors are considered to influence whether a firm is learning from partnerships or not, and are supposed to influence learning relatively independent of the actual partnership (Svalheim & Evjen 1994: 37, drawing on Hamel, 1991). Intent refers to the extent to which each partner views the collaboration as an opportunity to learn new skills. Transparency refers to the openness of each partner, or how easy it is to get to know the partner. Receptivity
refers to a partner’s capacity to learn (Tidd et al 1997:pp 231-232). Receptivity is the ability to recognise the value of new, external information, assimilate it and apply it to commercial ends (Svalheim & Evjen 1994: 26).

3.3.8: The age of the relationships; new networks new learning and old systems deeper learning?

Findings in a STEP study on innovation collaboration suggests that firms sustain old relationships rather than build new ones: "The growing complexity of the knowledge base and the more rapid rate of change seems to make it attractive for most of the product-innovating firms to establish selective relationships which are medium-to long term" (Ørstavik & Nås 1998:15)

The grounding concept introduced above implies that older relationships are better for knowledge transfer than newly established ones. Håkansson, Havila & Pedersen (1999) points out how age of the relations between firms may influence learning in two respects. Newly established relations implies the possibility of gaining new and different knowledge, while older relations is a necessary condition for deeper learning (Håkansson et al 1999:444). Lasting relations provide the opportunity to transmit subtle and complex messages within the framework of a relation.

A common argument for the positive learning environment of long-term relationships is that trust and confidentiality is crucial for all interaction, and the uncertainty of the innovation process will probably enhance this effect. Building efficient networks/systems takes time and resources, and the functionality of the network is facilitated by shared culture and mutual trust28 (Ørstavik & Nås 1998:10). However, well-established relationships can have major drawbacks. Dodgson argues that

28 Different kinds of trust will be picked up in more depth, together with empirical examples of how it can be built, in chapter four, page 72.
established networks have a tendency towards isomorphism, that is, they tend to copy each other’s behaviour (Dodgson 1996:67). This indicates that within old networks, in which actors has been sharing knowledge for a long time, the actors will begin to resemble each other to such an extent that novelty and innovation becomes an unlikely possibility. The changes that are more likely to occur within these well-established networks are incremental improvements on existing products and processes. Another negative aspect with old relationships is that dysfunctionalities emerge over time, and may therefore not be discovered, or regarded as problem. Generally, people, and the organisations they represent, are good at detecting sudden threats, but sometimes cannot see small problems accumulating into bigger ones over time. A comparison is often made in this regard, to organisations as frogs, in the respect that frogs refuse to jump into boiling water, but if they are already in the water, they will not jump out although the temperature increases, leading them to die because of this refusal to act (Senge 1999). The boiling water may be used as a metaphor for dysfunctional relationships, obsolete knowledge or technological trajectories.

3.3.8: Dyads or networks

Håkansson et al 1999’s main finding of everyday learning in a Swedish construction project is that networking is the most important variable influencing supplier learning. Dyadic relationships between buyer and supplier give inferior learning conditions for each supplier, than networks consisting of several actors, Håkansson argues. The assumption is that extensive networks, consisting of many nodes and connections, provide better environments for learning than alone standing relationships between
two actors. This is because a large number of interfaces are viewed as providing a
general variety (in perspectives etc) that is proven useful for learning.

The argument that a variety of interfaces between different actors are important for
the learning potential of each firm, is also at the core of the more macro oriented
theory of innovation and learning, namely the theories of National systems of
innovation.

3.3.9: Summing up strategies
This section focused on how bottom-up, or preferably “middle-up-down” strategies
should dominate over top-down initiated strategies. The responsibility for knowledge
creation must be shared between the individual worker and the organisation at large.
Individuals are encouraged to share their experience with others, articulating own
knowledge through work stories. At the organisational level, search for relevant
information should be an integrated part of the organisational routines.
Collaboration is regarded as a good strategy for knowledge creation, especially if the
firm has intention to learn and the ability to learn (receptivity).
3.4: What kind of learning environment is the Norwegian National Innovation System?

The NIS\textsuperscript{29} approach is a useful analytical tool that helps social scientists, policy makers, engineers and technicians to focus on the institutional and organisational framework within which firms operate, and how a common context may foster learning and innovation. The hypothesis is that the institutional set-up and the economic structure (specialisations of sectors within a country) affect the interactive learning process in a profound way. Following the interactive perspectives on innovation and learning, Lundvall (1992) focuses on every day, routine activity in working life, in the production, distribution and consumption spheres, as important sites/settings for learning. NSI recognizes the importance of “searching and exploring” organisations such as universities, R&D\textsuperscript{30} departments and technology institutes as the core of the innovation systems, but their actual focus lies on everyday business activities and policy makers, perhaps to a greater extent than research and development. NSI is thus in line with the interactive, systemic perspective on innovation. Lundvall (1992) argues the NSI can play a supporting role for learning in firms. Shared origins usually implies a minimum of shared norms, and these shared norms can help the organisations overcome what is termed the traditional barriers to learning; uncertainty involved in innovation and the tacitness of knowledge (Lundvall 1992: 3). The theoretical framework of NIS argues that nations provide shared historical background, shared culture and language, which ease the interaction between partners of the same nationality. Thus one would assume that using partners of the same nationality would be an advantage for knowledge transfer.

\textsuperscript{29} The abbreviations NIS and NSI is used interchangeably throughout the thesis, for National innovation systems and national systems of innovation. These terms are merely two different names for the same theoretical framework.

\textsuperscript{30} R&D is a common abbreviation for research and development.
3.4.1: Defining national systems of innovation

Lundvall defines systems of innovation as: "elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge" (Lundvall 1992: 2). The national aspect implies that these elements and relationships are located within or rooted inside a nation state. The nation provides shared historical background and culture, whereas the state provides a shared set of explicit rules, namely the laws. Metcalfe defines national systems of innovation as “a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies” (Hauknes 1999:4). The theory of NSI has two major strands, those of Lundvall and Nelson. The Nelson approach can be termed an organisational approach, since it focuses on the (mainly public) institutional infrastructures. I choose to follow the other strand, termed the cognitive approach. The central theorist in this strand is Lundvall, and this approach is broader, focusing both on social and institutional infrastructure and exchange relations (Hauknes 1999). While Lundvall focus on the interactivity of the system, and the social embeddedness of knowledge, Nelson is more concerned with analysing the institutional framework that makes up NSI, and the policies that can be made to support NSI. I will not aspire to describe the Norwegian national innovation system and the institutional set-up of the Norwegian economy/business system per se, but look at what enabling and constraining conditions are present in the business environments of the selected Oslo-based firms, and how well the firms of this study is exploiting the potential inherent in NSI knowledge infrastructure.
3.4.2: The Norwegian National System of Innovation in the European context

Conditions for innovation and learning in organisations vary across nation states. The national economy provides firms with resources through the educational and financial system. Furthermore, policies on taxation, income distribution and welfare acts as a encouraging or discouraging incentive for firms to invest in uncertain future outcomes of innovative investments (Hauknes 1999).

The societal structure and the business system are often distinct from country to country, and studies find that different regions in Europe have similar characteristics. The welfare states in Scandinavia could be viewed as one such set of societies, with specific operating conditions for firms. A characteristic of Scandinavian NSI is a highly developed technology service infrastructure that partially explains the high prevalence of networking within these countries (Lundvall 1992:126). The "interactivity" of the sample in the STEP “innovation collaboration survey” in 1998 was great; almost three out of four of the projects identified in the study had been undertaken with external partners (Ørstavik & Nås 1998: 12).

Core dimensions are necessary means to learn, incentives to learn\(^{31}\), individuals’ capability to learn\(^{32}\), access to relevant knowledge\(^{33}\) and “remember to forget” These theorists argue how one of the necessary conditions for learning is fulfilled within the Norwegian nation state (Lundvall 1992:302) Regarding necessary means to learn, Norway is well off because of the equality of the educational systems, which distribute learning abilities fairly equally. There is a good system for training skilled workers in addition to education in more abstract reasoning. Social security, retraining and labour market structures is a public responsibility in Norway, thus enabling

\(^{31}\) For instance salaries, income taxes, patent laws, firm level tax rules.
\(^{32}\) Individuals’ capability to learn” refers to diverse aspects such as flat organisations, personnel in circulation, interfaces available between firms and public organisations.
\(^{33}\) Access to public service organisations designed to bridge the gap between certain industries and universities, governmental policies for ICT-use.
individuals and organisations to “remember to forget”. Many interfaces for learning and an informal culture, combined with good access to knowledge infrastructure and a good social welfare system would indicate that the Norwegian NSI is relatively well off.

3.4.3: the supply side of national systems of innovation
The supply side of national systems of innovation may be divided into four categories:
1. Universities and research institutes
2. Science parks as innovative environments
3. Network actors
4. The private consultancy sector.

Universities and research institutes can act to support knowledge creation and innovation in national industry. Educational systems, universities and research labs are examples of NSI knowledge infrastructure. How well the knowledge infrastructure interacts with private firms, the quality of its organisations and its ability to change will influence the overall quality of the innovation system, and subsequently how easy knowledge is transferred between actors.

One central argument of National Systems of Innovation theory is that firms in contact with other (NSI-) actors have greater potential for learning and innovation than firms operating in isolation. One of the research questions that sheds light on what kind of potential for knowledge transfer there is within collaboration projects, is to what extent the 15 firms engage in contact with the knowledge infrastructure, or the supply side on the Norwegian national innovation system. This question will be debated in chapter four, pages 91-97. But first the institutions that are most commonly used as input partners in the innovation project are presented.
3.4.4: Science and technology infrastructure institutions in Norway

Norway has four universities, located in Tromsø, Trondheim, Bergen and Oslo. One important actor in the Norwegian NIS is the research institutions called the SINTEF group. “The SINTEF Group performs contract research and development work for industry and the public sector in technology, medicine and the natural and social sciences” (www.sintef.no) SINTEF is one of Europe’s largest independent research organisations, and works to promote the competitiveness of Norwegian industry. This research group has close collaborating links with the “Norwegian University of Science and Technology” (NTNU) in Trondheim, but also cooperates with University of Oslo. SINTEF is a partly state owned Norwegian technical institution, closely related to NTNU, a leading university in technical and natural sciences in Norway.

Network actors can be defined as organisations that generate and diffuse knowledge to national industries. The Research Council of Norway is regarded as important for innovation and learning for several of the firms involved in this study. The function of the Research Council of Norway is threefold; it is a government advisor on knowledge and research, a co-ordinator of innovation networks and a funding agency for research programmes and projects. It is this latter function that is brought forward as important for the firms in this study. One third of public sector research investments in Norway are channelled through the Research Council (www.forskningsradet.no) and this organisation is also granting doctorate programmes to firms who fulfil specific criteria.

The private consultancy sector is rapidly growing in the Oslo region, providing various business services such as change management and project management (Aslesen, Braadland, Smith & Ørstavik 1999:46). “DET NORSKE VERITAS” (DNV)

---

SINTEF is an abbreviation for the foundation for scientific and industrial research.
was established in 1864, and is an independent foundation whose objective is to secure life, values and the environment. DNV is the leading Norwegian certification organisation, and supplies service of certification to various products and production systems: “A certificate from The Norwegian Veritas documents that the firm has systems that enable production of goods and services of required quality” (www.dnv.no).

3.4.5: Answer: good access to knowledge infrastructure
In this section of the thesis I examined the Norwegian NSI as a general environment for firms, and presented some important Norwegian knowledge infrastructure actors. Overall, the conditions for learning and innovation seem to be quite good for Norwegian firms, and especially for firms in the Oslo-region, with good access to many knowledge infrastructure actors. Their importance in the innovation projects that form the empirical core of this thesis is discussed in section 4.4.

3.5: Theoretically based conclusions
Drawing together the main arguments of the above theoretical discussion, one can find a certain pattern of firm characteristics that are supposed to be correlated with learning and innovating organisations. Following these theoretical perspectives, one would expect organisations that learn and innovate to have the following characteristics:

1) Is an Operating Adhocacry organisation, preferably with hypertext structure, spurring the SECI spiral.

2) Encouraging lots of social interaction, joint practical problem solving.

3) Outgoing and proactive strategy, with intention to learn from surroundings.

4) Have extensive contact with NSI knowledge infrastructure actors.
Chapter 4: Empirical analysis

In chapter 1, page 3, the overarching question for this thesis was raised: what factors must be present in firms, and in innovation collaborations, for significant learning to be generated? In this chapter, this question is confronted from the four different angles of the research questions, from which I have chosen to view the empirical material. The analytical framework outlined and assessed in the previous chapter is now confronted with the empirical findings. The findings represent the most important trends from the 15 innovation stories. Due to limited resources and a strict time schedule, the richness of the material is far from exhausted.

4.0: Presenting the cases

Table 3: Presenting the firms and their product innovations

<table>
<thead>
<tr>
<th>Firms and sectors</th>
<th>Product innovations</th>
<th>Size of project(^{35})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm nr 3(^{36}), 13 in food and drink industry</td>
<td>New design on snacks, new packaging of drinks</td>
<td>5 of 10, 20 of 30</td>
</tr>
<tr>
<td>Firm nr 12, 15 in data and telecommunication industry</td>
<td>New TV-signal decoder, New technological platform for data storage on tape</td>
<td>15 of 25, 70 of 120</td>
</tr>
<tr>
<td>Firm nr 5, 9, 14 in publishing/media industry</td>
<td>New layout of magazine, Internet publishing, Internet publishing</td>
<td>21/21, No answer, 5 of 10</td>
</tr>
</tbody>
</table>

\(^{35}\) Own employees engaged in the project, and the total number of people involved.

\(^{36}\) The numbering of firms merely represents the succession in which the interviews were made. See brief firm presentation in the appendix.
| Firm nr 1 in electric industry | Splash proof electrical switches | 6 of 20 |
| Firm nr 7, 10 in engineering | A new process for cleansing gasses in aluminium plants, Adapting a bought-in design for development of electrodes in smelting plants | 4 of 6, 6 of 10 |
| Firm nr 2, in aerosol industry | Innovation not launched | 2 of 3 |
| Firm nr 4 6 in the marine/offshore industry | Chemical tanks/new distribution system\(^{37}\) Additional Software to radars in order to measure waves | 22 of 400, 4 of 6 |
| Firm nr 8 in packaging (paper and pulp) | Cardboard bench | 7 of 15 |
| Firm nr 11 in generic medicine (pharmaceuticals) | Synthetic Antibiotics against multi resistant bacteria | 2 of 25 |

\(^{37}\) As mentioned in chapter two, I did not receive any information about this innovation project from the interviewee, this information stems from the STEP Cotech database.
4.1: The relationship between organisational type and learning potential

4.1.1. Organisational types revisited

How suitable are the different organisations in this study for learning, change and innovation? Using the typology of Lam that was presented in chapter three as an analytical tool, I will now discuss the learning potential of each of the firms. Recall that Lams’ first category is called Professional bureaucracy. Firms in this category are most dependent upon explicit and individual knowledge, embrained knowledge. Status boundaries are strict and based on credentials, and the amount of tacit knowledge is limited. Examples of PB- firms can be the generic medicine- firm, and the suppliers of marine and offshore equipment, and supplier of environmental technology. These firms base their capabilities on advanced professionals such as engineers, chemists, or biologists, and have a closer connection to research communities than the rest of the sample. Their knowledge base are more influenced by these formal knowledge communities; Following the terminology of Nonaka, one could argue that the judgment criteria for “true” (acclaimed) knowledge are co-developing between the firm and their cooperating research institution. The product innovations of these firms are science based and knowledge intensive. Highly educated individuals in R&D departments have developed them. One weakness of PB in relation to learning and innovation is that knowledge creation and innovative activities are viewed as a restricted activity, exclusively for the experts of the organisation. The organisations are thus very dependent upon some individuals, and find it hard to distribute knowledge throughout the organisation, and making learning and innovation an every day activity for more departments than R&D.

Machine bureaucracies are most dependent upon encoded, collective knowledge. The structure is hierarchical, with orders going downwards and reporting going upwards.
This kind of organisation is efficient for routine work. Empirical examples of MBs could be the aerosol producer, both firms in food and drink industry and the packaging supplier. These firms seem to have distinct boundaries between planners and executors, and production is standardised according to formal procedures, and the activities of the front-line workers are routine, requiring low-skilled workforces. Contrary to what the theory predicts, these firms have been innovative. However, they are more seldom innovative than the rest of the sample. Innovation projects are a seldom activity, but when it do happen it often changes the entire system of production as was the case in the innovation project of firm B in food and drink industry. Their supplier of production equipment also trained the production crew in the handling of the machinery and the altered production process.

Operating Adhocacies are relying on tacit and individual knowledge, called embodied knowledge. An expert individual within a project group is the main knowledge agent, and large amounts of tacit knowledge are created. However, tacit knowledge is not easily accumulated because of the project character of its operations, where projects are not sufficiently related to accumulated tacit knowledge\(^\text{38}\). Knowledge within this firm tends to draw its value within certain contexts, and thus knowledge is not easily accumulated across contexts. Principals, who specify the needs that OAs work to meet, often define projects. This customer influence could be one reason why OAs cannot seem to accumulate its tacit knowledge. The firm in the electro industry, the supplier of metals and materials and informant B in data and telecommunication industry can be described as OAs. Data from interviews and

\(^{38}\) Recall the discussion of SECI in chapter three, where a potential reason for not accumulating tacit knowledge was given. Some organisations have a tendency towards using insufficient time and resources on internalisation at the intersection of two projects, thus not distributing insights from one project to another, or from the project group to the larger organisation.
questionnaires from these firms point out their reliance upon “dispositional knowledge”, and their activities are focused on providing creative problem solutions to their customers. Each and all of these firms collaborated with customers during their innovation project. Particularly firm B in the data and telecommunication industry shows some features of an OA. The following statement illustrates the ascribed importance of embodied, tacit, dispositional knowledge in this firm:

“Our most critical competence is probably tied up to individuals and a life time of experience… there are a lot of mumbo-jumbo and gut feelings in these things… some aspects of our work is extremely complex, and these things takes a lifetime to acquire…those people who know these things are so good now because they have worked hard and with enthusiasm for many years. Some employees are among the top world class … and these competences are almost impossible to clone” 39

Firm B in data and telecommunication industry is at the borders of Operating Adhocacry and the J-form organisation, as it seems to rely equally on individual tacit knowledge and knowledge inherent in social norms.

39 I translate all quotes from interviewees from Norwegian to English.
Lams’ fourth and final category is termed the J-form organisation, or the Japanese organisational form. Recall from chapter three that a J-firm organisation is characterized by collective and tacit knowledge that are embedded in organisational communities, with shared norms and routines. A formal hierarchical structure is combined with ad-hoc teams, joined together by a strong company culture.

Firm A) in publishing is closest to being classified as a J-form organisation. Drawing on information from the interview, I got the impression that it derives some, if not all, of its capabilities from organisationally embedded knowledge, capabilities embedded in shared culture and routines. This firm also uses a lot of resources to various social happenings and “team-building” conferences, and the informant works to combine the social with “a feeling of community and interaction within certain limits”. Getting the employees emotionally committed to the firm is an important goal for the informant, because he believes this would both spread the rumour about their firm and increase the performance of the employees: “We want the employees to have a stronger perception of their firm... so they actively market our firm... using the employees as messengers is important in such a small organisation”. This firm has a low turn- over, and is described as a good work place, but the downside of this is that “this culture on the job eventually characterizes the people here, maybe we tend to look at things the same way, and then maybe can’t see things so clearly”. When I asked about possible disadvantages of tight corporate cultures, the informant laughed and said that, to be honest, he sometimes found it necessary to destroy the communities he had contributed building. “Sometimes it can become too “social” and the cliques has to be broken up—in this respect it is healthy to start projects that involves external actors”.

None of the firms studied here have the full-blown characteristics of the J-form organisation. Although it is common to use project organisation in developmental activities, it is hard to argue that these firms’ main knowledge assets are embedded in the organisational routines and shared norms. The finding that these firms do not easily fit into the category of the J-form organisation is not unexpected. Since the J-form organisation is a typical Japanese organisational form one would expect it to be rare in a Scandinavian, open economy.

4.1.2: Combining Lam’s typology with SECI and COP

Drawing together the theoretical frameworks of Lam and Nonaka would result in a theory that describes which organizational type that primarily engages in each of the specific knowledge conversion modes.

I argued in chapter three that externalisation is a precondition for MBs and the most common knowledge conversion form in this type of organisation. Similarly, J-form is best at socialisation, PBs is best at combination\(^{40}\) and Oas is best at internalisation.

According to Lam, COPs\(^ {41}\) are most likely to be found in the OA and J-form organisations. She is here using the more narrow, institutionalised version of COP. The broad interpretation would, however, argue that COPs might exist in every type of organisation, even the “learning impeding” organisational form of “machine bureaucracy”. The broad conception of COPs implies that COPs exists everywhere people come together over work tasks. However, how well it is supported will depend on the organisational structure.

\(^{40}\) I will classify PBs as drawing most on combination, although the main knowledge agents in PBs are individuals, and not communities. PBs pre – requires an individual internalisation process by its professionals, followed by externalising this knowledge in documents. However, what best characterizes a community of professionals is the combination of existing explicit knowledge, i.e. theories.

\(^{41}\) Communities of Practice is defined and debated in chapter three.
Table 4: Categorizing the sample

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Tacit</th>
<th>Explicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td><em>(Internalisation)</em> Operating Adhocacy: Supplier of electro-equipment (1), firm B in media, supplier of metals and materials (10) and firm b) in data and telecommunication industry (15) Institutionalised COP</td>
<td><em>(Combination)</em> Professional Bureaucracy: marine industry (4) and offshore supplier (6), supplier of environmental technology (7) and firm in generic medicine (11) (14, firm C in media/publishing) COP underrated?</td>
</tr>
<tr>
<td>Organisational</td>
<td><em>(Socialization)</em> J-form organisation: Firm A) in publishing? Institutionalised COP</td>
<td><em>(Externalisation)</em> Machine Bureaucracy: Aerosol producer (2), firm A) (3) and B) (13) in food and drink industry and the packaging supplier (8) Repressed COP?</td>
</tr>
</tbody>
</table>

What kind of implications does this categorisation of firms have to predict about their innovativeness? The theory of Lam (1999) argues that MBs limits innovation and PBs inhibits innovation, and that J-forms are best equipped for incremental innovation and OAs are best equipped for radical innovation. Consequently, one can assume that the

---

42 I did not receive sufficient information about firm nr 9 and 12, informant B in publishing and informant A in data and telecommunication industry, to be able to categorize these firms. All categorisations are tentative and preliminary, as they are based on information derived from the perspective of one informant from each firm.
innovativeness of the firms studied here would increase as one moves from the MB to the OA. The empirical findings however, do not fit the pattern one would predict based on the theory. The firms are scattered around\textsuperscript{43}, and the relationship between organisational type and innovativeness seems to be more complex than the theory expects.

Table 5: Innovativeness\textsuperscript{44} and organisational type

<table>
<thead>
<tr>
<th></th>
<th>Seldom innovative</th>
<th>Occasionally innovative</th>
<th>Often innovative</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB</td>
<td>Aerosol producer, Firm B in food and drink industry</td>
<td>Informant A in food and drink industry, Packaging supplier</td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>Firm C in media/publishing</td>
<td>Offshore supplier</td>
<td>Supplier of environmental technology, Generic medicine firm</td>
</tr>
<tr>
<td>J-form</td>
<td>Firm A in media/publishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OA</td>
<td>Firm B in media/publishing (?)</td>
<td>Supplier of metals and materials, Firm A in data/telecommunications (?), (marine supplier?)</td>
<td>Supplier of electro-equipment</td>
</tr>
</tbody>
</table>

The typology of Lam is mostly concerned about knowledge forms and main knowledge agents in various types of organisations. The aspect of organisational structure, hierarchies and flat organisations, are not picked up in depth by Lam.

Therefore, I choose to draw on Nonakas’ theory of the outmost knowledge creating company, the hypertext organisations, which combine hierarchy and project teams.

\textsuperscript{43} This categorisation is tentative, and is restricted by the objections and possible problems that were mentioned above.

\textsuperscript{44} The question was: “How often do you come out with new releases? (Product or process). See question 6 in the interview guide. The categorisation does not distinguish between which of the product innovations that can be termed radical (expected to be correlated with OAs) or incremental (expected to be correlated with J-form).
4.1.3: Organisational structure; hierarchy vs. flat organisation

Hierarchy impedes the potential for learning is the assumption made by Lam, Nonaka and Senge. Most of the informants also voice this assumption. For instance firm A in the food and drink industry emphasized the negative aspects of hierarchical systems and limited resources for learning and innovation. In his opinion, every developmental project is very top-controlled. Proposals have to go through several eyes of a needle before they get status as real projects that they are allowed to invest time in. Until then, they have to do a lot of exploration off-record in order to be able to develop good proposals. Informant A in the data and telecommunication industry regards a flat organisational structure combined with a culture that discourages internal competition as important in creating a good environment for learning. They try to encourage a culture in which “one uses ones mouth” or discusses things openly. They also try not to hire people that are more comfortable working behind closed doors.

Of the 15 firms studied here, 8 of these consider themselves as hierarchies, two interviewees insist that they have a hierarchical structure combined with a flat organisational culture, and 3 firms perceive themselves to be flat organisations.\[45\]

4.1.4: The hypertext organisation revisited

Recall from Chapter three, page 27, that Nonaka argues that the hypertext organisation, with a business system, project team and knowledge base layer is the most suitable organisational form for all four knowledge conversion modes. One of the characteristics of the hypertext organisation, that makes it distinct from a matrix

\[45\] I did not receive sufficient information on this subject from the remaining two firms.
organisation, is that each employee only report to one superior at any one time; either to the boss in the business unit system or to the project team leader.

10 out of 15 firms usually run projects simultaneously with their business units. However, most firms use a matrix system, where employees have to answer to two bosses simultaneously, thus often resulting in employees being drawn in two directions by incongruent/ incommensurable demands. Thus, this matrix structure has an inherent potential for conflict.

Informant B in the data and telecommunication industry was the only firm that had developed what resembles a hypertext organisational structure; with both business units and project teams, with the explicit principle that employees when engaged in projects only should answer to the project leader, and not to their superior in the business unit system. Transfer of information between the two layers is sought ensured by regular meetings within the business unit system, where middle managers in the business unit system present their work and invite others to hold presentations. “Colloquium sessions “ within subjects are also open whoever is interested.

4.1.5: Summing up; unambiguous correlation between organisational type and innovation

The relationship between organisational type and innovation was shown above to be more ambiguous than theory predicts. To the contrary to what theory assumes, firms that can either be categorised as PB or MB firms, and/or classify themselves as hierarchies have nevertheless been innovative.
4.2: What is the best interaction form for knowledge transfer inside a firm and between partners?

The second research question revolves around which interaction form that is better suited for knowledge transfer within own firm and between partners in collaboration. The theory of COP assumes that practical co-operation, on-the-job training resulting in dispositional knowledge embedded in a community of practice, is the best interaction form for transfer of tacit knowledge. I use the theory of COP here in relation to single firms. Similarly, the theory of grounding and trust is applied to the collaborating firms. Each and all of these theoretical frameworks emphasize the aspects of a common understanding and outlook on work and the world as important for knowledge creation. This common outlook is, it is argued, easier obtained through distinct interaction forms. However, it is important to point out how firms employ a wide array of interaction forms; e-mail communication, face-to-face meetings, telephone conversations, exchanging documents, etc. The list of interaction forms is endless.

4.2.1. Communities of practice revisited

Of the theories reviewed in chapter three, the framework of “communities of practice” places most importance on informal work groups as good learning environments. The way informant A) in publishing industry, 46 presents their working environment strongly resembles a “community of practice”, also because they have internal conflicts between the editorial staff (journalists), and the graphics department. This firm also links a good learning environment to dispositional knowledge:

46 This firm is categorised above as a possible J-form organisation.
“This is part of our culture... we must place great importance on competence, the practical know-how that makes you able to carry out the tasks is most important...

Competences and ability to carry things through, effecting plans, should not be empty phrases”.

In a similar vein, the supplier of packaging believes that it is one thing to come up with ideas that are feasible, but actually carry through the hard work in order for the idea to become a product innovation, is indeed another story: “some people might develop the ideas, but then someone has to have the abilities to actually do the things that are necessary, for instance someone who is extremely accurate /precise/perfectionist about each detail of construction etc”.

Firm A in publishing/media industry has a low turn-over, and is described as a good working place, but the downside of this is that “this culture on the job eventually characterizes the people here, maybe we tend to look at things the same way, and then maybe we can’t see things so clearly. Sometimes it can become too “social” and the cliques has to be broken up—in this respect it is healthy to start projects that involves external actors”.

One major drawback of tight communities of practice, based on years of grounding work and physical co-operation, is that learning will follow established norms and trajectories, leaving little or no room for radically new knowledge required for radical innovations. This is, perhaps, part of the reason why firms that display aspects of tight COP value the competence building aspect of their collaborations as beneficial.
Table 6: The importance of shared values and visions

4.2.2: No dominant interaction form

As mentioned above, all firms use the entire range of interaction forms in their daily activities. For instance are e-mails a commonly used and highly valued medium for information exchange. I will not go into the entire range of interaction forms and their implications for learning, but sum up by drawing attention to how the literature on learning and innovation that was reviewed here seems to limit their analysis too narrowly on one single interaction form, namely physical and social co-operation.

I will now proceed by discussing which interaction forms were used in the collaborations, and what these findings implicate for the learning potential of the collaboration.
4.2.3: “Trust”

Trust is essential in every relationship. One might think that trust is more important in personal relationships than in relationships between firms. However, successful collaboration is dependent upon partners trusting each other, enhancing the credibility of the information that is exchanged during interaction.

Drawing upon Saho 1991, Dodgson (1996) is differentiating between different types of trust that are relevant for interaction between partners.

“Contractual trust” exists when partners hold the belief that their partners will adhere to agreements. This kind of trust is often ensured through explicit and extensive formal contracts. One of the learning effects the producer of aerosols has drawn out of the failed project\(^ {47} \) is that they ought to use contracts more. The collaboration with their English partner was not formalised, and as a result of development problems, the English partner backed out, and the product innovation was not launched. The informant emphasizes how he tries to avoid using contracts, and how he usually regards “gentlemen’s agreements” by handshake to be sufficient. However, later experiences have forced him to change his mind:

“\textit{I have come to realise that the world is changing... I am used to look people in the eye, shake hands and then we agree... the same people are there 20 years later. Now, however, one must relate to many different individuals within one company, as activities are more team based and as people change jobs more often. Given these circumstances, I have had to realize that we need to use formal contracts}”.

This implies that it might get harder to build contractual trust informally, and that formal contracts are preferred.\(^ {48} \) 9 of the 15 firms studied here, had formal contracts

\(^{47}\) The project “failed” in the sense that no product innovation was launched on the market.

\(^{48}\) Later in this chapter we will see how MacDonald 1992 argues that innovation requires informal interaction, and that learning potential might be restricted when formal contracts are used.
as the basis of their relationship to partners, and only two firms reported explicitly that no formal contracts were used in the innovation project.

Choosing the right partner to cooperate with, is a huge decision to make, with possible far-reaching consequences. When collaboration between partners has been agreed upon, partners have to believe that the others will perform their role competently, that is, they must have “competence trust”. Last, but not least, for a partnership to be successful, the partners have to believe that all parties are equally committed and open, dependable and “discrete”. This is called “Goodwill trust”. Although I did not ask explicitly about this “Goodwill trust”, many respondents drew this aspect forward during our conversation. For instance, informant A in data and telecommunication industry was happy that their French partner was committed to pragmatic problem solving, and solved arising conflicts by practical collaboration and face-to-face interaction instead of “running to the contracts” (assigning blame and reducing own loss).

4.2.4: Grounding

Recall from chapter three, page 36, the assumption that interaction between multiple participants requires some degree of mutual understanding. The concept of grounding can be used to understand the importance of close physical interaction for knowledge transfer. The assumption is that different interaction forms not only bring different constraints to learning directly, but also indirectly, by restraining the grounding process. Different interaction forms give different opportunities for grounding. For instance, face-to-face interaction is very different than videoconferencing when it comes to ability to see the same things (co presence), receive messages at the same

49 The concept of grounding is similar to Nonakas’ concept of BA- a common context and shared context for knowledge creation.

50 This is the theoretical background of the question of which interaction forms interviewees had typically employed during the innovation project, question 19 in the interview guide.
time it is sent (co temporality) and whether both parties can send messages
simultaneously, or have to take turns. Hence, face-to-face interaction requires less
grounding efforts from the participants than videoconferencing (Dillenbourg 1999)
Taking this argument further would imply to view the cases that included frequent
face-to-face interaction as better environments for transfer of knowledge than the
cases where interaction was restricted to exchanging e-mails. Informant B) in data and
telecommunication industry was convinced that personal relationships had to be
established in order for video- and teleconferencing to be successful. The actual social
feeling of physical proximity is argued to be important for knowledge transfer, and
hence is teleconferences regarded as the hardest working method, as the transfer
context is harder to grasp. Videoconferencing is regarded as somewhat better. Since it
allows people to show models and diagrams on clipboards, one can see the facial
expressions and body language, in short one has much more information on the social
context of the communication partner.
Informant A in data and telecommunication industry has similar views on interaction.
In relation to the innovation project, they have contact with their French partner on a
daily basis through telephone and e-mail contact, and most importantly personal
meetings. They travel to see each other every 6th week, in order to” renegotiate” the
product:
“E-mails are easy to use, and practical as it eases the barriers of time and place. The
downside is that e-mails are impersonal, and it is easy to misunderstand one another.
The human aspect of this is important, and so we insist on meeting each other
regularly in order to reset the negotiations… working on this technology is
complicated, and naturally, problems arises. Handling these problems is a human
issue that cannot be resolved by e-mail correspondence. Personal relations have to be built in order for us to be able to solve problems we know will arise”.

This firm had relations with the French competitor well before this project was initiated. Their French partner is highly valued because of “their pragmatic attitude... when problems arose, they chose to work it out together with us, instead of running to the legal documents. Together, we were able to concentrate on solving the actual problem, instead of maximising the crisis”.

4.2.5: Physical proximity as beneficial for knowledge transfer
Physical co-operation were shown above to be important for knowledge transfer. However, very few of the firms engaged in such close contact with their partners. Two atypical cases is the alliance of the supplier of marine equipment and the collaboration firm A) in publishing undertook for innovative purposes:
The interaction forms used in the alliance between the marine supplier and their partner is very broad, ranging from lots of e-mail communication, to managers conferences and local meetings with respective sale forces. The amount of contact is regarded as significant.
The collaboration project undertaken by firm A) in publishing is described as “traditional”, involving a lot of face-to-face interaction and practical problem solving. At first, consultants derived information about their product and then began developing sketches and suggestions that were discussed in work groups. The external experts were put into work groups both with people from graphics and journalists. The intention was for the three groups to “play ping-pong backwards and forwards”, as the informant put it. In this way, ideas were discussed and agreed upon before being implemented, leading also to a certain amount of knowledge transfer from the external experts on layout to the employees. This face-to-face contact is, according to
the informant, essential to the success of the project. “The only thing exchanged by mail was the contract”.

Table 7: The importance of different interaction forms for knowledge transfer

1 indicate most important, 7 indicate least important.

<table>
<thead>
<tr>
<th>Interaction Form</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face practical problem solving</td>
<td>2</td>
</tr>
<tr>
<td>Joint meetings</td>
<td>3.07</td>
</tr>
<tr>
<td>Conferences</td>
<td>3.92</td>
</tr>
<tr>
<td>E-mail correspondence</td>
<td>4.35</td>
</tr>
<tr>
<td>Videoconferences</td>
<td>4.35</td>
</tr>
<tr>
<td>Joint courses/training</td>
<td>4.42</td>
</tr>
<tr>
<td>Mail correspondence</td>
<td>5.28</td>
</tr>
</tbody>
</table>

4.2.6: Actual proximity to collaboration partner

Contrary to what could be expected from the response to the question above, most of the firms have an “arms’ length” approach to collaboration. Developing the product innovation is often the sole responsibility of the informant; the other firms are viewed as merely tools, a means to achieve their goal, and hence are not actively involved in the definition of the goal/purpose. This strongly reduces the amount of contact between the partners, and they remain different knowledge communities. Lam (1989b) views this “arms’ length approach” as a common method of working together. An arms’ length interface collaboration involves “a clear division of labour across the two partner firms, that is the partners each work independently on one part of the project and join forces at the end to link the separate development effort into a final product” (Lam 1989b: 31)

---

51 See question 8 in the questionnaire.
For most of the firms, the vision, or desire to create something new has been entirely their own, and I believe that the conditions for joint knowledge exploration and mutual knowledge exploitation would have been better if both parties had the same level of commitment to the development of the product. E.g. firm B) in data and telecommunication industry recalls that the specifications his company made for their partner were too strict/rigid, and as the partner followed the specifications too literally, the innovation process got overly expensive. One of the learning experiences for this firm is that they in future projects need to sit down together with their partners and co-develop the specification.

A prototypical example is the supplier of environmental aluminium technology. The informant says that the innovation process included no direct collaboration with external partners, in the literate sense:

“Some aluminium factories in western Norway were involved, and there was no direct cooperation, but they gave us permission to use their gas so that we could test [the product innovation] in real life. They are annually updated on the status of the project, but they are not actively participating in the programme... we run our own show”

Another quite typical example is firm A) in the food and drink industry, in which the only interaction with one of the partners consisted of choosing among alternative sauces their supplier brought forward to them. The number of examples that could be drawn from the empirical material here is great.

These firms’ use of external partners usually involves solely buying services into the company, or outsourcing some aspects of the product. When they do use external actors, they are always controlling the final stage themselves. To push things a bit to the extreme, the knowledge enhancement of this collaboration goes only through
products or services. This means that partner competences are not as easily transferred and absorbed by the organisation, as they could have been if the collaboration involved shared responsibilities and working together more. The general trend among these firms is that areas of responsibility in the collaboration are distinct, and that communication is on the level of passing messages, specifications and results. However, these firms also speak highly of extensive physical/social interaction as most beneficial for knowledge transfer. This seemingly inconsistency will be discussed in the concluding chapter.

4.2.7: Summing up; the relationship between interaction form and learning potential

The main conclusion here is that there is consensus both in the theory reviewed and among the firms, about how practical co-operation is the better-suited interaction form. However, few of the collaborations involved much practical co-operation.
4.3: Strategies for knowledge creation

The third research question of this thesis concerns what strategies for knowledge creation and transfer firms should employ and are employing. I will start by discussing methods for knowledge transfer inside the firm, and then proceed by focusing on collaboration as an external strategy for knowledge creation and transfer. I have chosen to categorise strategies as either top-down or bottom-up, although I do recognise that these concepts should not be used as a dichotomy, but rather should be seen as a continuum, where the strategies can be categorised as more or less top-down or bottom-up.

4.3.1: Top down strategies for knowledge creation and transfer inside the firm

What these strategies have in common is that they are initiated by managers, and often also institutionalised within the organisation.

4.3.2: A Master-apprentice model

Building a good learning environment is a management concern for the supplier of metals and materials. The interviewee’s department has established a unique master-apprentice system, where every new employee is given her/his very own “sponsors”/godfathers. The godfathers are seniors with many years of experience as outgoing consultants; becoming godfathers are voluntary, and few have turned down this opportunity. The juniors are introduced to the organisation, and are given introduction to the tools and systems that are commonly used in their department. This context seems to be a good condition for transfer of tacit knowledge. Given the close co-operating aspects of the Master-apprentice system, I will suppose that this model is most beneficial for the knowledge conversion mode socialisation. Within this system, newcomers are continually “tested” for their operational/practical problem solving
abilities, so the managers can find the most suitable and challenging tasks for them.

New employees are followed up closely, and are given independent tasks on the works after 1-5 years: “we try to take them out in deep water to see if they can swim... they have to be tested a bit, we have to see what they are capable of and how we can put them to use”.

The practical aspects of the master-apprentice model are emphasised by the informant. Newcomers are not passive bystanders observing a master, but are constantly introduced to new challenges. Newcomers are given minor practical problems to solve in the projects; and their performance is taken as a sign on how fast tougher tasks should be handed to them. Feedback from the master-apprentice system is not institutionalised, but the informant makes sure he has informal talks with all the newly employed, so they have an opportunity to air their opinions.

4.3.3: “Cloning programs”
The interviewee from firm B in the data and telecommunication industry thinks transferring knowledge internally is a major challenge. He believes the development department is understaffed relative to their tasks, and hence they do not use sufficient time to nurse competences. They do, however, have a specific program for knowledge transfer, which the informant calls “a cloning program”. A person embodying critical competence is picked out to train another individual on her/his area of expertise. However, he believes that some of the seniors, or “knowledge gurus” as he calls them, are impossible to clone due to the complexity of their experience-based knowledge. Several “cloning\textsuperscript{52} programs” are going on simultaneously. How the actual process goes on is dependent upon the prior knowledge level of “the trainee”, but it is usually

\textsuperscript{52} The use of concepts here is interesting. I believe cloning for this informant means to replicate a whole person with its inherent knowledge complexities—however; the actual process is a classical master-apprentice model, the same as other firms report employing.
the trainee who is doing the job, and the senior acts as a mentor, providing invaluable advice.

4.3.4: Is strategies for knowledge transfer unimportant?

For the producer of spray cans, internal knowledge transfer was not an explicit concern. This finding can be related to the size of the firm and the small geographical and knowledge distance between the employees. However, it is evident that knowledge transfer is an everyday activity in this firm, although not reflected upon, since no major problems concerning knowledge transfer has arouse. The informant more or less took it for granted that 5-6 people are so familiar with the operations that they are more or less all replaceable. In a small and transparent firm the efforts that are made for knowledge distribution is not as visible and reflected upon as in large corporations.

4.3.5: A database for CVs and professional meetings

Informant 11, the pharmaceutical company, uses both informal meetings where projects are presented, and have systematised employees CV database. In order to transfer information and knowledge his department has regularly meetings within their department, with one administrative part, submitting general information about what goes on in the corporation at large, and one professional part, where the employees take turn to present anything from an interesting scientific article to status updates on their (innovation) projects. This interaction results in Combination, where different knowledge communities come together to combine their knowledge at an organisational level. Nonaka & Teece (2001:18) terms such presentations as factors
that constitute combination through dissemination, encouraging transmittance of newly created concepts.

Concerned about taking advantage of the competences of each individual in their organisation, a specific database for resumes has been constructed; containing information about courses, credential subjects taken at different universities, etc – everything relevant for that person’s competences. This database is available to everyone, and the informant thinks it is used frequently. Using Nonaka’s typology, this database is a strategy for combination, as it synthesises and processes information, increasing its wider accessibility.

Transferring knowledge within the electric company has become a more explicit strategy after they merged with a larger French-owned company. This corporation has its own product data management system, databases with information about each product and ongoing projects from initiation to the death of products. This database presupposes externalisation, and lays the ground for combination. As the CV database mentioned above, the product database calls for synthesis and processing.
4.3.6: The performance appraisal process

Virtually every informant draws forward a performance appraisal process as important for internal knowledge transfer. Typically, each employee is meeting his superior for a discussion of the work that has been done, and about expectations for future work. This appraisal interview is important for transfer of information, and gives middle and top manager a feel for the concerns of front-line workers. The effect on knowledge creation and transfer seems however to increase if a performance appraisal system is combined with an incitement system, i.e. the “the technological career ways” of informant B in the data and telecommunication industry. They categorise employees of the development department as developers, senior engineers and chief engineers. The fringe benefits and salaries increase as employees climb the ladder. Each role has clearly defined criteria that must be fulfilled by the employee playing that role, and they appraise the competences of each employee annually, in conjunction with the annual individual salary negotiation. The chief engineers must use 20% of their time, guiding and counselling other employees.

Also for the marine supplier, the performance appraisal process is intended to fuel the desire to learn in each individual, as the performance appraisal process includes career planning and the educational needs of the individual. In addition, the human resource department implements its directives through “human resource personnel” in all departments.
4.3.7: Courses
As a response to the question of what their firm is doing to ensure knowledge transfer within own company, the vast majority of the firms instantly began talking about courses.\textsuperscript{53} Most firms are reluctant to use courses as a strategy for knowledge creation due to large costs. The interviewees reflect thoroughly on what it actually costs in terms of lost labour and high course fees. There is a tendency among this sample to reduce the amount spent on courses, and some also say that there really are not any useful courses out there for them. One exception is firm A) in publishing industry where all employees are preferred to attend courses both in spring and autumn, and they use quite a lot of money on courses and training.

4.3.8: The importance of training/education for learning in firms:
3 of the 15 firms saw post-school training as an important strategy for knowledge creation. Four of the firms used trade exhibitions as a source of information.

Table 8: The importance of education and training for learning

53 I interpret this as an illustration of how there is a common tendency to restrict knowledge creation to something that occurs only when things are taught, through learning-by-studying. The indirect learning taking place within everyday activities are not as easily reflected upon.
4.3.9: **Bottom-up strategies for knowledge creation and transfer inside the firm**

4.3.10: **Space for exploration**

Firm A) in the food and drink industry felt that his company allowed little room for exploration and pursuit of ideas. This is a common concern among the firms in this study. The most usual response is that their organisations do not provide enough systematised room for exploration.

However, some exceptions are interesting. The informant in packaging industry has institutionalised room for exploration for the development department. Employees are encouraged to spend some time in shops, or with the wholesalers. Helping the sales staff unpack the merchandize gives the developer a good practical sense/feel for the products, and a good understanding of user needs. Nonaka & Teece (2001:18) says these activities provide accumulation of tacit knowledge and facilitates socialisation. Similarly, the manager of the aerosol-producing firm also uses the technique Nonaka calls “wandering outside”. This means getting ideas for new products from daily social life, from wandering in shops or getting advice for adjustment by main customers.

Although the common concern by interviewees was that their firm did not encourage exploration enough, the informant of supplier of offshore equipment believes there had been too much room for exploration at the expense of exploitation of existing products and knowledge. In his opinion, they use too many resources on research and development, and the activities are too much led by each employee.
4.3.11: An open corporate culture that encourages learning

Some traits of a culture that encourages bottom-up strategies were found in most of the firms. Especially the packaging supplier and the generic medicine firm encouraged a direct and open culture, and valued discussion and dialogue between employees of various backgrounds highly. To develop “a culture where every voice is heard” seems to be a common concern. This implies emphasizing self-motivation and autonomy as important parts of corporate philosophy.

The informant from the generic medicine firm considers trust and openness within the corporate culture to be the most important conditions for learning. He believes that missing trust in a relationship could block the potential for benefits/returns entirely. A good environment for learning is an environment where conflicts are brought out into the open, and where everyone feels entitled to hold and voice opinions. He describes the learning environment of his research department in this way:

*I will not speak laudatory about our internal environment… it is by no means the Garden of Eden… Personally, I often say how it is much better to have occasional quarrels, than constantly sulking and withholding stuff… we encourage people to be open, and to acknowledge the competences of colleagues…although you possess expertise in one area does not mean that you cannot learn anything form people with other backgrounds, that they can actually help you solve the problem… we try to clear the ground for an environment where you can speak your mind freely, and it certainly helps that we also see each other outside the usual work setting”.*
4.3.12: The dilemma between deepening existing knowledge and distributing knowledge widely

The management of the supplier of offshore equipment has recently become more aware of the disadvantages of always sending their “best men” out on jobs, thus undermining the competences of other employees, and enhancing their dependence upon a small core of senior employees. Now they are putting more effort into training newcomers, and send these out on commissions as soon as possible, with support from core workers available 24 hours a day. Firm B in the data and telecommunication industry refers to similar experiences: “When we enter critical phases and milestones, our project leaders want to “hire” the most experienced gurus, to make sure the task is handled competently. However, using this strategy implies that no one besides some 3-4 gurus know how to do this task… this is a problem we are aware of ...”.

This dilemma can be better understood using the theoretical framework of COP. In order to build COP, knowledge must be distributed widely. The position in the “legitimate periphery” for instance learning by observing the master, and gradually take on responsibility, is according to the theory of COP the best position for learning. This situation of master-apprentice could also be a good opportunity for the master to reflect on and externalise important aspects of her/his competence. However, disseminating knowledge must of course be combined with activities that ensure expansion of the frontiers of knowledge.
4.3.13: Collaboration as a strategy for knowledge creation

In most of the literature on innovation, collaboration is perceived as beneficial. However, Macdonald 1992, in Dodgson (1993) argues that legal stipulations on collaboration can restrict the informal collaboration which is necessary for innovative efficiency. Dodgson argues that collaboration, as a supplement and not a substitute to in-house R&D, can speed up the learning process in firms. In general, firms are organisationally conservative and wants to stick to what they know best. Learning through collaboration may help firms learn how to deal with new technologies and an ever-changing operating environment (Dodgson 1993:31).

4.3.14: Innovation as mean to an end: profit

Neither of the firms regarded “knowledge transfer” as the most important motivation for the collaboration. 6 out of 15 firms had “sales / profits” as the most important motivation, while cost reduction” was most important to 3 of the firms.
4.3.15: Exceptions; knowledge transfer as motivation for collaborating

The most important motivation for the collaboration project undertaken by firm A) in publishing was access to complimentary competence, followed by transfer of knowledge and risk reduction. The least important motivation was to avoid competition. Drawing upon the knowledge bases of other firms is an often-used strategy for this firm: “why should we sit here and invent the bicycle all over again, when somebody else has done it already? It is that simple”. This attitude is common among the informants, but only this firm rated knowledge transfer as one of the most important objectives for collaboration. The focus of knowledge creation is evident and the informant explains how when a challenge is identified, they usually sit down to discuss what they are looking for, where they can get help and how they can do this. “When we ask someone for help it is usually because a) we don’t feel that we have this competence ourselves and b) fresh eyes will probably view this challenge..."
differently, and this will lead to a better result”. External actors are viewed as important because they first and foremost are “external”, and therefore able to provide other perspectives into the problem solving. The informant from the marine supplier says that one of the effects of the alliance, is that it has significantly driven the need to improve, as “we are now not just representing ourselves, but also others”.

4.3.16: Dyads or networks revisited

Following, Håkansson et al 1999, My sample of firms have not been drawing upon their entire networks in the development of these product innovations, but have been engaging in dyadic relationships. The firms I interviewed, had 1 to 4 partners in their innovation projects, but did not draw upon their entire network in these specific instances, and engaged in relationships that are better described as unilateral. This also implies that their partners did not have contact with each other, except through the main firm. Recall from chapter three the theoretical assumption that extensive networks, consisting of many nodes and connections, provide better environments for learning than alone standing relationships between two actors. This is because a large number of interfaces are viewed as providing a general variety (in perspectives etc) that is proven useful for learning (Håkansson et al 1999: 445).

In other words, the network is loose, connected only through the focal actor (the informant firm), and not tight – partners having contact independently of the relationship to the core/main agent.

Figure 1 illustrates a typical collaboration situation, where the informant engages in dyadic relationships. The dotted lines show possible links that are not utilised by the firms. Using both the whole lines and the dotted ones would be typical for a more
tightly knit network that would provide better opportunities for learning than the existing dyadic relationships, as the number of interfaces increased.

Figure 1: Dyads and networks

K indicates knowledge infrastructure agent
S indicates supplier
C indicates customer
4.3.17: Long term strategies and relationships, the age of the dyads

Long-term relationships give greater opportunity for firms to exchange information equitably, as effective communication is established (Dodgson 1993:154). This is the consensus in both the literature on innovation and among the firms of this study. The packaging supplier view on this is representative of the other firms. He says: “personal contacts are extremely important- among customers and in laboratories- as they ease communication, and they will more readily understand what we are talking about – we can work more efficiently. None of the informants agreed with what the theory of Dodgson (1996:67) predicts about the downsides of old relationships. To become too similar and hence having no difference to transfer was not raised as a concern by any of the informants. When asked, they could not see anything negative about long-term relationships. The only exception is the producer of generic medicine, where the informant occasionally was drawn into internal work conflicts of their partner, against his will. This reflects how close this informant is to the collaborating institutions, and the informant sees the conflict negotiation as inevitable, but not as a problem.

4.3.18: Summing up; strategies

The firms that make up this case study employ a wide variety of strategies. Although some firms have successfully combined these strategies, the majority do not combine all strategies. Regarding innovation collaboration as a strategy for learning, a question that has come up is; could collaboration be beneficial for firm competence regardless of motivation? For most firms, knowledge transfer or access to complementary skills was not an important motivational factor behind the collaboration. However, they

54 See page 45, chapter 3.
rated the collaborative innovation project as having contributed positively to their firms’ competences.
4.4: How embedded are these firms to the Norwegian NSI?

4.4.1: Knowledge infrastructure as information sources

Were any of the actors belonging to the knowledge infrastructure\(^{55}\) of the Norwegian NSI considered to be important information sources for these innovation projects?

The major trend within the material is that the knowledge infrastructure is regarded as relatively unimportant information sources for these projects. They receive rankings of 12-14, the bottom-end of the scale indicating least importance.

Support knowledge infrastructure actors, branch and public research institutes, universities and consultancy firms were assessed as being among the least important information sources in these innovation projects, ranked on average 10, where 1 signifies most important and 14 signifies least important.

4.4.2: Same nationality facilitates interaction

Recall from the theoretical discussion of NSI in chapter 3 how the aspect of nationality as beneficial for partner transfer was argued. 10 out of 14 firms in this study had Norwegian partners in the innovation project.

4.4.3: NSI knowledge infrastructure as partner

The NIS knowledge infrastructure was highly appreciated when used by the firms. The following are examples on which institutions that were engaged in the projects, and what kind of interaction there was among the firms and knowledge infrastructure actors. The producer of spray cans used SINTEF as a problem advisor for bacteria in water. The supplier of offshore equipment was granted a doctoral programme from the Norwegian Research Council (NFR), and the doctorate disputed on the product innovation in August 2001. The firm is extremely satisfied with this doctorate, and

\(^{55}\) Knowledge infrastructure in NIS was restricted to public or branch research institute, universities and consultancy firms. See question 11 in the questionnaire in the appendix.
consider themselves lucky to be able to include this doctorate within their staff. They are very concerned to keep in contact with relevant research environments, both for recruitment and for knowledge transfer.

The development department of the supplier of environmental aluminium technology comes out as very much in contact with research “environments”, as they use both institutes of basic research and customers R&D departments (hydro aluminium, Norway, Hamburg aluminium Germany), and particularly one of the 14 research centres of their own multinational, situated in Sweden, specialising in air and gas control (management). A research institute was also engaged in the development of the product innovation of the packaging supplier. The product was tested at a branch institute for paper and pulp, and these partners went through several different stages together in order to reach a more optimal solution. The firms’ connection to this research institute is old; my informant estimates that they have been using this institute for at least 15 years. This particular product innovation was also tested and approved according to European standards on benches, thus reassuring their customers of the quality of the product through thorough documentation and testing.

4.4.4: Financial support

The development project undertaken by the firm in the electro industry had received public financial support, which was highly valued: “the everyday activities tend to be prioritised over development projects. In order for us to do something new, it is nice to have moral and economical support from the Norwegian state... when adventuring out on thin ice, it is truly essential that the Norwegian state give financial support to industry”.
The innovation project of the supplier of offshore equipment also received public financial support, initially from 1996-98, and then the financial support was prolonged until 1999. The financial support from the Norwegian state was assessed as really important, since the supplier is a small firm that otherwise would not engage in such huge projects. However, this firm used 15 million Norwegian Crowns (NOK) on the development of the product innovation, and received approximately 2.5 million NOK. The subsidized amount is so small that it seems symbolic, but it is nevertheless, or for that very reason, highly appreciated by the firm.
4.4.5: Position in the value chain influences partner choice

I will argue that, for some of the firms, the choice of partners is more or less motivated by their value chain positions, and collaboration is viewed as a necessary precondition in order to ensure their contribution to the larger value chain of a product. This value-chain related motivation for external contact is quite different from the partnerships engaged in by companies that seek external competence (from science institutions or competitors) in order to build superior products.

The firm operating in generic medicine is the only firm in the sample that collaborated with a public science institution. Their project is about developing a raw product that is further refined and developed by their own production department. The connections to public knowledge infrastructure cannot be ascribed to the firms’ position in the value chain, but must be ascribed to the desire to expand their knowledge bases together with eminent research communities.

Several of the innovation collaborations are based on customer relations, e.g. the supplier of packaging tested their products through some of their customers, as was also the case for the supplier of offshore equipment. The aerosol producer got an inquiry from a potential English customer that started the innovation process.

Firm A) and B) in the food and drink industry, firm C) in publishing and Firm B) in data and telecommunication industry all used suppliers as collaboration partners.

Suppliers as collaboration partners in innovation projects are common: “The importance of technological inputs of suppliers and users into firms’ innovative activities are well known” (Dodgson 1993:21).

The “innovation project” of the supplier of metals and materials is a case where a department builds on and adapts the bought design from a Spanish competitor to end-
user needs. 2 out of 3 firms in the media sector used private consultancy firms in their innovation process, which was about improving existing products.

I will argue that it does not affect the learning potential whether the partner is a supplier, a customer or a research institute. The level of sophistication of the knowledge that is transferred may vary, but the important thing for the firm is to acquire whatever knowledge they need, and regard as relevant.

4.4.6: Educational levels

One of the prerequisites of a good NSI was called “necessary means to learn”, and is linked to educational levels of the workforce. The level of education within the firms is quite high, and few of the employees are un-skilled. According to the informants, university degrees are common in nine\(^{56}\) of the firms, medium levels of education are found in three of the firms\(^{57}\), and the lowest levels of education are found in three of the firms\(^{58}\). All in all there is a variety of educational backgrounds within this sample, ranging from journalists to engineers. The level of meritocracy is quite high in Norway, with a wide variety of vocational training at different levels and university degrees.

\(^{56}\) Firms nr 1,4,6,7,9,10,11,12,15.
\(^{57}\) Firms nr 8, 14, 5.
\(^{58}\) Firms nr 2,3,13, also classified as MBs.
4.4.6: Geographical proximity to partners is less important?

Except for all the firms in publishing, geographical proximity to partners was not important for any of the firms. The firms in publishing industry, however, all talked about how the Oslo based media environment limited relevant potential collaboration partners. Potential reasons why the locations of partners are unimportant are that interaction over vast distances is not so expensive anymore, due to ICTs\textsuperscript{59} and low travel expenses. In addition, the complexity of products implies that the important thing is to get a relevant partner, and the relevance is so much more important than the location of the partner. Moreover, most of the firms are heavily involved in trade unions and branch organisations at the European level, and thus a part of sectoral innovation systems that span national and sectoral boundaries.

4.4.7: NSIs and MNEs – a contradiction?

Some of the informants claim to have no contact with the knowledge structure of the Norwegian NSI. They ascribe this to their belonging to a multinational, or that their knowledge is quite atypical for the Norwegian NSI, and hence their most relevant partners are located elsewhere. A consequence of the merger the producer of electronic equipment has gone through is that they now cooperate more seldom with external actors outside the corporation. \textit{“The corporation is now so huge that we do not see the feasibility in approaching other actors, as we can do it all ourselves, we have no reason to go to competitors.”}. Neither of the two firms in the data and telecommunication industry is embedded to a Norwegian NSI, in the sense that they do not draw upon the knowledge sources of the knowledge infrastructure or view customers or suppliers in Norway as potential partners. However, these firms have

\textsuperscript{59} ICT is an abbreviation for information and communication technology.
extensive international contact within their respective sectors and can thus be said to belong to sectoral innovation systems that crosses national borders.

4.4.8: Is there a connection between organisational type and NSI connection? All firms that are categorized as PBs show closer links to knowledge infrastructure than the rest of the sample. These are supplier to marine and offshore industry, supplier of environmental technology, producer of generic medicine and informant A in data and telecommunication industry. This finding implies that the traditional pattern of collaboration between science and industry remains traditional. Businesses that base their expertise on educational backgrounds are more prone to use research institutes as information sources or main partners in innovation projects, than firms that have a more distant relationship to knowledge infrastructure. Similarly, one would expect the MBs to have the least contact with NSI knowledge infrastructure, and this expectation is confirmed.

4.4.9: Summing up; what is the connection between these firms and NIS support structure? The general finding is that NSI knowledge infrastructure actors are not considered to be important sources of information, whereas in the cases where NSI knowledge infrastructure actors have been used, the firms are quite pleased with their collaboration. NSI support structure is also highly valued by those who have received financial support. The relationship between knowledge infrastructure and firms varies a lot according to sector; especially the relationship to research is an either/or question. The pharmaceutical company is the only firm that perceives themselves as close to research actors. This informant also claims that the relationship between research and business in his sector has become closer in recent years, as the attitudes
and objectives pursued in the public research sector have become more similar to business objectives. At the other extreme is firm A) in the food and drink industry, which has no contact with either research centres within their own corporation or national or international universities. However, all of the firms studied here have reported these innovation projects as beneficial for their competences. The small amount of contact with Norwegian science and technology infrastructure is not experienced as a problem.
Chapter 5: Preliminary conclusions

5.0: Main objective revisited

The aim of this thesis was to shed light on enabling and constraining conditions for knowledge creation and transfer within a firm and between firms collaborating in order to develop a product innovation. The two-sided objective of both exploring what factors that must be present for significant learning to be generated both inside firms and in collaborations was reflected throughout this thesis.

I found it important to conduct an empirical study so as the compare theory with the empirical findings and suggest further developments for both theory and research. However, the explorative nature of this study is making the conclusions here suggestive and preliminary.

5.0.1: General conclusions

5.0.2: Knowledge is socially constructed

My basic assumption that knowledge is socially constructed had not been weakened during this study. More than ever, I presume that communities have to be built in order to transfer knowledge, and that the most valuable knowledge resides not within individuals, but exists in the social spaces created between individuals as they engage in social interaction.

The four research questions which was outlined in the introductory chapter of this thesis has structured the discussion. Now it is due time to draw together major conclusions based on the discussions from the theoretical framework and the empirical findings.
5.1: Is there a connection between organisational form and learning potential?

As we understand from the above discussion of the theoretical framework of Lam, Nonaka and COP, they all presume that the strategic value of tacit knowledge is higher than that of explicit knowledge. This is one of the reasons why PBs and MBs are not considered as good environments for learning. Especially the machine bureaucracy was pointed out in the literature as the organisation farthest away from becoming a learning organization. However, all three firms in this category attempted a product innovation, two of them succeeded. The amount of learning effects from these collaboration projects is not to be underestimated. However, theoretical assumptions that MBs innovate seldom are confirmed, and the most inexperienced collaborators of the sample were a MB firm. It is also interesting to note how many of these successfully innovating firms that have and hierarchical structure. It seems evident that a wider multiplicity of factors must be studied in order to understand the connection between organisational form and innovative capacity. Looking into the interplay of different factors influencing innovation seems to me to be a fertile research area in which we should invest our time and resources.

5.2: Is there a connection between interaction form and learning potential?

What type of interaction form is best suited for learning? What type of interaction is most common in the collaborations?

Physical co-presence and social interaction is best suited for knowledge transfer but seldom the main strategy for knowledge transfer in the collaboration. The fact that most of the informants emphasized physical co-presence and joint practical activities as the most important social context for them to acquire knowledge from their partners, can be taken as an argument for the assumption that it (these interaction forms) are assessed as important just precisely because they allow transfer of tacit
knowledge to occur, tacit knowledge that may give a competitive edge. However, “innovation collaboration” did very seldom imply joint development and shared responsibilities, and was more often about distinct areas of responsibilities; e.g. clear specifications to subcontractors. The discrepancy between what is ultimately regarded as the best learning environment (physical co-presence, close social interaction) and the actual quality of the collaboration (separate partners, working on its own parts) here is interesting. It points to the conclusion that the learning potential in collaboration projects is not optimised. The interactions between the partners are not close, but resemble transaction at arm’s length distance.

The finding is however, not surprising when we keep in mind that extremely few of the firms engaged in the collaboration for learning purposes; the most common motivation was access to markets and sales.

Intermediate and “interfering” aspects between collaboration and learning potential could be:

1) learning and knowledge transfer was not the point of the collaboration, the point was profit, increased efficiency and specialization/division of labour
2) physical interaction is both resource and time demanding, and would make expensive innovation projects even more so
3) the uncertainty in developing a novelty would imply that one must seek to reduce the risks of heavy investments, thus reinforcing the argument that they collaborate in order to spread risk
4) the hypothesis that physical interaction and joint problem solving could be a trend or some fashion word that do not relate to reality- hence the informants talk about it, but does not know how to implement this vision.
5.3: Strategies for knowledge creation and transfer

The third research question was: What strategies do the firms use to ensure internal knowledge transfer in general, and what strategies do they use to ensure knowledge transfer between themselves and their partners?

Most informants confirmed the downsides of a strict top-down strategy. Most firms described themselves as flat organisation that gave lots of autonomy to its employees. The strict normative and value laden character of the concepts hierarchy and flat structures does not make it likely that informants willingly describe their organisation as a hierarchy, although maybe this would be a more accurate description of the actual practices of their organisation.

General information searching procedures are easily and usually conflated with strategies for knowledge creation. The abundance of strategies the theories reviewed here prescribe for the learning organisation contribute to the confusion.

However, there seem to be no confusion about the beneficial learning potential inherent in innovation collaboration. Seemingly regardless of motivation did all firms here assess the innovation collaboration as beneficial for their technological competences. A question that came up under the discussion of the empirical material in chapter four was whether or not collaboration could be beneficial for firm competence regardless of motivation. Most of the firms studied here initiated the collaboration in search for increased sales and lower costs, but got beneficial learning effects as part of the bargain.
5.4: Connection to NSI knowledge infrastructure

The fourth and final research question was: How embedded are these Oslo-based firms to the knowledge infrastructure of the Norwegian national innovation system? What does this implicate for learning?

The theory of NSI prescribes that firms are better off if the have extensive linkages to the knowledge infrastructure. However, successful innovations were ensured regardless of contact to knowledge infrastructure. The findings do, however, confirm traditional patterns of contact between industry and science, were science-based technological development drew most heavily on research environments. The extent to which any firms cooperates with knowledge infrastructure is still very much dependent on its sector belongings, and most sectors considers their activities to be something completely different than the activities that take place within universities and research centres.

One major focus within NSI theories is on the public knowledge infrastructure, universities and research institutes. The theory predicts that firms that have no contact with these actors are worse off than actors that have contact. However, this distinction between “in-contact” and “NSI isolated” firms is blurred considering this empirical study. Those firms who relied only on competitors, customers and suppliers were also able to innovate, and termed this collaboration successful knowledge wise.

5.5: Main conclusion

The main conclusion of this thesis is that the quality and quantity of the learning effects of an innovation collaboration is depending on i) organisational type, ii) strategies for internal and external knowledge creation, iii) interaction form and iiiii) embeddedness to NIS.
5.6: Suggestions for further research

The conclusions that can be drawn from the study above are tentative. More case study and survey research should be undertaken on the relationship between learning and innovation inside innovation collaborations, in order to develop a more accurate theoretical framework that encompasses the diversity of innovating firms that were shown above.
Appendix

Bibliography


Freeman,L & Soete,L (1997) The Economics of Industrial Innovation. London:Pinter


**Articles found on the Internet:**

www.esst.uio.no/orginfo.html  
www.sintef.no  
www.forskningsradet.no  
www.dnv.no

Interview and questionnaire material
The Cotech database, STEP group
Material from ESST lectures:
Interview guide

The informant
*Name:
*What does your position within the company entail?
*What subdivision of the company or department do you work for?
*What is your educational background?
*How many years have you worked for the company in total, and how many years in your current position?

The company
1. Where is your department located within the company?

2. How is the organisational structure of your company? Line or matrix, Hierarchical vs. flat communication, centralised decision-making etc

3. In what sector does your department operate?

4. What kind of products do you (your department) produce?

5. What kind of knowledge does one need to innovate in your industry?

6. How often do you come out with new releases?

7. How do you keep updated on what goes on at the technological frontier?

Recruitment
8. How do you recruit?

9. What is the educational level in this department, and in the company at large?
* Which are the most important educational institutions for your department/company? Do you cooperate with any of these?

Knowledge diffusion strategies within the firm
10. What methods does your company use to ensure that the entire organisation, or relevant actors, know the competences of individuals, and is able to exploit this competence?
[Examples of methods: Info-meetings, internal presentations or exhibitions, lectures, etc]
Alternatively:
What methods do this company use to make individual knowledge common to the larger organisation?

General Experience with collaborations
11. What are your experiences with alliances in terms of knowledge enhancement for the department involved?
Identify key project / “the innovation success story”
12. Can you name and then describe one specific collaboration project you have been or are engaged in, that concerns innovative activities?

13. Which part initiated the collaboration, and what were the stated motives behind contact?

14. What is/was your role within this project?

15. Can you estimate the importance of that particular project for the overall competence level of the involved department and the larger firm?

16. What is the core competence within this project?

17. What forms of interaction do you use in the project?  
   [Practical collaboration, joint activity or separate areas of control/responsibility, joint conferences, courses etc, correspondence through e-mail or mail, web pages]

18. How is this innovation project financed?  
   *Do you receive support from NFR, SND or other public subsidiaries?  
   If yes, what is your experience with that?

19. Which are the most important national and international research institutions for your department? Do you cooperate with them on this project?

20. How often does your firm or your department engage in collaboration with external partners?

Learning effects
21. Do you think that your firm learnt something from this specific innovation project?  
   *What was learnt? [Did you increase your technological know-how, gain perspectives, learned new working methods, learn about project management? Etc]

22. What was changed (for your department, or the firm) through the work on the project?

Partner transparency
23. What type of competence have your partners contributed with in this collaboration?

24. How was this competence communicated?

25. Is your firm all in all satisfied with what your partners actually offered you during collaboration?

Age of the network
26. Did you have any contact with these partners prior to the particular innovation project? For how long have you known these actors?  
   What do you consider to have gained over time in this project?
[Do you lose something over time? etc established relationships not so creative etc]

*Is this particular innovation project in any ways related to prior innovation projects?  How?

**Overlapping competences**
27. To what extent do you consider the competence bases of your partners to be overlapping with your firm’s competences?
* Does it have any positive effect on the mutual learning process?

**Formalisation**
28. To what extent is this collaboration formalised?

**Shared national innovation system**
29. According to your experience with collaborations, can you pinpoint out situations were a shared culture helped solving difficulties, or when different cultures made collaboration more difficult?

**Uncertainty**
30. How do you think uncertainty influences the interaction between the parties? (*How do you assess the sincerity of your partners?)

**Higher level or double loop learning**
31. Have you ever experienced that your firm has changed their visions or parameters for action after interaction with external partners? If you remember such an instance, can you tell me about this change?

**Public sector research actors**
32. What role do external R&D actors (in the public sector) usually play in the innovation activities of your firm?

**Summing up:**
33. What factors must be present in a company to stimulate learning?
* What do you consider a good learning environment?

What factors must be present in a company to stimulate innovation?
Questionnaire

1) Name:
2) Corporation:
3) Department:
4) Position:

During a prior interview, you described one project in which your firm collaborated with external partners. Please try to answer these questions while having that particular innovation project in mind.

5) Please rate the importance of these motivations for this particular collaboration, where 1 indicates the most important and 7 the least important

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocking competition</td>
<td></td>
</tr>
<tr>
<td>Reduce risk</td>
<td></td>
</tr>
<tr>
<td>Access to markets</td>
<td></td>
</tr>
<tr>
<td>Transfer of knowledge</td>
<td></td>
</tr>
<tr>
<td>Cost saving (economies of scale)</td>
<td></td>
</tr>
<tr>
<td>Access to complementary skills</td>
<td></td>
</tr>
<tr>
<td>Sales and profits</td>
<td></td>
</tr>
</tbody>
</table>

6) Please rate the importance of these factors for learning. -2 indicates unimportant and +2 indicates crucial

<table>
<thead>
<tr>
<th>Factor</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>+1</th>
<th>+2</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the job training/job related education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job rotation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social happenings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open forums for discussion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution of decision power and responsibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal Communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


112
7) What kinds of knowledge did your company acquire during this project?
(Several answers possible)

| a) Increased ability to cooperate |
| b) Increased technological competence |
| c) Increased formal/abstract knowledge |
| d) Increased problem solving abilities |
| e) Enhanced strategic and business development skills |
| f) Strengthened project management capabilities |

8) Please rate the importance of these interaction forms for knowledge transfer between firms
(1 indicates most important, 7 the least important)

| Face to face practical problem solving |
| Correspondence by e-mail |
| Correspondence by mail |
| Joint meetings |
| Videoconferences |
| Conferences |
| Joint courses/training |

Please indicate number inside the box:

9) How many employees from your firm is/was involved in this project?

10) Approximately how many people is/was involved in the project in total?

11) Please rate the importance of different sources of information for this particular project:
(1=most important – 14=least important)

<p>| Clients or customers |
| Employees |
| Suppliers of equipment |
| Suppliers of materials |
| Exhibitions |
| Conferences, literature |</p>
<table>
<thead>
<tr>
<th>Competitors</th>
<th>Public research institute</th>
<th>Trade research institutes</th>
<th>Universities</th>
<th>Consultancy companies</th>
<th>Patent documents</th>
<th>Internet</th>
<th>Informal networks</th>
</tr>
</thead>
</table>

12) Please indicate how you relate to the following statements:

<table>
<thead>
<tr>
<th></th>
<th>-2 agree completely</th>
<th>-1 disagree somewhat</th>
<th>0 neutral</th>
<th>+1 agree somewhat</th>
<th>+2 agree completely</th>
</tr>
</thead>
</table>

a) “If the firm has increased its competences during this project, it is more because of the prior/existing capabilities of our firm than the actual partnership itself”

b) “Transfer of knowledge is easier within own company than between companies”

c) “When we do learn from partners, the lessons learned are more important to us than knowledge we could have acquired from within our own firm”

d) “Collaboration projects usually requires change in organisational values and goals to adjust to partners”

e) “How easy our company acquires knowledge is more dependent on our motivation to learn than on prior competences”

f) “Learning is enhanced in settings of joint activity, with shared visions and values”

g) “Top management tolerance of occasional financial failure is of utmost importance for innovation, allowing room for exploration”

THANK YOU VERY MUCH FOR YOUR COOPERATION
**Brief presentation of the sample**

**Firm nr 1: supplier of electric devices**
This firm operates within the electrical engineering sector; it sells electrical plugs and contacts, wiring devices and installation systems. The firm is based on three competence bases: electromechanically know-how, electronics knowledge and telecom and data-related knowledge, and all this has to be combined and incorporated into the end-product; white boxes that are installed in houses and offices. The interviewee, working now as part-time technical consultant, has been responsible for product development for 26 years in this firm. The interview was conducted 18/6.2001. The product innovation was a splash proof switch.

**Firm nr 2: producer of spray cans**
Firm nr 2 is a “contract filler”, and produces different products on spray cans as specified by a “principal”. This firm is manufacturing aerosols on behalf of its principals. Since producing aerosols requires specific permissions and operating under strict regulations, it often is regarded as too expensive for the various manufacturers to make spray can versions of their products themselves. This Norwegian aerosol firm is small, with a total of 30 people employed. 4 people are handling the administrative and developmental tasks, while the rest is employed in the production. Due to the fact that they use suppliers of material, in order to “contain” specific products on behalf of different principals, and are located in the southeastern parts Norway, transport costs reduce their market to the home market (Norway), with some deliveries to the rest of Scandinavia. The interview was conducted 18/6.2001. The innovation project of this firm was never finalized, as their principal backed out of the collaboration.

**Firm nr 3: firm A in the food and drink industry**
This firm is a part of a larger MNE, and their business area is snacks. The informant has been working as product developer in the laboratory the last 5 years, and has been employed in the firm for 30 years. This firm’s product innovation was an innovative design of snack, packing it together with sauce.

**Firm nr 4: a product supplier to marine industry**
This firm has long traditions in the Norwegian maritime industry, and was established in 1934. It is a total supplier of products to all kinds of vessels, including marine chemicals, refrigeration, safety systems and maintenance and repair. They have now established a joint venture with a large British multinational competitor. This alliance includes a marketing agreement, a customer service centre and a logistics agreement. The informant is director of the business development department in Oslo, and responsible for looking after this firm’s interests in the alliance.\footnote{MNE is short for Multinational Enterprise.}

\footnote{This interview was not about an innovation project that led to launch of a new product, but revolved around this alliance. Hence, insights from this informant about collaboration and learning are included in the thesis.}

115
Firm nr 5: firm A in publishing industry
This firm is an information centre for the largest unions in Norway. It creates trade papers on behalf of these organisations, 6 periodicals come out 10 times a year. Firm nr. 5 employ administrational staff, journalists and graphics. The person I spoke to, is the administrative editor and daily manager, and was one of the persons involved at the start-up 7 years ago. This firm is an independent foundation, although owned by the unions, and employs a total of 22 people. The interview was conducted 21/6.2001. The product innovation was a new layout for one of their main magazines.

Firm nr 6: a supplier of offshore equipment
This is a small Norwegian company employing 25 people, operating within the offshore sector, producing systems within meteorology and oceanography. Its market is not large, and all products are produced in low volumes and sold to specific niches within the offshore industry. The person I spoke with, has been the CEO of the company for 5 years now, and is the only person within the company with a degree in economics. The company at large consists of people with PhD’s in engineering, or civil engineers. The interview was conducted 21/6.2001. The product innovation was software that used ordinary radars to measure waves.

Firm nr 7: supplier of environmental technology
The “products” firm nr. 7 deliver is supplying turnkey deliveries of environmental technology to the aluminium industry.
In this case, the informant who had filled out the 2000 questionnaire, had left his position within the company, and another MNE acquired the department responsible for developing the product innovation. However, I got in contact with another informant, who was termed one of the “fathers” of the product, and he was, together with one female representative of the R&D department, willing to talk more about the innovation project that led to the launch of the product. These informants both worked for and environmental branch in Oslo, under the aluminium division, respectively for departments “marketing and technology” and “R&D”. The interview was conducted 22/6.2001. The product innovation was a process for cleansing gasses from aluminium plants.

Firm nr 8: supplier of packaging
This firm delivers packing of various products to grocery shops and packing of furniture, and white goods. My informant is managing product development, a position he has held for 15 years. He has been employed in there since 1964. The department he works for is called “technical customer service/support”, and it is responsible for packaging machines, technical equipment, development of packing, and preparing/adapting normal constructions.
This firm employs 300 people. Production has been located in Sweden since a larger corporation acquired firm 8 two years ago. The location I visited, in the Oslo region, includes a sales department, development department and a small test production site. The interview was conducted 25/6.2001. The product innovation was cardboard benches.

Firm nr 9: firm B in the publishing industry
This firm is a leading Norwegian online company, founded by one of the largest national daily newspapers in Norway. 33 people are employed. Half of them are journalists; the other half works in administration, sales and technical development.
The informant is the development manager, a position he has held since the autumn of 1997. He is also currently studying a master’s degree in media science. The interview was conducted 26/6.2001. The innovation project concerned Internet publishing in general.

**Firm nr 10: supplier of metals and materials**
Firm nr 10 is a supplier of metals and materials, serving the steel, foundry, chemicals, electronics and aluminium industries. Main products are ferroalloys, silicon metal, aluminium and carbon. This firm is one of Norway’s largest industrial companies. The informant is the technical manager of “engineering and projects” within the department of “shared services”. He has worked in this firm since 1984, and has held the managing position the last 3 years. The main function of this department is to adapt “bought in – technology” to various industrial plants, as well as giving general technical assistance. The interview was conducted 28/6.2001. The innovation project revolved around adapting a bought-in design to users at plants.

**Firm nr 11: generic medicine**
This informant belongs to the Norwegian branch of a multinational pharmaceutical company with headquarters located in Norway and the USA. It is one of the leaders of the market in the Nordic countries and Indonesia, in generic medicine. The informant is educated as a cell-biologist from the University of Oslo, specialising in DNA-technology. He has worked for this company for 16 years, the last 8 in his present position. The interview was conducted 29/6.2001. The innovation project concerns development of synthetic antibiotics and is not yet finalized.

**Firm nr 12: firm A in the telecommunication/data industry**
Firm nr 12 has this self-presentation on their web-pages: [it is a] market leader in the provision of open solutions for the digital broadcasting of audio, data and video across various networks including broadband, cable, satellite, terrestrial, IP and Telecom. Headquartered in Norway, [it] employs over 600 highly skilled and knowledgeable people (…). The 2000 success–study’s informant had quit her position in the company, but I was able to track down another person who was the project manager of the success-project, and he was willing to discuss it. The informant has worked in the company since 1998, and has been a project manager for one year. The interview was conducted 3/7.2001. The product innovation was a new TV-signal decoder that improved transfer and representation of colours.

**Firm nr 13: firm B in the food and drink industry**
This firm is producing alcohol primarily for the Norwegian market. The informant is head of marketing, and his department makes the decisions about which products to sell, or quit selling, including the development or adjustment process. The interview was conducted 9/7.2001. The product innovation was about packaging wine in plastic bags inside cardboard boxes, with a tap.

**Firm nr 14: firm C in publishing**
This firm is one of Norway’s largest magazine publishers. It publishes weekly and monthly popular magazines, and has recently begun publishing on the Internet. The informant is the organisational manager, responsible for personnel and development. She has been employed in this firm for 20 years, and has held the top
management position for three and a half years. The interview was conducted 1/8.2001. The product innovation was the adaptation of an old column to web pages, providing an old service through a new medium to their consumers.

Firm nr 15: firm B in telecommunications/data industry
This firm is a supplier and manufacturer of professional tape information storage products based on different technology platforms. Active partnerships are used to build up strength as supplier of professional data storage market. The informant was head of the development department until last fall, and is now head of a spin-off company. He is also a member of the top leader group of the firm. He has worked for this company since 1996, and was directly involved in the innovation project just before its launch, but knows the history of its development and its processes. The development department consists largely of engineers and people with degrees in informatics, as well as a few doctorates and technicians. The interview was conducted 16/8.2001. The product innovation was a new platform for data storage on tape.