

Innovation processes and practices in innovative manufacturing firms

Comparison of innovative Asian, Norwegian and
"Euro-American" manufacturing firms

Helge Godø
Pål Børing

Rapport 15/2011

NIFU

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Preface

This report presents and analyses the findings of a survey, MINE Norway. MINE is an acronym for “Managing Innovation in the New Economy”. As will be explained, MINE was a large international research project on innovation in private sector firms. The project was aimed at developing the conceptual framework of “games of innovation”, i.e. explaining how and why firms innovate. The MINE Norway survey was part of the Work Package 1 (WP1) on “Innovation Processes” in a larger project at NIFU with the acronym GIPOL, or more formally as “Understanding innovation in a globalizing economy: The Norwegian case”. This project was funded by the Research Council of Norway, through the research program “Vekstforsk”.

The rationale for the project “Understanding innovation in a globalizing economy: The Norwegian case” is the recognition that as a result of globalization, new ways of organizing production and new modes of innovation have emerged. Previously, innovation occurred mainly within single firms or in contractual relationships between firms. This “closed” mode of innovation has increasingly been substituted by more open modes of innovation and distributed knowledge networks. The goal of the project is to analyze this and develop a new conceptual framework relevant for innovation policy in Norway.

Within this framework, the aim of WP1 on “Innovation Processes” is to study innovation processes in different types of Norwegian firms and industries. The results of this work are presented in this report, where Norwegian manufacturing firms are compared with Asian and Euro-American manufacturing firms. This comparison was made possible because the project was given access to the data from the main MINE project of the Ecole Polytechnique of Montreal, for which we would like to thank professor Roger Miller. We would also like to thank Mr Jon Vigrestad for providing input to the report, who at the time of the MINE Norway survey was done in 2008, worked as chief analyst at the Federation of Norwegian Industries.

The report has been written by Helge Godø of NIFU, in collaboration with Pål Børing.

Oslo, March 2011

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1 Introduction: Innovation in a globalized world economy

In a highly competitive and increasingly globalized economy, the successes of Asian firms have been a topic of debates and a source of political tension and envy (and admiration) for decades. One of the earlier¹ signs of these successes was the Japanese textile industry in the 1930s, which rapidly established a world leadership. Although this hegemony was disrupted during World War II and for a period afterwards because of the massive wartime destruction of Japan, Japanese companies gradually reemerged as highly successful in the 1960s. Toyota is of these, now the world's largest automotive manufacturing company. Toyota has its ancestry in the textile industry that developed in Japan in the 1930s, an ancestry that Toyota shares with other Japanese companies that have subsequently developed and become large multinational industrial corporations, such as Suzuki. The core of Toyota's success in textile manufacturing was due to a number of technological innovations developed by the founder, Sakichi Toyoda (1867-1930, also referred to as the "King of Japanese inventors"), which increased the productivity and quality of textile production dramatically.

The success story of Toyota has been emulated by other Asian companies; in recent decades this has become apparent in the so-called "newly industrialized" countries, such as South-Korea, Taiwan and People's Republic of China. In this report, the focus will be set on these three countries in a comparative perspective, i.e. manufacturing firms in these countries will be compared with the same type companies in Norway and a category of firms which will be called "Euro-American" firms, as will be elaborated soon.

The simplistic explanation of the success of Asian firms is their low labour costs and a work culture, with emphasis on diligence and discipline. These aspects are often reported by Western media, by investigative journalists, e.g. reports from "high-tech sweat-shops" in China where young female workers from rural areas work as a modern type of indentured labour, living in cramped company dormitories and work for 12 hours a day or more, without holidays or days off – all this done at pay rates that are a fraction of what factory workers in Europe or North-America earn. However, these aspects do not explain why an increasing number of Asian firms are highly innovative in terms of technology and product development, i.e. the main reason why these companies are highly competitive and have become successful in the global markets. Unfortunately, poor and inhumane working conditions and low pay are prevalent in many other parts of the world outside Asia, even in some sectors of European and North-American economies this is rampant and it does not lead to an increase in innovation: Illegal immigrants work in fruit orchards in Spain and California, or leather work factories in Italy or Romania – and this does not contribute much to innovation. Hence, on a more general level, the interesting question is how firms in the increasingly globalized economy strive to succeed – and what they do for creating and promoting innovations, and, closely related to

¹ Europe has imported technologically advanced manufactured goods from the Far East for millennia, such as porcelain and silk. In fact, the "Silk Road", the main historical trade route between China and Europe, has its ancestry back to the Han dynasty (206 B.C-220 A.D).

this, how they understand and perceive, analyze, interpret and plan their innovation strategy and related activities.

One analytical approach to this is the conceptual framework of “games of innovation” (Florice & Dougherty, 2007; Miller & Florice, 2004, 2007). Although this conceptual framework has some resemblance to others in innovation theory, such as the notion of “technological regimes” (Geels, 2002; Rip & Kemp, 1998) and “innovation regimes” (Godoe, 2000, 2006) – and a somewhat broader conceptual framework of “innovation journey” (Ven, Polley, Garud, & Venkararaman, 1999), the conceptual framework of “games of innovation” puts more explicit emphasis on the dynamic and strategic aspects related to innovation activities, which may explain why the term “games” has been chosen as a designation, i.e. the dynamic connotation that one associates with something that is called a game. Although using the term “game” in this context may be considered as a misnomer because a game is usually associated with activities pursued for fun, leisure and pleasure, i.e. an activity where entertainment² is set in focus, the term “games of innovation” relates to the commonsensical understanding of “game” as a type of activity where there is an element of competition between the participants for attaining a certain goal – and that the actions and interactions involved are defined according to a set of rules. In other words, “game” should be understood in a metaphorical sense, somewhat similar to the notion of “innovation journey”. The conceptual framework of games of innovations is, however, different from “game theory”.³

The analyses presented in this report are based on data collected in the MINE project, which had its main base at Ecole Polytechnique in Montreal, Canada, until 2010, when this part of the project was finished⁴. MINE is an acronym for “Managing Innovation in the New Economy”. The focus of MINE has been on innovation strategies and processes in successful and innovative private sector companies, aimed at characterizing challenges facing firms because of the emergence of what was initially termed as the “New Economy” (Miller & Florice, 2004). From around 2005, the MINE project designed and undertook a survey, which by 2009 had obtained 940 respondents in many countries, as will be explained in the next chapter, chapter 2. The MINE Norway⁵ survey, which was done in 2008, came in addition, so the data matrix used in the analyses presented in this report is based on a total of 1,005 respondent firms.

In this report, the results from the analyses of data from the MINE survey will be presented in a comparative perspective, i.e. a comparison of Asian manufacturing firms with Norwegian and “Euro-American” manufacturing firms. These three categories of firms and the procedures used in analyses will be presented and explained in chapter 2. The topics that will be presented in this report are:

² Game is of course also an industry, as evident in cities such as Las Vegas or Macau, or in global events such as the Olympic Games or the European Tour de France.

³ Game theory is a branch of mathematics that attempt to provide formal (stylized) explanation of strategic choice in situations of competition and conflict, such as the concepts of zero sum game or cooperative games, etc.

⁴ The home page of MINE, www.minesurvey.polymtl.ca, was closed down early in 2011.

⁵ This research is part of a larger project, GIPOL, funded by the Research Council of Norway.

- Firm performance
- Perception of contextual factors
- Value creation capability of the firm
- Innovation awareness in the organization
- Innovation strategy processes and decision making
- Strategies and practices for innovation, with the following sub-topics:
 - o Exploration activities
 - o Decision-making and portfolio management
 - o Policies and practices relevant for innovation projects
 - o Commercialization practices

The purpose of this report is to find out if Asian companies, which have enjoyed considerable success during the past decades in an increasingly globalized and competitive economy, differ in terms of their innovation processes and how they innovate – the way they think, plan and work with innovation. In the material presented in this report, the manufacturing firms that participated in the MINE survey are fairly similar in terms of performance, although Asian firms seem to have a slightly better overall performance in terms of criteria used for business success. Based on these criteria, one may suggest that there are numerous ways of obtaining business success, and the rest of the report will focus on what these differences are.

As will be shown, the firms differ in terms of their perception of contextual factors (chapter 4). The analyses of the material suggest that Asian firms are more market oriented in their outlook, however, this is combined with a high awareness of competition and technological development outside the firm. Norwegian manufacturing firms, in contrast, have a stronger technology oriented outlook. Euro-American firms are similar to Asian firms in their emphasis on markets, however, this emphasis is not so distinct as their Asian counterparts.

The topic of value creation capability of the firm (chapter 5) provides an insight into how the firms that participated in the MINE survey perceive the potential of their own firm. The analyses of the material from this part of the survey showed a high degree of commonality between the firms; hence the differences must be characterized as slight. In spite of this, there are some distinctions: Asian firms are slightly more customer focused in their understanding. In contrast, Norwegian manufacturing firms seem to have a higher focus on techno-economic aspects of their firm. Euro-American firms are in a way similar to the Norwegians, however, they have a stronger focus on their firms' products.

The topic of innovation awareness in the organization (chapter 6) may provide an insight into the “innovation culture” or “innovation climate” in the firm, i.e. to what extent and how innovation is placed on the agendas of the firms and in the minds of individual employees. The analyses of the material from this part of the MINE survey showed that Euro-American firms are distinctly different from Asian and Norwegian firms, i.e. that Asian and Norwegian firms have some commonality in terms of innovation awareness in their organizations. Both categories of firms put emphasis on interpretation of innovation, however, whereas Norwegian firms attach importance to aligning this with formal management processes, Asian firms attach this to individuals within the organization and

their interpretations of innovation. In contrast, Euro-American firms put emphasis on communication and action as important for innovation awareness in the organization.

Contrary to what management science (Robert G. Cooper, 1996; Robert G Cooper, Edgett, & Kleinschmidt, 2000) extoll about the importance of top management attention and strategy thinking related to innovation, the MINE survey on innovation strategy processes and decision making (chapter 7) suggests that this is not the case: All firms are similar in that innovation is neither high on the agendas of top management – nor is innovation an important topic for senior managers. Compared to the results obtained on innovation awareness (chapter 6), these observation may seem puzzling. However, this may be the result of how decision making is done. The results indicate that in Asian firm, NPD-teams (New Product Development teams) are given high autonomy and empowered to make decisions that are related to innovation. In other words, innovation is delegated to specialist entities. In Norwegian firms, a similar type of delegation may be observed: Business Units (BUs) are responsible for NPD. Euro-American firms are similar to Asian firms, i.e. NPD-teams are put in charge, but not so strongly as in Asian firms.

The topic of strategies and practice for innovation (chapter 8) cover four sub-topics. The first one is about exploration activities. Together with commercialization, exploration activities is perhaps the most interesting and significant issue in contemporary innovation research. Being able to select the “right” idea for innovation development is seen as the most important success criterion for firms: No matter how excellent or perfect a subsequent product or service development is, a poor idea will just become a poor new product or service; however, a good idea may survive in spite of a poor product or service development. The notion of “Fuzzy Front End” of innovation (Robert G Cooper, et al., 2000; Gordon, Tarafdar, Cook, Maksimoski, & Rogowitz, 2008; Koen et al., 2001) has gained increasing interest among innovation strategy managers, reflecting the emphasis that is put on this. The responses made in the MINE survey suggest clear-cut differences between the three categories of manufacturing firms: Whereas Asian firms may be characterized as having an extrovert outlook in their exploration activities, Norwegian and Euro-American firms are introvert in their outlook. To a much larger extent than the other categories of firms, Asian firms orient themselves to sources outside the firm, such as suppliers, external experts and academic community, industrial networks, etc. Norwegian and Euro-American firms, in contrast, focus on leveraging resources within the firm in their exploration activities.

The second sub-topic on strategies and practice for innovation is on decision-making and portfolio management (chapter 8.2), i.e. mainly what on happens and what is done once an idea is selected and implemented . The results obtained from the analyses indicate commonalities in many variables between the three categories of firms. The firms are also similar because a multitude of strategies seems to exist. However, there are some distinctions: Asian firms, more so than the other two categories of firms, emphasize empowerment of middle managers and use of portfolio management approach in innovation activities.

The third sub-topic on strategies and practice for innovation is on policies and practices related to innovation activities. As with decision-making and portfolio management, analyses of the topic of

policies and practices also showed that there are many similarities between the three categories of firms. Still, in some aspects, there are differences: Asian firms emphasize the importance of using a rigorous and experimental approach at all stages of product development in order to secure success. This attitude is also shared by Euro-American firms. In contrast, Norwegian firms seem to favor a different approach because they put emphasis on reusing successful solutions and components from earlier development projects (“object orientation”) and importing proven solutions from sources outside the firm.

The fourth sub-topic on strategies and practice for innovation is on commercialization practices. As with selection, commercialization is seen as the most important issue in contemporary innovation research. This is about “getting the prototype out of the lab and into the market”. The results obtained by the analyses suggest that Norwegian firms “deviate” from the other categories of firms, mainly because they, in comparison with the other two categories of firms, may be characterized as fragmented and “frugal” because only a few aspects are given high priority. In contrast, the commercialization practices of Asian and Euro-American firms appear to be strong, cohesive and comprehensive. The methodological aspects related to the findings of the survey and the analyses done with the data will be elaborated in chapter 2, but the sample of firms that were recruited as respondents to the MINE-survey was a strategic sample (in contrast to a random sample), because an important criterion for selecting respondents was that their firms were successful, both in terms of innovation and other attributes related to business success.

The interesting question is: If all the firms that responded to the MINE survey and that were analyzed for this report have enjoyed business success, do the differences matter? Clearly, one may assume that the firms are participants in the same or fairly similar types of “games of innovation” because they are all homogeneous according to the broad categories of NACE⁶. In order to approach this question, we need to have some type of understanding or interpretation of what the differences imply. In the concluding chapter of this report (chapter 9) this will be a topic of discussion. However, at this stage of the report some introductory points may be made.

The rationale for the approach presented in this report is that globalization and the role of innovation in this may be understood by analyzing and comparing the “...role of shared cognitive frameworks in structuring social systems” (Miller & Floricel, 2007), i.e. exploring and comparing how firms from different parts of the world participate in their game of innovation. By participating in a specific game, the purpose and rules of this game will of course determine how a firm plays. But their strategy and practice will be influenced by their understanding and interpretation of the game they are participating in – and the dynamics they encounter in these, i.e. how they interpret and act on their perception of the game. Although the “reality” of the game in globalized markets ideally should be identical for all participants, the success of Asian firms raise the question of whether the “...shared cognitive framework” is different. Of course, one may presume that the games themselves are malleable due to various types of interventions that, either overtly or more unintentionally, will

⁶ NACE = Nomenclature statistique des activités économiques dans la Communauté européenne, similar to SIC (Standard Industrial Classification), used for classifying firms according to the sector and branch they belong to. Further information: http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

change how the game is played and the “rules” of the game. If so, are there salient and specific aspects that may explain, or at least be observed, in the performance of Asian firms during the last decade?

Research on corporate organization (Fang, 2010; Hofstede, 2007; Hofstede, Hofstede, & Minkow, 2010; Zhang & Dodgson, 2007) suggests that cultural factors make firms around the world different even if they participate in globalized markets and face each other as competitors on more or less equal footing, i.e. they participate in the same game of innovation. Cultural diversity is also an assumption in the conceptual framework of national systems of innovation (NSI) (Lundvall, 1992, 1999 ; Nelson, 1992; Nelson & Rosenberg, 1993), i.e. that nations differ in their innovation capabilities for a number of complex factors. This may explain why firms also have national and ethnic identities which is reflected in their “shared cognitive framework”, which in turn may influence (and explain) how they think, plan and act in terms of innovation. This, in turn, may explain their performance and contribute to a better understanding of why firms around the world approach globalization in different ways.

One interpretation that may be made from the results presented in this report is that Asian manufacturing firms have a dominant strategy and practice that increase its exposure for ideas that may be conducive to promotion of radical innovations. In contrast, Norwegian and Euro-American manufacturing firms have a dominant strategy and practice more oriented towards exploitation activities that will lead them towards incremental innovation as an outcome of their introvert orientation. Following March (1991), one could suggest that Asian manufacturing firms are more *exploration oriented*, in contrast to Norwegian and Euro-American manufacturing firms that seem more *exploitation oriented*. A similar conceptual dichotomy has been developed by Ven et al. (1999) in their conceptual framework of “innovation journey”, in the concepts of *divergence* (similar to March’s “exploration”) and *convergence* (similar to March’s “exploitation”). Because of the contrast between Asian manufacturing firms on the one side and more “occidental” manufacturing firms on the other, one may be tempted to ask if this divide reflect cultural factors, i.e. general norms and values of the society of the firms. This is an assumption in the theory of “innovation games” (Miller & Floricel, 2007). One may also point to framework conditions, e.g. industrial policy regimes in the People’s Republic of China, Korea and Taiwan that put great emphasis on scientific and technological research directed to development of an advanced industry. These broad topics, although interesting, are outside the scope of this report. Still, if the interpretation that Asian firms are more exploration oriented is considered satisfactory, and if this may be accepted as an explanation of why Asian firms are so innovative, this aspect should be of interest to innovation research – and, ultimately, for innovation policy.

2 The comparative approach

2.1 The MINE survey

The analyses presented in this report are based on data collected in the MINE project, which had its main base at Ecole Polytechnique in Montreal, Canada, until 2010, when this part of the project was finished⁷. MINE is an acronym for “Managing Innovation in the New Economy”. The now retired professor Roger Miller of Ecole Polytechnique was its project leader. MINE had its main funding from the Social Sciences and Humanities Research Council of Canada and collaborated with the Industrial Research Institute⁸ (IRI) of Washington, USA. IRI is a membership organization for promoting innovation activities and R&D in private sector companies and federal laboratories, mainly in the USA, but many of its members are European and Asian multinational corporations. In the beginning, MINE started up by doing qualitative interviews, mainly with IRI’s members, on innovation strategies and processes in private sector companies, aimed at characterizing challenges facing firms because of the emergence of what was then termed as the “New Economy” (Miller & Floricel, 2004). Then, around 2005, the MINE project used the findings from these interviews as input to design a survey, which by 2009 had obtained 940 respondents in many countries, as will be explained below. A copy of the English⁹ version of the questionnaire is enclosed this report as Appendix 1. The MINE Norway¹⁰ survey, which was done in 2008 as a web-survey, came in addition, so the data matrix used in the analyses presented in this report is based on a total of 1,005 respondent firms.

2.2 Rationale of strategic sample

The criterion used for recruiting the respondents to the MINE survey was *strategic*, i.e. not random sample, which is the mainstream approach to doing surveys: Using the strategic sampling approach, firms with a track record of giving innovation high priority, such as members of the IRI, were approached and recruited to the MINE survey. The point of contact with these was usually top executives responsible for innovation, such as the CTO or the R&D vice-president, of the firm. In Norway, the firms were selected from a record kept by the Federation of Norwegian Industries¹¹ on R&D and innovation in their member firms: The top 100 companies in this record, i.e. those firms that are most innovation intensive, were approached and asked to participate in the survey. In the main MINE survey, the network of IRI (Industrial Research Institute) of USA was used for recruiting respondents, cf.: <http://www.minesurvey.polymtl.ca/> and articles written by Roger Miller and his associates in the MINE project (Floricel & Dougherty, 2007; Miller & Floricel, 2004, 2007). Strategic

⁷ The home page of MINE, www.minesurvey.polymtl.ca, was closed down early in 2011.

⁸ Cf. <http://www.iriweb.org/>. IRI also publishes the journal *Research Technology Management*

⁹ In Norway, a Norwegian language version of questionnaire was used. This was an exact translation from the English. The respondents in Norway were free to choose the English or Norwegian version.

¹⁰ This research is part of a larger project, GIPOL, funded by the Research Council of Norway.

¹¹ We are grateful for the help and advice given by Mr. John Vigrestad, who until 2010 was a chief analyst at the Federation of Norwegian Industries, in doing the survey.

sampling is also known as non-probability sampling, because in this type of sampling, only a part of a population having a specific characteristic is selected. This sampling method will impose constraints on statistical generalization, an aspect that will be elaborated in section 2.5 below. The rationale of the strategic sample may be illustrated by an analogy: For studying the phenomenon of high performance marathon running, what provides the best data would be to study runners who are high performers (e.g., the 1000 fastest at the marathon distance); a random sample of all runners (e.g. a sample of 1,000 marathon runners drawn randomly from a population of 1 million marathon runners) would probably provide interesting information, but would give less focused information on high performance runners; in such a random sample, the chances of drawing a high performer is just as low or high as the lowest performer ($p= 0.001$).

2.3 Survey design and rationale

In accordance with the assumptions in the conceptual framework of “games of innovation” (Florice & Dougherty, 2007; Hopkins, Tidd, Nightingale, & Miller, 2011; Miller & Florice, 2004, 2007; Tirpak, Miller, Schwartz, & Kashdan, 2006), the MINE survey is designed to elicit information on how firms participate in their specific game of innovation. More specifically, the questionnaire is designed so as to elicit and obtain information from people in key decision making positions in innovative firms. The respondents that were selected are responsible for innovation activities in a firm. Hence, an assumption in the design of the survey is that elicitation of how these key decision makers think, plan and act will give relevant information and data for explaining their firms’ innovation activities. The design of the MINE questionnaire is shown in Figure 2.1.

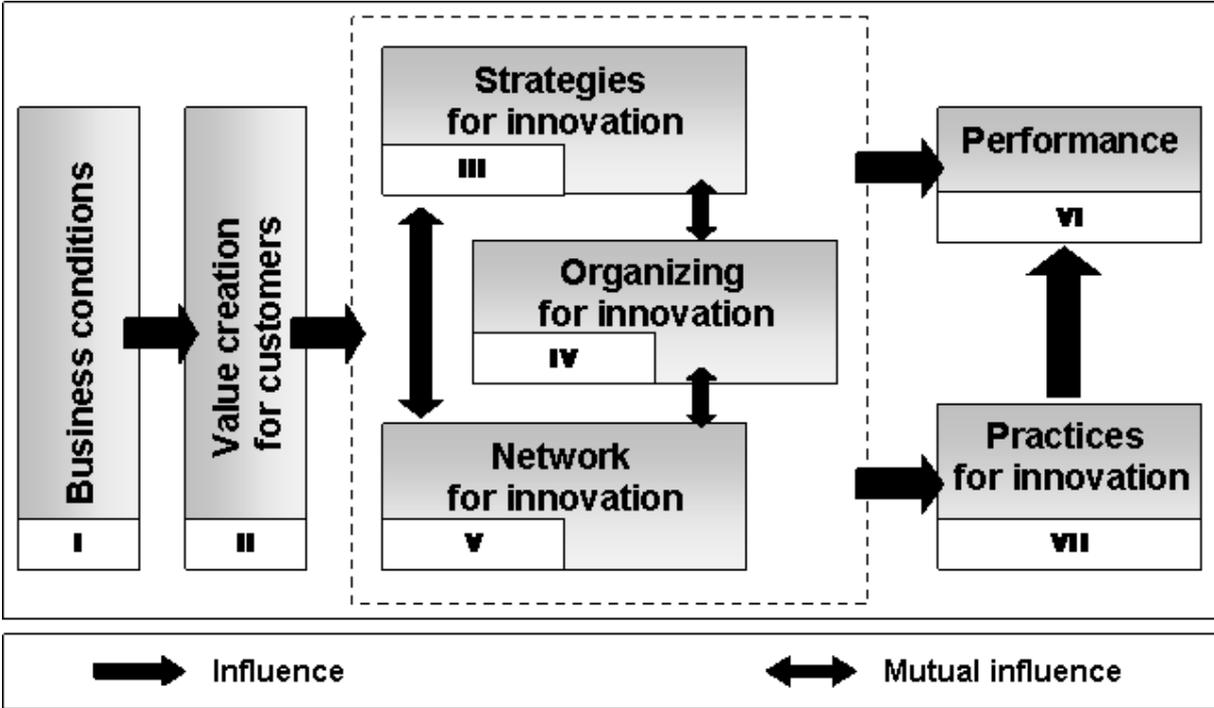


Figure 2.1: Design of MINE questionnaire

As shown in Figure 2.1¹², the questionnaire is organized in seven “compartments” or main topics that are relevant for obtaining data on innovation processes, strategies and practices. The figure also gives an indication of causalities by arrows representing influences and, by this, a type of linearity of the elements that constitute innovation processes. The middle of the figure, the part that is delineated by the stippled lines, constitutes the conduct of the innovation process. As shown in figure 2.1, the questionnaire consisted of these parts:

- *I – Business conditions*, in which the respondents were asked to indicate on a seven point scale going from “Totally disagree” to “Totally agree” to 32 statements,
- *II – Value creation for customers*, in which the respondents were asked to indicate on a seven point scale going from “Not important” to “Extremely important” to 12 statements
- *III – Strategies for innovation*, in which the respondents were asked to indicate on a seven point scale going from “Not important” to “Extremely important” to 47 statements – and in addition click on buttons for eight questions on more tangible data on the firm
- *IV – Organizing for innovation*, in which the respondents were asked to indicate on a seven point scale going from “Totally disagree” to “Totally agree” to 38 statements,
- *V- Network for innovation*, in which the respondents were asked to indicate on a seven point scale going from “Not important” to “Extremely important”, or “Totally disagree” to “Totally agree”, to 15 statements – and in addition click on buttons for two questions on more tangible data on the firm
- *VI – Performance*, in which the respondents were asked to indicate on a seven point scale going from “Worse than rivals” to “Better than rivals” to six statements– and in addition click on buttons for three questions on more tangible data on the firm,
- *VII – Practices for innovation*, in which the respondents were asked to indicate on a seven point scale going from “Totally disagree” to “Totally agree” to 47 statements.

Altogether, the questionnaire consisted of 197 statements, as explained above, and informants were asked to give more specific information on 13 issues. A copy of the questionnaire is enclosed as appendix 2 in this report. The questionnaire would normally require 45-60 minutes of attention from a respondent ; none of the questions (statements) were of a nature that would require respondents to check into company records, etc., i.e. the “answers” were (are) in the minds of the respondents.

The intention of asking respondents about these topics was to elicit how relevant decision makers for innovation activities think and act in their work. Of course, what they and the firms they work for actually do – or fail to do – may theoretically be something different. The research of Van de Ven et al. (1999) has suggested numerous discrepancies between “textbook ideals” and reality (“what we see”), i.e. their observations and other empirical material on how firms make decisions on innovations and how innovation effort and projects actually evolve deviate much from “textbook ideals” and their strong prescriptions. In the material from the MINE survey, the probability that

¹² Source: MINE homepage, downloaded from www.minesurvey.polymtl.ca (now (2011) closed).

respondents gave answers according to “textbook ideals” or other standards of “political correctness” is of course pertinent, but does not seem reasonable or probable for a number of reasons. Although some innovation researchers such as Robert Cooper (Robert G Cooper, et al., 2000) present prescriptions of doing innovation activities according to the “Stage-Gate” approach seem to have some influence, there is no unified or coherent theory or tenets as to what the “textbook ideals” are. Second, there was no incentive in the survey for respondents to answer opportunistically or whatever they would think is “correct” or according to the “textbook ideals”¹³. Third, one may assume that the least complicated way to respond to a survey is to give answers according to his or her own understanding of reality. Hence, one may assume that the responses given provide a fairly accurate picture of how decision-makers think about innovation activities – and what they emphasize in their decision-making and their views on the firms’ various strategies, policies and practices related to innovation activities.

The design of the questionnaire reflects assumptions that may be recognized as belonging to the Structure-Conduct-Performance-Paradigm (SCPP) of industrial organization theory (Bain, 1951), although in the publications from the MINE project, no explicit reference is made to SCPP. In SCPP, the basic assumption is that an industry’s performance, such as measured by volume of sale and other proxies that represent value creation, depends on the *conduct* of the firms, i.e. what the firms do and how they do this, i.e. the center part of Figure 2.1. The conduct in turn, depends much on the structure, i.e. external factors such as technology, regulations – and, of course, characteristics of the markets, such as demand, number of buyers and sellers, product differentiation, etc. Superimposing the SCPP on figure 2.1, one could say that:

- *Structure* is represented by: I – Business conditions and II – Value creation for customers
- *Conduct* is represented by: III – Strategies for innovation, IV – Organizing for innovation, and V- Network for innovation,
- *Performance* is represented by: VI – Performance and VII – Practices for innovation

An extension of SCPP to innovation theory would be that performance to a large extent reflects innovation capabilities of a firm and its ability to compete with others within the opportunities and constraints set by the SCPP that the firm belongs to.

In the research done in the MINE-project, one of the published papers (Miller & Floricel, 2007) presents a review of the literature relevant for exploring and analyzing the conceptual framework of “innovation games”. In their approach, they have structured this into what they call “three theoretical pillars” of relevant innovation studies:

- research on innovation systems,
- theories about the role of shared cognitive frameworks in structuring social systems,
- research on the sources of heterogeneity in innovation processes.

¹³ This is a type of comment that has been offered for the way Asian informants may respond, i.e. that they are “polite” and have an “eager to please” attitude and for this reason make responses that they think will please the researcher and comply with standards of correctness.

Of these, the most relevant in terms of answering the question of how firms make decisions on innovation activities is the second one, the one about the role of shared cognitive framework in structuring social systems, because these are related to actions and action rules. Miller and Floricel explain that this type of research is relevant because they focus on “..decision-making processes that, together with a capacity base, enable managers to develop and implement innovation strategies” (Miller & Floricel, 2007, p. 8). Accordingly, rules and conventions that prescribe what to do may provide blueprint for what kind of decisions that are actually made. Some of these are general and shared by “everyone” within a culture or a society, however, others are specific and related to the game of innovation that the firm participates in.

According to Miller & Floricel, there are specific “rule of games” in innovation, i.e. that each type of innovation game have sets of “rules” that are unique for the firms that participate in these. In their mind, rules of the game “offer a clear path to implementation” in terms of innovation activities, which explains their suggestion that “rather than recommending concrete strategies and investments, the rules state ideal propensities to innovate and to create barriers, attack, or cooperate” (2007, p. 9). In justifying this, they attempt to make an analogy to Ludwig Wittgenstein’s (1889-1951) notion of grammar, i.e. “rules” that are embedded in a language and that people have to adhere to when they communicate. According to the authors, the “rules of the game” approach has more explanatory power than those that explain innovation activities in terms of life-cycles or waves (e.g. Schumpeter (1934 (1974)), Perez (2002)), or evolutionary, systemic approaches (e.g. Edquist et al. (2004) and Lundvall (1992)). The role of rules in an innovation game is, according to Miller & Floricel that of forming a “coherent totality around the value creation process” (p. 10) – and this also explains the dynamic that is active in generation of heterogeneity. Accordingly, understanding innovations is a matter of understanding how firms interpret and apply rules when they play their game. This assumption is also shared by the conceptual framework of technological regimes (Godoe, 2000; Rip & Kemp, 1998). However, in the conceptual framework of “games of innovation”, these rules seem to emerge from contextual conditions, some of which are stable – others, more transient. These variations may in turn determine what type of game that emerge. There are three dimensions in these:

- knowledge production dynamics, i.e. the flow of new, relevant knowledge,
- structuring potential, i.e. the potential for firms to capture value
- demand specificity, which refers to what type of demand and purchasing powers that customers have.

In their model, these three dimensions are put on a tripartite, ordinal scale (high-average-low) matrix – and various combinations of the three dimensions and their value on the ordinal scale define different games. In theory, this may provide 27 different categories of innovation games, however, Miller & Floricel (2007) have identified 11 distinct games. In an earlier paper (Miller & Floricel, 2004), only eight games were presented, which means that criteria for what constitutes a game is flexible. According to the conceptual framework of “games of innovation”, each game has what Miller & Floricel (2004, 2007) call a “dominant logic” for value creation – and, more interesting for us – rules that determine how innovation activities should be organized, i.e. organizational forms that are

related to the contextual conditions and “dominant logic of value-creation”. Hence, they spell out four sets of rules:

- Innovation capability in terms of knowledge, engineering and management, and ability to transform and commercialize scientific knowledge,
- Network skills, i.e. building relationships to external parties such as customers, investors, competitors, regulators, etc.,
- Competitive and collaboration strategies, which influence allocation of resources to doing innovation activities such as R&D and/or collaboration with other firms. Depending on what type of game the firm participates in, the R&D intensity for some is in the range of 40% of their revenues, while in others, this may be as low as 1-2 % of the revenues.
- Internal organization of innovation activities, which varies according to what type of game the firm is playing. In some, innovation activities play an important role and have attention of top management; in others, this is something “taken care of” by a specialised unit such as a R&D unit in the firm.

According to Miller & Floricel, the conceptual framework of innovation games is an evolutionary model, hence dynamics of evolution are relevant for how games develop. In this, there are three key concepts:

- *variation*, which is created by individual and corporate agents (2007, p. 25); in particular entrepreneurs play an important role in creating variation, but the rate of knowledge production is also an important source,
- *selection*, which occurs because of the competition between ideas, technologies and firms,
- *retention*, in which rules become institutionalized and create various types of path dependencies that constitute developmental trajectories.

Looking more closely at the theoretical explanations given for justifying the conceptual framework of innovation games, the ambition seems eclectic, in the sense that they have attempted to assemble elements from a number of different theories on innovation for explaining something that resembles explanations that have been developed within the framework of sectorial systems of innovation (Godø, 2008). Miller and Floricel are explicit in pointing out that their use of the term “game” has nothing to do with the mathematical understanding such as in “game theory”, but their use of “game” as a metaphor has been inspired from sports, such as a game of soccer, where teams are the metaphorical equivalent of firms. However, the MINE survey is unique because it attempts to elicit information that reflects how key decision makers in firms think and practice innovation. One may suggest that the justification for doing the MINE-survey in which the purpose is to map how managers of innovation activities perceive and judge different aspects related to innovation may be parallel to asking a captain or a team coach of a sports team about how they play their game. This latter point is not spelt out or explained in this way, but it seems to be a fair interpretation of their suggestion that they want to “identify the rules of the game by measuring and comparing managers’ cognitive representations of the value-creation network, participants and roles, strategies and practices” (Miller & Floricel, 2007, p. 28).

2.4 Globalization

In the research reported here, the approach has been different compared to the one described above (Miller & Floricel, 2004, 2007), because the main focus is set on globalization and how innovative firms from different parts of the world participate in their game of innovation. In debates, both popular and public policy debates and in more academic research communities, the topic of why specifically Asian firms have shown themselves capable of competing with considerable success has been on the agenda for many decades, cf. Kline & Rosenberg (1986) and Freeman (1988). A number of explanations for the success of Asian firms are put forward, such as Asian firms succeed because they are skilful in imitation, i.e. they are adept at reverse engineering of Western innovations (hence, Asians are “free-riders”) and have skills and other capabilities in terms of manufacturing these imitations which make them competitive. The notion of undeveloped nations “catching-up”, which also often enters into explanations of the Asian success, is that these nations are able to succeed because of extraordinary efforts and second-mover advantages. Recently, the economic stagnation of the Japanese economy for the last decade has been used as an argument for the “catching-up”-hypothesis. According to this, the Japanese have successfully caught-up with the rest of the world and has now encountered problems because the allegedly imitative strategy for Japan has reached its limit; Japan has entered a type of developmental “dead end”. A weakness of this argument is that it veils that Japanese companies are still very profitable and competitive, mainly because they are highly innovative, as is evident in a large number of Japanese companies in the automobile industry, in electronics and computers, in new materials, entertainment, etc. (e.g. Toyota, Sony, KyoCera, Nintendo, etc.). Japan’s economic stagnation and problems since the 1990s are mainly due to structural maladies of the Japanese domestic economy and society (e.g. aging population and low fecundity, etc.) – and an ineffective political system.

The rationale for the approach presented in this report is that globalization and the role of innovation in this may be understood by analyzing and comparing the “role of shared cognitive frameworks in structuring social systems” (Miller & Floricel, 2007), i.e. exploring and comparing how firms from different parts of the world participate in their game of innovation. To extend the game of innovation metaphor: By participating in a specific game, the purpose and rules of this game will of course determine how a firm plays. But their strategy and practice will still be heavily influenced by their understanding and interpretation of the game they are participating in – and the dynamics they encounter in these, i.e. how they interpret and act on their perception of the game. Although the “reality” of the game in globalized markets ideally should be identical for all participants, the success of Asian firms raise the question of whether the “..shared cognitive framework” is different. Of course, one may presume that the games themselves are malleable due to various types of interventions that, either overtly or more unintentionally, will change how the game is played and the “rules” of the game. If so, are there salient and specific cultural aspects that may explain, or at least be observed, in the performance of Asian firms during the last decade?

Research on corporate organization (Fang, 2010; Hofstede, 2007; Hofstede, et al., 2010; Zhang & Dodgson, 2007) suggests that cultural factors make firms around the world different even if they participate in globalized markets and face each other as competitors on more or less equal footing.

Cultural diversity is also an assumption in the conceptual framework of national systems of innovation (NSI) (Lundvall, 1992, 1999 ; Nelson, 1992; Nelson & Rosenberg, 1993), i.e. that nations differ in their innovation capabilities for a number of complex factors. This may explain why firms also have national and ethnic identities which is reflected in their “shared cognitive framework”, which in turn may influence (and explain) how they think, plan and act in terms of innovation. This, in turn, may explain their performance and contribute to a better understanding of why firms around the world approach globalization in different ways. Exploring this then became an objective of the analyses presented in this report.

As pointed out earlier, the success of Asian firms has been a source of much debate among incumbent countries, i.e. Western countries, in Europe and North-America. Simultaneously, this has also become a source of pride to the “winners”- Asian countries and in particular Asian firms that have succeeded in terms of profits, sales growth, market shares, etc. in globalized markets. In Europe and North-America, many of the explanations given (often used for justifying demands for trade protection policies¹⁴) imply that Asian industry has set plagiarism into system and that they are basically not capable of creativity and innovativeness, as Western industry. Although much of this may be characterized as “normal” partisan, ethnocentric rhetoric with associated nationalistic chauvinism, this may also be due to ignorance and cultural barriers. The normal perception of Asia in Western countries is that they are backward because there is little understanding of Asian culture and language. Hence the knowledge that Asian countries have a cultural and techno-scientific heritage that is advanced, based on millennia of highly educated people (Mokyr, 1990; Needham, 1964), is not well appreciated. Innovation has always been a centrepiece in Asian culture, however, the perception of this may be obscured to many people in West because they understand Asia as traditionalistic and status-quo oriented. In Nordic countries, this is amplified by an understanding that their culture is superior to all others, specifically what is termed as the Nordic model is seen as the best¹⁵, also in terms of innovation (Jensen, Johnson, Lorentz, & Lundvall, 2007).

2.5 The analytical approach

As indicated earlier, explaining the success of Asian firms in terms of low labor costs, hence also low price of products is too simplistic given the high quality and other attributes that indicate high degree of innovativeness and high level of knowledge embedded in the products. The purpose of this report

¹⁴ In 1987, in the “Toshiba-Kongsberg scandal” that involved a subsidiary of Toshiba and the Norwegian company Kongsberg Vaapenfabrikk, trade protection activists in US were vocal in demanding sanctions against Japan.

¹⁵ At the World Economic Forum in Davos in January 2011, a high profile presentation of the “Nordic Model” was made by Mr. Jens Stoltenberg, the current prime minister of Norway. According to media, Mr. Stoltenberg was accompanied by the presidents of Finland and Iceland and the prime ministers of Denmark and Sweden – and their argument was the “Nordic Model” has proven itself to be robust and resilient to the financial crisis of 2009, with the underlying message of its superiority. A similar sentiment reflecting a belief on the superiority of the Nordic Model is evoked in the work done by a research group ESOP based at the University of Oslo (www.esop.uio.no). Of course, there are many merits to the Nordic Model, specifically its emphasis on social, economic and gender equality, but this should not automatically translate into total superiority, such as superiority in terms of innovation policy and strategy.

is to explore how management of innovation plays a role, i.e. what type of practices are used for promoting innovation in Asian manufacturing firms, as compared with European and North-American firms . The comparative approach chosen for this in the report may be termed *triangular*, as illustrated in Figure 2.2.

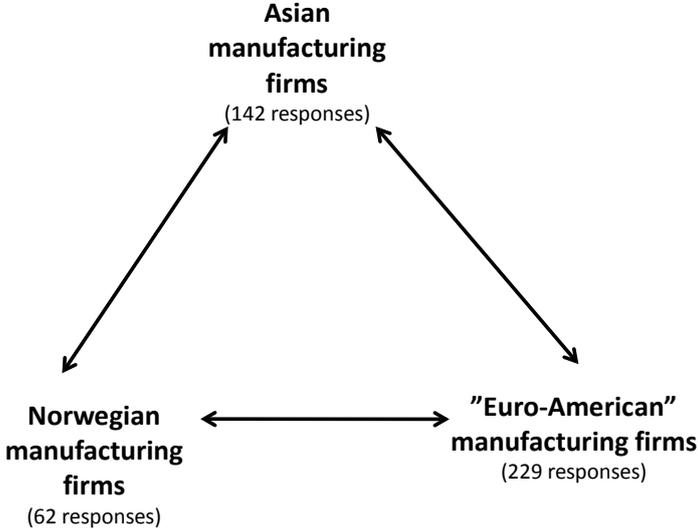


Figure 2.2: Model of comparison used in analyses of the MINE survey data on innovation practices presented in this report

In the material analyzed, we have responses made by informants from 142 Asian manufacturing firms (NACE category C, based on the Standard Industrial Classification SIC2007) in the MINE survey (76 firms from China, 38 firms from Korea, and 28 firms from Taiwan). The regional distribution of respondents (i.e. firms) in the MINE survey is shown in Table 2.1.

Table 2.1: Regional distribution of respondents participating in the MINE survey

Region	Total in the MINE survey	NACE category C: Manufacturing
Africa	1	0
Asia	193	142
Europe	208	122
Of these:		
Norway	65	62
Other European countries	143	60
North America	351	157
Oceania	14	5
South America	52	7
Multinational	186	40
Total	1005	473

Note: Manufacturing firms are firms included in NACE category C, based on the Standard Industrial Classification SIC2007.

The respondents from the Asian manufacturing firms will be compared with two other groups of respondents:

- Norwegian manufacturing firms, of which 62 firms were classified as belonging to the NACE C category, i.e. manufacturing firms,
- Euro-American firms, i.e. a category consisting of 60 European firms (Norwegian and multinational firms are not included in this group), 157 firms from North America (63 firms from US and 94 firms from Canada), 5 firms for Oceania (Australia) and 7 firms from South America (Peru), in total 229 firms, all belonging to the NACE category C.

The questionnaire used in the MINE survey was long – and not all respondents who participated in the survey and submitted answers responded to all the questions in the questionnaire. Hence, the response rate for individual questions varied around 80 to 90 per cent. In addition to this, there are methodological implications related to how the respondents were recruited – and which the readers should be made aware of. As indicated earlier (section 2.2), the MINE survey is based on a strategic sample, which is different from the “normal” approach in doing surveys, i.e. random sample. Hence, making statistical generalizations is limited. Still, the strategic sample used in the MINE survey is advantageous because the focus will be set only on successful firms, i.e. how key decision makers (the respondents) think, plan and act in terms of innovation and innovation activities. The Norwegian firms that participated in the survey are among the 100 highest innovation performing manufacturing firms in Norway. In our context, the underachievers and non-innovating firms are not interesting, because the purpose of the analyses presented in this report is to explore if, and to what extent, successful firms that participate in the globalized, competitive markets differ from each other – and to explain these differences. Non-innovating firms are in a sense irrelevant for this research. As will be shown, there are differences between the three categories of firms presented in this report that seem profound. In addition, there are questions related to the comparability of the material. The Asian countries from which the Asian firms that participated in MINE came from are large, both in scale and scope. Hence the 142 Asian firms in the analyses of this report are sampled from a much larger population of manufacturing firms compared to the Norwegian. The same consideration will apply to the category “Euro-American” firms. However, these findings will need much more research in order to establish the magnitude and full implications of these. This topic will be discussed further in chapter 9, in the conclusion.

The triangular approach used in this report is illustrated in Figure 2.2. There are some rudimentary assumptions in this model:

- The Norwegian firms are assumed to represent the type of work culture typical of what is known as the “Nordic” model, i.e. little hierarchy, emphasis on “democracy in work”, egalitarian interpersonal relationships, comparatively high degree of autonomy for individual employees in terms of decision making, generally high level of education and knowledge among the employees, etc. (Jensen, et al., 2007). The relationship between labor unions and management is basically considered as congenial and cooperation oriented.
- The Euro-American firms (this category does not include Norwegian and multinational firms) are assumed to represent work organizations and cultures that are more formalized,

hierarchical and status oriented, hence more power and authority given to managers, compared with the “Nordic” type of model; relationships between labor unions and management are often antagonistic and the notion of worker autonomy and participation in management is weak.

- The Asian firms are distinct because their cultural background and values are different from the Norwegian (Nordic) and the Euro-American firms, possibly with greater emphasis on Confucian norms and ethics in terms of respect for seniors and leaders, loyalty, diligence and discipline – representing a contrast to the other two categories of firms. The notion of paternalism is strong in management philosophy. Labor unions, if they exist, are generally weak and co-opted by the firm, however, high degree of loyalty and strong identity to company values are expected.

The responses made to these statements in the MINE questionnaire (cf. section 2.3 above) were analyzed by using Principal Component Analysis, a type of factor analysis that creates new factors, or in this case, new components based on analysis of the initial (observed) variables, i.e. the responses made to each statement. In the analysis, this procedure was used separately for all the three categories of firms, i.e. an identical analysis of the three categories: Asian manufacturing firms, Norwegian manufacturing firms and Euro-American manufacturing firms. The results obtained were then put together, in tables, as will be shown throughout this report, with separate columns for each category of firms.

The structure of this report is based on the structure of the questionnaire, hence there will be one chapter for each topic, or compartment, in the questionnaire, save two topics that have been omitted, i.e. part III – Strategies for innovation and part V- Network for innovation, mainly due to budgetary constraints in the project, which forced us to prioritize which parts of the material that would be most relevant for the research questions. As seen in figure 2.1, the parts that have been selected will constitute a chain of data consistent with the SCP model presented earlier (cf. section 2.3), i.e. that parts selected will provide the analyses with data that cover all elements in the SCP approach. However, the report will start with a presentation the data from part VI on firm performance. The reason for this is that the reader should be made aware of what kind of firms that have responded to the questionnaire, i.e. that these are exceptional in the sense that they are above average – they are high achievers in terms of innovation and other attributes that are associated with successful business enterprises that are innovative. This, of course, makes the analyses more challenging, because, performance of the firm, as a “dependent” variable of innovation, then becomes more complex and makes it more challenging to draw definite conclusions.

3 Firm performance

In the MINE survey, data on firm performance indicators relevant for innovation were collected by asking informants how their firm's performance compared relative to its competitors and a rough assessment of their firms' sales growth and profitability the last three years, cf. Table 3.1 and Table 3.2. As an extension of this, they were also asked to give more "objective" information on their firm's sales and profitability, in the last section of the MINE questionnaire. Here, the respondents were asked to provide specific information on their firm, such as its number of employees, total sales, market share, international and national structure, sectoral and branch identity, etc. However, the quality of the data obtained in this last part of the questionnaire was poor because too few respondents answered. Furthermore, some of the data that was given in the open part of the questionnaire is hard to understand and interpret. For this reason, most of this type of data was not used, except for the information on country and sectorial category.

Table 3.1: Firm performance – Respondents' assessment (Section VII, part 1)

<i>How well is your firm doing, relative to competitors, in each of the following areas?</i>	Asian manufacturing firms		Norwegian manufacturing firms		Euro-American manufacturing firms	
	Mean	Median	Mean	Median	Mean	Median
Scale: 1=Worse than rivals; 4=About equal; 7=Better than rivals						
Growth rate of firm (or of the relevant SBU used in the survey)	5,0	5	5,3	5	4,9	5
Creation of customer value through innovation	5,0	5	5,3	5	5,3	5
Number of new businesses generated through innovation	4,7	5	4,5	4	4,4	4
Number of spin-offs and start-ups generated through innovation	4,4	4	3,5	4	3,5	4
Frequency of major new products releases	4,8	5	4,3	4	4,6	4
Proportion of revenues generated through new products	4,7	5	4,5	4	4,7	5

As shown in Table 3.1, respondents in the survey were asked to give their opinion on how well their firm is doing compared to its competitors, in a number of dimensions:

- Growth rate of the firm
- Creation of customer value through innovation
- Number of new businesses generated through innovation
- Number of spin-offs and start-ups generated through innovation
- Frequency of major new product releases
- Proportion of revenues generated through new products

The results obtained and shown in Table 3.1 are subjective assessments, which may raise methodological concerns as well as the question of what these data represent, because the topics covered by this table could plausibly be rendered more satisfactory by obtaining information from more “objective” sources, such as annual reports and company accounts, etc. Critics would perhaps suggest that people in general want to present themselves and the firm they work for as more successful than what is “objectively” the case. On the other hand, why should informants respond willfully wrong ; who do they want to impress by doing so in an anonymous questionnaire? There were no incentives in the MINE survey to encourage specific type or direction of responses. Furthermore, one would expect that because of the way the respondent were recruited, i.e. the strategic sampling approach that selected firms with a high innovation track record, the outcomes shown in Table 3.1 and Table 3.2 should not come as a surprise. As shown, most of the respondents, as measured both by mean (average) and median, indicate that their firms are somewhat ahead of their competitors; they are not far ahead, but still, moderately superior.

Table 3.1 shows that the difference between the three categories of manufacturing firms is not large. However, within these slight variation, Asian manufacturing firms gave scores on their firms’ performance that were slightly better than Norwegian and Euro-American manufacturing firms. These differences become much less distinct when comparison is made of the sales growth and profitability of the three categories of manufacturing firms, as shown in Table 3.2. As shown, Asian and Norwegian firms seem to have obtained a higher annual growth rate over the last three years; they are in the range of 10-20 percent annual sales growth, which is respectable and good in terms of sales growth. Still, in terms of net profits from sales and average return on investment (ROI), respondents from Norwegian firms indicate that their ROI was highest; Asian firms reported highest average net profits on sales over the last years, slightly more than their Norwegian counterparts.

Table 3.2: Firm performance – Sales growth and profitability (Section VII, parts 2 and 3)

Sales growth and profitability (part 2 and 3)	Asian manufacturing firms		Norwegian manufacturing firms		Euro-American manufacturing firms	
	Mean	Median	Mean	Median	Mean	Median
<i>Scale: 1=Negative; 2=0-5%; 3=5-10%, 4=10-20%; 5=20-40%; 6=40% and over</i>						
Average annual sale growth over the last 3 years	3,9	4	3,8	4	3,3	3
Average net profit on sales over the last 3 years	3,6	3,5	3,4	3	3,0	3
Average return on investment (ROI) over the last 3 years	3,4	3,5	3,9	4	3,1	3

Table 3.1 shows the results of a statistical exercise designed to identify in which areas there are statistically significant differences between the three categories of firms in terms of the dimensions explored in Table 3.1 and Table 3.2. In each column in Table 3.3 we compare the mean values of the firm performance variables in Tables 3.1 and 3.2. We see for example from Table 3.1 that the mean

value of the number of spin-offs and start-ups generated through innovation among Asian firms (4.4) is higher than the corresponding mean value among Norwegian firms (3.5). The question is whether the difference is significant or not. Table 3.3 shows the conclusions from these calculations; this is based on a procedure explained in detail in Appendix 1 of this report.

Table 3.3: Comparison of scores made by responding firms, statistical significance

<i>How well is your firm doing, relative to competitors, in each of the following areas? Sales growth and profitability?</i>	Difference Asian-Norwegian firms		Difference Asian-Euro-American firms		Difference Norwegian-Euro-American firms	
	<i>Significance level satisfied at 1 or 5 %</i>	<i>Level at 1 or 5 %?</i>	<i>Significance level satisfied at 1 or 5 %</i>	<i>Level at 1 or 5 %?</i>	<i>Significance level satisfied at 1 or 5 %</i>	<i>Level at 1 or 5 %?</i>
Growth rate of firm (or of the relevant SBU used in the survey)		No		No		No
Creation of customer value through innovation		No	5 %	Yes		No
Number of new businesses generated through innovation		No	5 %	Yes		No
Number of spin-offs and start-ups generated through innovation	1 %	Yes	1 %	Yes		No
Frequency of major new products releases	5 %	Yes		No		No
Proportion of revenues generated through new products		No		No		No
<i>Scale: 1=Negative; 2=0-5%; 3=5-10%, 4=10-20%; 5=20-40%; 6=40% and over</i>						
Average annual sale growth over the last 3 years		No	1 %	Yes	5 %	Yes
Average net profit on sales over the last 3 years		No	1 %	Yes		No
Average return on investment (ROI) over the last 3 years	10 %	Yes, higher	5 %	Yes	1 %	Yes

An assumption in the design of the MINE questionnaire is that firm performance is an outcome, i.e. the “dependent” variable, of all the aspects that influence the innovation processes and strategy of the firm. The tables 3.1, 3.2 and 3.3 show that although all firms think that they are slightly better

than their rivals in most of the dimensions which are relevant for characterizing success in business – and seem to enjoy a healthy level of profitability, some differences between the firms seem to exist, as pointed out by the statistical amplification presented in Table 3.1.

The results presented above support the assumption of the MINE project that the firms that participated in the survey have good track record in terms of innovation performance – and that this has contributed to their profitability. Although some differences between the various categories of firms may be observed, as explained, the general picture is that the respondent firms are successful in an innovation perspective. The question of if, and how, they differ in terms of innovation then becomes interesting in the global perspective adopted as the approach of this report. This will then be the main topic in the rest of this report: Are there differences between the three categories, Asian, Norwegian and Euro-American firm in the MINE survey in how they innovate? If so, what are these differences – and what do these imply?

4 Perception of contextual factors

In games of innovation, a basic assumption is that the management, strategy and practices for firms are influenced by their understanding of the game, i.e. their perception and interpretation of their environment – and, ultimately, the markets they attempt to play in. In order to explore this, the MINE survey asked the respondents to indicate to what extent they agreed or disagreed to a series of statements related innovations relevant factors outside their firms.

Factor analyses of the responses made show that although the differences between the three categories of firms are not sharp, there are nevertheless some differences which may be considered significant when comparing what may be termed as the dominant trend of firms, i.e. the first component that explains the largest percent of the variance:

- Compared to the other categories of firms in this analysis, Asian firms emerge as more market oriented because they put strong emphasis on the importance of customers, users, academia and the technological environment of their firm.
- In contrast, Norwegian manufacturing firms put greater emphasis on aspects that may be termed as a technology oriented outlook.
- Euro-American firms seem more fragmented, but in their dominant trend, they emphasize some of the same aspects as the ones emphasized by Asian manufacturing firms.

In attempting to interpret these observations, one may suggest that these differences indicate that Asian manufacturing firms are generally more extrovert in their orientation, compared to the other categories of firms. In contrast, Norwegian manufacturing firms seem to pay more attention and emphasize factors that may be considered as important with the technological regime that they belong to, i.e. a more introvert orientation. Euro-American manufacturing firms seem to be split between these two extremes, because they are more pluralistic. The results obtained from the factor analysis are shown in Table 4.1.

In terms of the factors that influence innovation in the firms and the sector they operate in, the contrasts observed above are not so distinct. This interpretation is based on the results of the factor analysis shown in Table 4.2. In fact this shows what may be interpreted as some degree of consensus between the three groups of firms on many issues related to contextual factors: All firms seem to share a common outlook in recognizing the importance of developing products that interconnect with other products, because this is considered important for creating value for their customers. Hence, recognition of technical compatibility and interworking of products with others is emphasized as important by all firms. All firms are also similar in that they – in their dominant trend – do not consider regulatory approval and IPR as important for their innovation activity. All firms also seem to put little emphasis on the potential for economics of scale in production and the potential of harvesting economic benefits from process innovation. They also agree that economic constraints are important. The responses made by the informants indicate that in terms of their outlook, the dominant trend seems similar, i.e. firms share a similar common understanding of external factors that influence innovation, which indicates that in this aspect, their perception of the “game of innovation” is uniform. Table 4.2 shows the details of this.

Table 4.1: The nature of the sector in terms of customers and scientific and technical knowledge production

Questions a-b, 9 statements	Asian manufacturing firms		Norwegian manufacturing firms			Euro-American manufacturing firms			
	Component		Component			Component			
	1	2	1	2	3	1	2	3	4
Customers provide significant expertise about how our products operate	0,656	0,058	0,068	0,098	0,861	0,044	0,771	0,321	-0,125
The customers served by firms in our sector have very complex needs	0,701	-0,242	0,123	-0,007	0,822	0,327	0,801	-0,102	0,095
Knowledge production in the academic fields relevant for our sector is very intense	0,786	0,120	-0,063	0,740	0,040	0,812	0,053	0,086	-0,024
Our sector contributes a lot of data ideas and papers to academic research	0,700	0,229	0,090	0,896	-0,061	0,848	0,068	0,038	-0,179
Our sector continually integrates many new systems and equipment	0,720	0,233	0,052	0,874	0,095	0,772	0,130	0,156	0,153
New knowledge results mainly from intense interactions between firms	0,290	0,589	0,762	0,167	0,159	0,364	0,082	0,601	-0,077
New technologies build on the latest technologies of other firms in the sector	0,157	0,808	0,859	0,117	-0,033	0,093	0,075	0,823	0,068
All firms in our sector rely on the same stable technological base	-0,086	0,737	0,739	-0,314	-0,160	-0,170	-0,284	0,310	0,662
New knowledge results from the gradual accumulation of experience inside firms	0,270	0,385	0,655	-0,001	0,182	0,046	0,136	-0,166	0,870
Percent of total variance explained by the component	34,1	17,1	27,7	24,6	15,6	30,3	14,6	12,3	11,9
Number of iterations for rotation to converge	3		4			5			
Number of components generated	2		3			4			
Percent of variance explained by these components	51,3		67,9			69,1			
Observations	142		63			228			

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser

Normalization.

Table 4.2: Factors that influence innovation

Questions I c, 10 statements	Asian manufacturing firms			Norwegian manufacturing firms				Euro-American manufacturing firms			
	Component			Component				Component			
	1	2	3	1	2	3	4	1	2	3	4
Regulatory approval is a critical prerequisite for commercializing any new product	0,121	- 0,122	0,827	0,173	0,045	0,858	0,164	0,051	0,834	0,096	- 0,053
Time and resources needed to obtain regulatory approval deter "me too" innovations	0,143	0,091	0,858	- 0,105	- 0,074	0,772	0,057	0,114	0,873	0,091	0,057
Intellectual property protection enables firms to capture all the value from innovations	0,429	0,278	0,457	- 0,427	0,548	0,118	0,091	0,037	0,375	0,690	- 0,188
The technologies produced in our sector are used for a wide variety of applications	0,676	0,316	0,106	0,008	0,878	0,056	0,007	0,451	0,057	0,562	- 0,013
We use many different technologies and technical solutions in our products	0,744	- 0,029	0,000	0,227	0,784	- 0,156	- 0,085	0,654	0,065	0,168	- 0,161
Products must interconnect with other products or systems to have value for customers	0,818	- 0,042	0,022	0,877	- 0,007	- 0,026	0,128	0,810	0,070	- 0,135	- 0,099
The operation of our products relies on the operation of many other technical systems	0,722	0,145	0,163	0,943	0,116	- 0,064	- 0,043	0,833	0,008	0,015	0,163
Large unit cost reductions can be obtained by increasing the scale of operations	0,175	0,754	- 0,117	0,052	- 0,086	0,106	0,690	- 0,072	- 0,034	0,742	0,243
Improving production processes brings much higher returns than product innovations	0,072	0,775	0,005	0,236	- 0,037	- 0,569	0,284	- 0,126	0,170	- 0,001	0,793
Most of the products of our sector face severe cost constraints	0,069	0,734	0,127	- 0,011	0,084	- 0,081	0,813	0,017	- 0,174	0,080	0,753
Percent of total variance explained by the component	31,3	16,7	12,9	21,4	17,2	16,3	12,4	23,8	16,6	13,8	10,4
Percent of variance explained by these components	60,9			67,2				64,6			
Number of iterations for rotation to converge	4			4				5			
Observations	142			63				228			

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

Table 4.3: Resources and strategic-dynamic growth in the sector

Questions Id-1e, 13 statements	Asian manufacturing firms			Norwegian manufacturing firms				Euro-American manufacturing firms					
	Component			Component				Component					
	1	2	3	1	2	3	4	1	2	3	4		
Governments allocate a lot of resources to support research and innovation	0,177	0,134	0,838	0,063	-	-	0,777	0,157	-	0,027	0,054	0,809	
Innovative startups have easy access to funding (seed money, venture capital, IPOs)	0,241	0,064	0,849	0,690	0,024	-	0,061	0,239	0,060	0,035	-	0,042	0,809
Total sales of our sector grow very fast compared to other sectors	0,244	0,757	0,053	0,902	0,120	-	-	0,163	0,065	0,753	-	-	0,161
Sales in recently opened niches within our sector grow extremely fast	0,311	0,635	0,180	0,766	0,276	0,139	-	0,165	0,679	0,034	-	-	0,114
The pace of change in our sector is very fast compared to other sectors	0,581	0,587	-	0,101	0,454	0,641	0,048	0,002	0,819	0,111	0,087	0,014	-
Very often new competitors enter the sector with innovative products	0,641	0,355	0,073	0,312	0,238	-	0,049	0,768	0,731	0,218	0,070	-	0,090
The technological frontier advances very rapidly in our sector	0,612	0,438	0,120	0,668	0,062	0,173	0,339	0,810	0,163	0,143	0,019	-	-
External factors are forcing unpredictable transformation in our sector	0,623	0,076	0,029	0,132	0,782	-	-	0,033	0,176	0,095	0,845	0,069	0,134
The boundaries of our sector are undergoing a major redefinition	0,563	0,239	0,265	0,454	0,531	-	0,052	0,080	0,311	0,809	-	-	0,098
Our sector is going through significant developments that nobody anticipated	0,659	0,206	0,039	0,047	0,848	-	0,104	0,126	0,258	0,805	0,043	0,031	-
Established competitors constantly challenge our positions	0,850	-	-	0,091	-	0,103	0,904	0,074	0,045	-	0,003	0,866	0,047
Myriads of actions by our rivals continually erode our advantage	0,857	-	0,011	0,151	0,023	0,862	-	0,049	0,095	0,221	0,830	-	0,018
Our products are constantly under attack from low-cost substitutes	0,726	-	0,039	-	-	0,725	-	0,129	0,256	0,447	0,318	-	0,125
Percent of total variance explained by the component	39,7	11,5	9,4	30,0	17,0	12,9	8,3	28,2	17,7	10,6	9,5	-	-
Percent of variance explained by these components	60,6			68,2				66,0					
Number of iterations for rotation to converge	5			5				5					
Observations	142			63				228					

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser

Normalization.

The consensus observed in Table 4.2 does not reappear when respondents were asked to consider statements on resource inflows, growth and strategic and competitive dynamics in their sector, as shown in Table 4.3. However, at a few points all three categories of firms converge: All firms think that government does not allocate many resources to support research and innovation – and that the pace of change in their sector is rapid compared to other sectors. Apart from this, the most clear-cut contrast seems to be between Asian manufacturing firms on the one hand, and Norwegian manufacturing firms on the other hand. Table 4.3 indicates that in this, Euro-American firms bear closer resemblance to Norwegian manufacturing firms, much more so than to Asian manufacturing firms. The scores in Table 4.3 indicate that Asian firms attach much importance to the dynamics of

technological development and competition in their sector. This is seen in the number of attributes in the profile of Asian firms (component 1) in that they, in contrast to Norwegian manufacturing firms and Euro-American firms, think that their products are constantly under attack from low-cost substitutes – and that their rivals are continually eroding their competitive advantage and challenging their positions. Furthermore, they think that their sector is in the process of significant, unanticipated developments, which will force unpredictable transformations upon the sector and redefine the boundaries of this. Hence, one may interpret this as an indicator of a high awareness and anticipation of competition, and the potential impacts on this on the structure and dynamics of their sector. This type of awareness is comparatively weak in Norwegian and Euro-American manufacturing firms. One may even be tempted to interpret this as a higher degree of complacency and introvert orientation, somewhat similar to what was observed earlier, in the interpretation of the results presented in Table 4.1.

5 Value creation capability of the firm

Following the logic and design of the survey described earlier, in the next section of the MINE survey respondents were asked to make an assessment of their firm's capabilities in terms of innovation. The respondents were asked to indicate their assessment of a number of statements on a scale going from "not important" at one end, to "extremely important" in the opposite end. The statements are shown in the left column in Table 5.1. As shown, these cover a broad range of topics related to skills and capabilities that innovation researchers think are important or significant for a firm's innovation capabilities.

The results of the factor analysis of the responses are shown in Table 5.1. These are interesting as cognitive maps, i.e. the importance firms attach to various innovation capability factors. As shown in Table 5.1, Asian firms, by comparison with the other two categories for firms, appear as more coherent in their perception of capabilities needed for innovation. In fact, Table 5.1 suggests that Asian firms converge in one dominant view – and one contrasting, minority view. In contrast, Norwegian and Euro-American manufacturing firms are much more pluralistic or diverse in what they consider as important innovation capabilities. Whereas Norwegian and Euro-American firms seem to put primary emphasis on a few capabilities, Asian emphasize numerous. In the latter, greatest emphasis is set on their firms' capability to anticipate and solve customers' problems and design solutions that enhance the full cycle of customer experience. Simultaneously, they put emphasis on quality of products, continuous introduction of novelties and product variety. These and related capabilities may be interpreted as Asian firms being *customer focused* in how they evaluate innovation capabilities. Asian firms also put emphasis on transforming academic research into useful products.

In contrast, as seen in Table 5.1, Norwegian manufacturing firms, in the dominant component (component 1), put emphasize capabilities that may be termed as *techno-economic focused*, such as quality and reliability of products and cost reduction. Euro-American firms, in their dominant component (component 1), seem to emphasize what may be termed as *product focused*, because they attach highest importance to low costs of products, continuous introduction of novelties and design of solutions aimed at enhancing customer experience. The capability of transforming academic research into useful products is viewed as less important in Euro-American firms, and, to some extent, also in Norwegian firms.

Interestingly, all three categories of firms share a perception that the capability to obtain regulatory approvals for products and acceptance of products as de facto standards is *not* considered important. This unity may be interpreted as a shared, hence common perception in the manufacturing sector, which presumably makes this different from other sectors of the economy. In telecommunications, ICT-equipment and pharmaceuticals, technical standards and regulatory approval are important, crucial, for the competitiveness and profitability of firms. This does not seem to be the case for manufacturing firms that participated in the MINE survey.

Table 5.1: Value creation capability of the firm

	Asian manufacturing firms		Norwegian manufacturing firms				Euro-American manufacturing firms			
	Component		Component				Component			
Questions Part II - 12 statements (not important - extremely important)	1	2	1	2	3	4	1	2	3	4
Capability to transform the results of academic research into useful products	0,552	0,224	0,449	0,130	-	0,435	0,215	0,117	0,083	0,597
Capability to legitimate products by obtaining regulatory approvals	0,455	0,660	0,088	0,188	0,297	0,742	0,018	0,156	-	0,813
Capability to gain acceptance for products as de facto standards	0,349	0,788	0,224	0,090	0,772	0,398	0,133	0,678	0,008	0,344
Capability to spur the creation of complementary products around open architecture	0,437	0,607	0,061	0,028	0,692	0,389	0,230	0,807	0,025	0,093
Capability to align with dominant solutions in order to avoid disruption for clients	0,601	0,203	0,029	0,259	0,796	0,194	0,164	0,778	0,184	0,021
Capability to engineer products with absolute reliability, safety, and security	0,680	0,068	0,810	0,151	0,250	0,082	0,019	0,090	0,484	0,661
Capability to continually reduce costs (including through supply chain design)	0,674	-0,099	0,864	0,226	0,002	0,082	0,030	0,052	0,755	-
Capability to continually improve the quality of products	0,715	-0,005	0,819	-	0,081	0,255	0,327	0,022	0,726	0,211
Capability to anticipate and solve customers' problems in special application	0,768	-0,033	0,201	0,817	0,030	0,280	0,400	0,210	0,469	0,144
Capability to increase product variety while keeping customization costs low	0,714	-0,042	0,050	0,782	0,262	0,069	0,819	0,053	0,225	-
Capability to continually introduce novelties (new product releases, and functionalities)	0,702	0,039	0,124	0,162	0,091	0,757	0,868	0,042	0,001	0,167
Capability to design solutions that enhance the full cycle of customer experience (product choice, transactions, use, service, disposal etc.)	0,701	0,130	0,175	0,851	0,041	0,103	0,542	0,329	0,411	0,089
Percent of total variance explained by the component	42,2	9,9	34,7	14,3	12,1	9,5	30,0	14,1	9,8	9,1
Percent of variance explained by these components	52,1		70,6				63,1			
Number of iterations for rotation to converge	3		5				6			
Observations	142		63				228			

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

In summing up, one may suggest that Table 5.1 gives support to an interpretation that there are regional distinctions in terms of what innovative manufacturing firms consider as important capabilities related to their firms' innovation activities. In this, Asian firms seem to be more *customers focused* and have a greater *focus on leveraging academic research*. They are also more coherent and unified in the capabilities that they consider as important. In contrast, both Norwegian and Euro-American firms are more pluralistic and put emphasis on other capabilities compared with Asian firms. Hence, Euro-American firms emphasize what was characterized as *product focus* and Norwegian firms have a stronger *techno-economic focus* related to their innovation. As will be

shown, these interpretations are congruent with findings that will be presented later in this report, i.e. that Asian firms seem to be more *extrovert and research oriented* in their innovation strategies and practices – in contrast to Norwegian and Euro-American, that are more *introvert*.

6 Innovation awareness in the organization

This topic, innovation awareness, sets a focus on an aspect of innovation culture and climate in the firms that participated in the survey, in the way this is reflected in the responses made by those who answered the questionnaire, i.e. people with high management responsibility for innovation in the firms, such as CTOs, R&D managers, PD managers, etc. This topic is important because one may assume that how innovation awareness is understood and how this manifests itself may be viewed as an indicator of the attitude of the firm towards doing innovation activities. It seems fair to assume that if a company has little awareness of innovation, then it seems hard to expect that the company give high priority to innovation activities. In contrast, if innovation awareness is considered important, research would be interested in finding out the implications of this. In the material presented earlier, in the responses to other topic in the survey, Asian firms diverge from Norwegian and Euro-American firms on many topics. Table 6.1 shows how the firms responded to the statements on innovation awareness. As shown, in the dominant component, the factor analysis generated highest scores for Asian firms, because this explains the largest percentage of the variance. According to this, Asian firms put emphasis on innovation awareness on people in their firm who *identify*:

- Long term marketing capabilities (highest score)
- Long term manufacturing capabilities
- Long term scientific and engineering capabilities
- People who are responsible for new product development projects in each unit of the firm.

In Norwegian and Euro-American firms, these aspects were not considered as important. As seen in table 6, there is some congruence between the scores from Norwegian and Asian firms: Both categories put emphasis on how their firms *interpret* information relevant for innovation regarding:

- The company's overall strategy
- All new capabilities the company might need for innovation
- New product strategies in the business(es)

Whereas Asian firms were oriented towards people, Norwegian firms put emphasis on formal management processes for learning from relevant experiences with innovation activities, in terms of:

- Learning from past projects and transferring lessons learned to new projects,
- Learning across different entities in the organization.
- Processes for assessing and improving capabilities in technology, NPD, marketing, etc.

These aspects were also emphasized by Asian firms, but the results obtained from the analysis does not show as high scores as with the Norwegian firms. In Euro-American firms, in their dominant strategy, these statements obtained low scores. Instead, the highest scores obtained on innovation awareness topics were those that Asian and Norwegian firms gave low scores, such as:

- Articulation of specialized knowledge in ways that make sense to other specialities,
- Understand issues and constraints in other functions,
- Problem solving capability related to innovation projects by exploring a variety of options,
- Take responsibility for the entire innovation project.

Table 6.1: Innovation awareness in the organization

Questions IV 1-5, 17 statements	Asian firms				Norwegian firms				Euro-American firms				
	Component				Component				Component				
	1	2	3	4	1	2	3	4	1	2	3	4	5
Understand how any new products fit with business strategy (few-everyone)	0,457	0,175	0,679	0,094	0,023	0,286	0,307	0,768	0,185	0,203	0,842	0,232	-0,034
Understand how technology programs contribute to corporate and business goals (few-everyone)	0,358	0,357	0,642	0,120	0,102	0,448	0,275	0,681	0,181	0,173	0,847	0,212	0,055
Understand priorities are among projects, programs and programs (few-everyone)	0,351	0,424	0,590	0,064	0,306	0,138	0,325	0,744	0,137	0,183	0,607	0,187	0,238
Interpretation of information regarding the company's overall strategy (rarely-regularly)	0,726	0,049	0,328	0,089	0,808	0,070	0,110	0,049	0,146	0,202	0,267	0,749	0,175
Interpretation of information regarding all new capabilities the company might need for innovation (rarely-regularly)	0,728	0,006	0,353	0,192	0,853	0,000	-0,099	0,226	0,190	0,159	0,173	0,835	0,185
Interpretation of information on new product strategies in the business(es) (rarely-regularly)	0,725	-0,077	0,337	0,075	0,780	0,029	0,038	0,273	0,175	0,216	0,246	0,764	0,248
Identify people who build (not just apply) long-term scientific and engineering capabilities (few-most)	0,810	0,360	-0,001	-0,039	0,080	0,238	0,852	0,195	0,262	0,774	0,234	0,155	0,025
Identify people who build (not just apply) long-term marketing capabilities (few-most)	0,867	0,186	-0,106	-0,060	0,111	0,161	0,865	0,120	0,232	0,805	0,107	0,177	0,083
Identify people who build (not just apply) long-term manufacturing capabilities (few-most)	0,823	0,235	-0,172	0,003	0,230	0,351	0,695	0,149	0,141	0,806	0,056	0,148	0,061
Identify people responsible for working on new product development projects in each unit (few-most)	0,795	0,132	-0,105	0,118	-0,189	0,207	0,601	0,463	0,280	0,637	0,440	0,004	0,049
Articulation of specialized knowledge in ways that make sense to other specialities (few-everyone)	0,406	0,722	-0,001	0,139	0,148	0,902	0,125	0,163	0,760	0,288	0,022	0,278	0,014
Understand issues and constraints in other functions (few-everyone)	0,301	0,789	0,043	0,199	0,122	0,854	0,307	0,185	0,799	0,266	0,057	0,293	0,073
Deal with problems that occur in innovation projects by by exploring a variety of options (few-everyone)	0,250	0,762	0,168	0,097	0,377	0,623	0,457	0,190	0,757	0,186	0,273	0,089	0,178
Take responsibility for the entire innovation project (few-everyone)	0,299	0,688	0,181	-0,101	0,218	0,726	0,209	0,311	0,712	0,162	0,248	-0,084	0,206
Formal management processes for learning from past projects and transferring lessons learned to new projects (disagree-agree)	0,558	0,186	0,175	0,644	0,710	0,461	0,067	-0,175	0,129	0,106	0,089	0,081	0,855
Formal management processes for enabling functions to learn from each other (disagree-agree)	0,478	0,305	0,071	0,739	0,596	0,563	0,107	-0,283	0,220	0,049	-0,040	0,232	0,850
Formal management processes for assessing and improving capabilities in technology, NPD, marketing, etc. (disagree-agree)	0,467	0,125	0,115	0,720	0,744	0,359	0,181	-0,173	0,088	0,052	0,294	0,386	0,701
Percent of variance explained by the component	48,1	9,8	7,4	6,6	43,2	17,6	8,6	6,4	41,1	11,9	8,7	6,7	5,9
Percent of variance explained by all the components	72,0				75,9				74,3				
Number of iterations for rotation to converge	5				8				6				

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

One salient aspect of how firms respond is that Asian firms appear to be more cohesive in their dominant strategy, i.e. the Asian firms had a component in the factor analysis that had the highest percentage of variance explained. Similar results were obtained in the factor analyses presented

earlier. However, in terms of innovation awareness, one may suggest that the comparatively large numbers of components that were generated in the factor analysis may indicate that Asian firms are pluralistic in terms of how they view the topic of innovation awareness; this pluralism may also be observed in both Norwegian and Euro-American firms. Still, there are differences: Whereas Asian firms put more emphasis on both interpretation and identification of issues related to innovation awareness, Norwegian firms emphasize interpretation and formal management processes related to innovation awareness. In contrast, Euro-American firms had high scores on aspects that may be characterized as communicative and action-oriented. All firms have in common that they do not put much emphasis on “understanding”.

One interpretation of the results presented in Table 6.1 on innovation awareness is that Asian and Norwegian firms are similar in the emphasis they put on many aspects; Euro-American firms deviate for this. This may possibly be explained as Euro-American firms being more action-oriented and less analytical in their innovation awareness, compared to Asian and Norwegian firms. Asian and Norwegian firms may be interpreted as more analytical because of the emphasis they put on interpretation in their innovation awareness. However, Norwegian firms align this with formal management processes. Although Asian firms also seem to attach some importance to formal management processes, this is not the case for Euro-American firms. In contrast to Norwegian firms, Asian firms align interpretation with people in the organization, instead of formal management processes as in Norwegian firms. One interpretation of this could be that Asian firms, to a greater extent than Norwegian and Euro-American firms, emphasize innovation awareness with individual employees in the organization. This, if valid, contradicts the assumption that in Asian firms, a collectivistic corporate culture is strong, in contrast to Nordic (Norwegian) firms in which individualism is considered as a salient aspect of corporate or company culture.

Another interesting result in Table 6.1 is the response of Euro-American firm on innovation awareness, which was earlier characterized as action oriented, in the dominant component. The implication of this outcome is difficult to interpret, but looking closely, one may notice that the highest score was given to the statement “understanding issues and constraints in other functions”. Hence, in innovation awareness, these firms attach importance to having a broad view of matters related to innovation, and, perhaps, the importance of interdependencies between functions. The scores on other statements suggest that they consider innovation awareness as something general and do not connect this to individuals or organizational entities within the firm. Hence, one may suggest that Euro-American firms have a weaker, perhaps more diffuse and general sense of what innovation awareness implies, compared to Asian and Norwegian firms. These firms (Asian and Norwegian) have more specific and operationalized view because they both emphasize the importance of interpretation, i.e. the analytical aspect of innovation awareness. However, they differ, as pointed out earlier, in how this is operationalized.

7 Innovation strategy processes and decision making

The topic of this section belongs to what some innovation studies suggest is a “black box”, because there is little knowledge on innovation strategy processes and related decision making. One reason for this is the difficulty of doing research on these topics, i.e. collecting data on these processes and decisions. Few researchers have been admitted to the arenas where such decisions are made, e.g. in order to do observations. Furthermore, this is a subject matter that is often ephemeral, transient and open for wide ex-post interpretations, as aptly pointed out by the research done by Van de Ven et al. (1999). In spite of these methodological difficulties, it should be possible to get some idea of what actors who participate in the innovation strategy process and decision making think and believe are important aspects, people and positions. For this purpose, the respondents in the MINE-survey were asked to express their opinion on 18 statements related to innovation strategy processes and decision making in the firm, indicating their opinion on each statement on a seven point scale from disagree to agree. These answers were analyzed by factor analysis, as described earlier, and the results obtained are shown in Table 7.1¹⁶.

At first glance, Table 7.1 once more indicates that there are differences between the three categories of firms, specifically by comparing component 1 of the factor analysis. First of all, component 1 of Asian firms has a much higher percentage of variance explained, compared to the two other categories of firms. In Norwegian firms, component 1 obtained the lowest percentage (19,7%) of variance explained and the factor analysis generated seven components; both figures indicate a high degree of heterogeneity and pluralism. This could indicate that Norwegian firms are not much unified in their perception of innovation strategy processes and decision making. In comparison, Asian firms seem more coherent, although pluralism also exists among these. Euro-American firms may be seen as having a position in-between Asian firms on one side, and Norwegian firms on the other, however, in this axis, they tend to be more similar to Asian firms than Norwegian.

Looking more closely at what differentiates the three categories of firms, one striking aspect is that Asian firms seem to put high priority on the role of New Product Development teams (NPD-teams) in vital functions related to innovation strategy processes and decision making. In addition, Asian firms emphasize the importance of people within the firm who have marketing capabilities, and also people with scientific and engineering capability, for innovation strategy processes and decision making. In Norwegian firms, Business Unit (BU) managers have the main decision making authority and power because this includes responsibility (and control) of NPD portfolio management, leadership role vis a vis R&D units – and implementation of innovation strategies. Euro-American firms bear some resemblance with Asian firms because they also put much emphasis on NPD-teams, however, but they do not put much importance on including people with marketing capabilities and

¹⁶ Table 7.1 is simplified because only two components from each category of firms are shown, these two being the ones that have the largest percentage of variance explained. The number of components that were generated in the factor analysis and the total percentage of variance explained by these, is shown at the bottom of Table 7.1

people with scientific and engineering capabilities in innovation strategy processes and decision making, as Asian firms do in their dominant strategy (component 1). Nor do the Euro-American firms empower NPD-teams to make decisions on product concepts, which may explain why they do not bestow the NPD-team with the power to command the entire NPD-process to the same extent as Asian firms.

Table 7.1: Innovation strategy processes and decision making

Questions IV 6, 18 statements	Asian manufacturing firms		Norwegian manufacturing firms		Euro-American manufacturing firms	
	Component 1	Component 2	Component 1	Component 2	Component 1	Component 2
New directions for the firm are on the agenda of every top management team meeting (disagree-agree)	0,304	0,037	0,168	0,018	0,079	0,762
Senior managers often disagree over the best strategic direction(s) for the company (disagree-agree)	0,196	0,105	-0,002	0,100	-0,111	0,152
Senior managers are formally assigned to improve processes that support innovation (disagree-agree)	0,344	0,086	0,684	0,240	0,186	0,721
Senior managers discuss strategic directions with employees at least monthly (disagree-agree)	0,335	0,061	0,126	-0,080	0,179	0,774
Employees regularly challenge senior managers' understanding of our firm's situation (disagree-agree)	0,280	0,175	-0,059	0,250	0,131	0,658
We come up with new capabilities before we know how they will be used for products (disagree-agree)	0,134	0,327	0,344	0,000	0,023	-0,045
People who build marketing capabilities decide which ones to develop, within strategic guidelines (disagree-agree)	0,608	-0,017	-0,014	0,633	0,384	0,088
People who build scientific and engineering capabilities decide which ones to develop, within strategic guidelines (disagree-agree)	0,511	0,065	0,033	0,089	-0,068	0,208
People who build manufacturing capabilities decide which ones to develop, within strategic guidelines (disagree-agree)	0,463	0,031	-0,039	-0,230	0,195	0,019
All business unit (BU) managers regularly update their portfolios with new products (disagree-agree)	0,345	0,798	0,741	0,107	0,084	0,332
BU managers keep R&D informed about new functionalities needed in products (disagree-agree)	0,458	0,681	0,542	-0,061	0,419	0,385
BU managers are free to decide how to implement their innovation strategies (disagree-agree)	0,337	0,624	0,808	0,025	0,077	-0,042
NPD teams decide how to define their product concept, within strategic guidelines (disagree-agree)	0,747	0,129	0,428	0,491	0,345	0,100
The same team controls the entire NPD process from definition to commercialization (disagree-agree)	0,730	-0,141	-0,084	0,083	0,509	-0,088
NPD teams can pull in corporate or business resources (R&D, marketing) as needed (disagree-agree)	0,775	-0,085	0,018	0,645	0,790	0,033
R&D managers ensure that their people participate effectively on NPD teams (disagree-agree)	0,746	0,235	0,185	0,850	0,749	0,222
Marketing managers ensure that their people participate effectively on NPD teams (disagree-agree)	0,780	0,193	0,059	0,573	0,851	0,162
Manufacturing managers ensure that their people participate effectively on NPD teams (disagree-agree)	0,810	0,118	-0,253	0,213	0,697	0,364
Percent of total variance explained by the component	39,2	8,3	19,7	13,6	28,6	10,1
Number of iterations for rotation to converge	6		9		5	
Number of components generated	5		7		5	
Percent of variance explained by these components	66,8		75,8		62,0	

Extraction Method: Principal Component Analysis.
Rotation Method: Quartimax with Kaiser Normalization.

Another interesting observation that may be made of the results in Table 7.1 is that all three categories of firms are similar in their view of some aspects related to innovation strategy processes and decision making:

- Innovation is not an important item on the agenda of top management meetings in the firms,

- Whether or not senior managers disagree over the best innovation strategy is not considered important,
- Senior managers do not discuss strategic directions with their employees frequently, and, reciprocally, employees rarely challenge senior managers' understanding of their firm's situation,
- Firms do not create new innovation capabilities without plans or strategies, nor do people related to manufacturing have authority to decide NPD.

By looking at what the three categories of firms emphasize and what they have in common in terms of low scores in Table 7.1, the following interpretations seem plausible:

- Top management and senior managers do not consider innovation an important issue. Innovation does not occupy a high position in their agendas, nor is this an important issue among employees.
- NPD is not a haphazard activity among employees, nor do people who are related to manufacturing functions of the firm influence decisions on NPD. At the "grass root" level of the firm, NPD and related innovation activities do not seem to play an important role.
- The material, as shown in Table 7.1, suggests heterogeneity among firms as to how innovation strategy processes and decision making is done.
- However, by comparison, Asian firms exhibit a larger degree of cohesion compared to the others, because its component 1 has the highest percentage of variance explained, compared to the other categories of firms.
- Asian firms seem to put much emphasis on NPD-teams in innovation processes, NPD-teams are given much power and autonomy in Asian firms.
- To a less extent, the same observation may be made in Euro-American firms.
- In contrast, Norwegian firms seem to emphasize BUs' role and power in NPD; Norwegian BUs also instruct the R&D function as to NPD, i.e. the BUs are supreme.
- However, in the heterogeneity of the responses reflected by the high number of components generated by the factor analysis as shown in table 6, one may find components with high degree of similarity, but these are usually weak, i.e. the percentage of variance that these explain is low.

The implication of the results presented in Table 7.1 and explored above seem to be that heterogeneity is a salient aspect in terms on innovation strategy processes and decision making in innovative manufacturing firms. Hence, firms have a multitude of innovation strategy processes and modes of decision making related to this, as evident in the high number of components generated by the factor analysis that resulted in Table 7.1. By comparing the components that had the highest percentage of variance explained (component 1), some aspects seem to be distinct:

- Asian firms give NPD-teams a high degree of autonomy and power over innovation strategy processes and decision making – and this is also associated with alignment of people who build marketing capabilities and scientific and engineering capabilities in the firms.
- Euro-American firms are to some extent similar to Asian and they do not have the alignment that Asian firms have made with people who build capabilities in terms of marketing and scientific and engineering capabilities.
- Norwegian firms, in contrast, rely on BUs for innovation strategy processes and decision making – and align this with senior managers in the organization who are formally assigned

to support innovation processes. Although this pattern is seen in the “strongest” component (component 1), the second strongest component (component 2) has some similarity with the one observed as component 1 in Euro-American firms, which points to the aspect of heterogeneity.

These aspects may be interpreted as differences in terms of dominant innovation strategy “philosophies” or cultures. The implication of the Asian dominant pattern is that firms prioritize dedicated, professional organizational entities within their organization, i.e. they empower the NPD-teams and extraordinary people (individuals with a keen interest in innovation) in their organization. A dominant belief in Norwegian firms, in contrast, is that innovation strategy processes and decision making should be made by the BUs. The “philosophy” or corporate culture in firms that make this type of priority is that responsibility for NPD should be taken by BUs because they are the ones that also should carry the costs of doing NPD – and they are the ones who are experts on what type and how much NPD should be done, i.e. the BUs will make NPD most cost efficient. Innovation studies suggest that the organization of NPD reflects the size and technological diversity of a firm (Tirpak, et al., 2006): In a “normal” growth pattern, as firms grow in size and outreach, they tend to become more divisionalized and organized into comparatively autonomous BUs that are given a high degree of responsibility for functions, such as R&D and NPD. However, as firms become really large and multinational, they tend to reintroduce separate, autonomous R&D and NPD entities funded by the corporate HQ because corporate management want to increase the innovativeness of their firm: Divisionalizing a firm often means downsizing R&D and NPD for reasons of cost – which in the long run may cause the firm to become obsolete.

8 Strategies and practices for innovation

8.1 Exploration activities

The main idea of the questions asked on this topic was to get a picture of what kind of practices decision-makers in innovative manufacturing firms pursue in order to explore opportunities for innovation and search for new ideas. Although termed “practice”, this is just as much about “policy” and “strategy”, i.e. what set of rules firms attempt to follow – and what type of goals they attempt to attain when they work with new ideas that may potentially be developed to become innovations. Increasingly, both innovation research and innovation managers suggest that this topic has become crucially important, perhaps one of the most critical and strategic part of doing innovation. Being able to select the “right” idea for innovation development is seen as the most important success criteria for firms: No matter how excellent or perfect a product or service development is, a poor idea will just become a poor new product or service; however, a good idea may survive in spite of a poor product or service development. The notion of “Fuzzy Front End” of innovation (Robert G Cooper, et al., 2000; Gordon, et al., 2008; Koen, et al., 2001) has gained increasing interest among innovation strategy managers, reflecting the emphasis that is put on this.

One of the most penetrating and comprehensive studies of innovation processes, the Minnesota Innovation Research Program, under the leadership of Andrew H. Van de Ven (Ven, et al., 1999), suggest that innovation processes, more often than not, are set in motion when firms experience what they perceive as “shocks”. This may be caused by an external source, such as a sudden loss of market shares and drop in sales, or, internal sources, such as a sudden shift in the firm’s strategy subsequent to the entry of a new management or a merger or acquisition by another firm. This will initiate a search or exploration for ideas for product or service development, i.e. the activities that constitute the fuzzy front-end of innovation. This initiation phase is characterized by Ven et al (1999) as a “gestation period”, which, analogous to a pregnancy, means the period from conception to the birth on an idea – or what other researchers call the fuzzy front-end of innovation.

According to Luoma, Paasi and Nordlund (2008), fuzzy front-end of innovation is important for the entire innovation process “...because it is at this stage that crucial decisions regarding the target markets and customers, strategic alignment and resources are made” (p.2). Although only 10% of the cost of product or service development is spent at this stage, Luoma, Paasi and Nordlund suggest that 70% of the total costs of a product development project are committed at this stage, however, the bulk of these costs are spent at the subsequent commercialization phase, which in terms of resources, is the most demanding. Hence, they suggest, there is a strong link between the fuzzy front-end of innovation and commercialization. These views are supported by Brem and Voigt (2009), who elaborate this by suggesting that the fuzzy front-end of innovation “...is one of the greatest areas of weakness of the innovation process and fundamentally determines the later innovation success” (p. 353). Poskela and Martinsou (2009) also support this view by stating that the fuzzy front-end of innovation “...is regarded as the most troublesome phase of the innovation process and at the same time as one of the greatest opportunities to improve the overall innovation capability of a

company” (p. 671). They characterize this as complex in terms of management, and suggest that innovation performance of a firm is determined by what kind of decisions and interventions that managers make at this early stage in the innovation process. Alam (2006) reinforces this viewpoint by summarizing research showing that “...a firm can benefit substantially by optimizing and improving the fuzzy front-end of an innovation process” (p. 468). This should be done with an emphasis on customer interaction, because this stage is what they characterize as the “most information intensive” in terms of planning and strategy related to product and service development. A similar understanding is expressed Bröring, Cloutier and Leker (2006). Some researchers (Backman, Borjesson, & Setterberg, 2007) suggest that the fuzzy front-end of innovation is particularly important for new product development aimed at creating radical innovations, however, this view is not supported by other research (Verworn, 2009; Verworn, Herstatt, & Nagahira, 2008). Still, research seems to be unanimous in considering that the fuzzy front-end of innovation is significant for the innovation process itself – and for the subsequent commercialization of a new product or service.

In the MINE survey, informants were asked to give their opinion on eight statements regarding exploration activities related to innovation management, i.e. what kind of practices and strategies they follow. For this purpose they were asked to indicate on a seven point scale, from “Totally disagree” (1) to “Totally agree” (7), with “Neutral” (4) in the middle.

Table 8.1: Factor analysis of exploration activities

Variable	Asian firms		Norwegian firms			Euro-American firms	
	Component		Component			Component	
	1	2	1	2	3	1	2
Long-term internal programs for new technologies	.510	.555	.733	.250	.152	.660	.274
In-house capability for market trends detection	.058	.731	.678	-.463	.338	.522	-.493
Encourage cross-fertilization of ideas by staff mobility	.381	.663	.722	.087	-.574	.737	.116
Time and resources given to employees	.475	.684	.844	.258	-.131	.691	.075
Interaction with key suppliers and customers	.570	.063	.492	-.100	.124	.521	.349
Participation in industry networks	.809	.174	.315	.124	.802	.302	.566
Co-opt external experts for future prospects	.825	.016	.014	.862	-.073	.214	.785
Cooperation with university spin-offs	.821	.179	.279	.704	.273	.167	.714
Percent of variance explained	46,9	12,8	37	17,6	13,4	34,3	16,5
Number of iterations for rotation to converge	3		5			3	

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

As shown in Table 8.1, the pattern of correlations between the eight initial variables and the two components with the highest (component 1) and the second highest (component 2) per cent of total variance explained for Asian manufacturing firms is to a large extent the reverse compared to the

similar pattern for Euro-American manufacturing firms. Norwegian manufacturing firms seem to resemble Euro-American manufacturing firms. In these two categories of firms (Norwegian and Euro-American manufacturing firms), the dominant practice corresponds to a large extent to the less dominant Asian practice. However, this contrast is not absolute: In terms of the variable “Long-term internal programs for new technologies” and “Interaction with key suppliers and customers” there is some communality in all the three categories of firms.

The overall results shown in Table 8.1 indicate that in terms of dominant practices related to exploration activities, the practices of Asian manufacturing firms are distinct in so far as they emphasize combinations of the following variables:

- Long-term internal programs for new technologies
- Interaction with key suppliers and customers
- Participation in industry networks
- Co-opt external experts for future prospects
- Cooperation with university spin-offs

Compared to the dominant practices of Norwegian and Euro-American manufacturing firms, one may suggest that Asian manufacturing firms are more *extrovert* and oriented towards cooperation with external actors, such as industry networks, external experts and university spin-offs. Norwegian and Euro-American manufacturing firms, in contrast, have dominant practices embedded in their innovation strategy that may be characterized as more *introvert*, compared to its Asian counterparts. This is evident because what emerged as the dominant practice in these firms was a greater emphasis given to the following variables:

- In-house capability for market trends detection¹⁷
- Encourage cross-fertilization of ideas by staff mobility
- Time and resources given to employees

This may be interpreted as an indication that Norwegian and Euro-American manufacturing firms give higher priority to leveraging the talents and resources of their own employees and internal activities in the firms in terms of exploration activities, i.e. that their dominant practice and strategy is to be more self-reliant, compared with Asian manufacturing firms. Hence, characterizing this as introvert seems apt.

8.2 Decision-making and portfolio management

This topic deals with how innovative manufacturing firms choose and give priority to various innovation projects, i.e. what kind of guidelines or rules they apply for making these types of decisions. At some point, firms will have to decide on matters relevant for initiating innovation activities. Of course, an important aspect in this will be the outcomes of the exploration activities analyzed in the previous section. A tangible and convenient approach to this question is to start with an organizational perspective, based on the assumption that decisions on innovation activities may

¹⁷ This was only moderately distinct in the Euro-American firms.

be considered as a type of investment, i.e. a type of commitment of resources and associated strategic choice (Godø, 2009). Similar to other types of investments decisions, these may be characterized by a dichotomy:

- *Formal decisions*, i.e. some type of approval (or rejection, which is also a decision) of a plan by a person with authority to make this type of decision, or, more common, some types of collective decision making units, such as a board or a committee or a group of managers and executives, etc. These types of decisions are typically for approving a plan and budget for a project, or more permanent, an annual budget for some organizational entity that is responsible for some types of innovation activities, such as a permanent R&D facility or product development unit.
- *Informal decisions*, sometimes even experienced as a “non-decision”, in the sense that innovation activities are initiated without formal approval from any governing body or person in the firm. However, more often than not, because those initiating the activities have a sense of “understanding”, some type of tacit approval or climate that favours these types of initiatives may exist. Extreme cases of informal decisions are those that initiate innovation activities in secret, often after a formal rejection of a project proposal or because those who initiate these types of activities anticipate that the formal mechanism for obtaining approval will end up in a rejection.

Of course, many in-between categories exist in the continuum between the formal-informal extremes. One common development path in innovation activities is that these are initiated in small scale as the result of an informal decision, e.g. exploration of some “bright idea”, or what Van de Ven would call a “gestation period” (1999). Then, at some point, a more formal plan is made and submitted “upwards” in the system for approval, i.e. a transformation into a formal decision making process. The informal process prior to this type of formalization is sometimes called the “Fuzzy Front-End” of innovation process (Gordon et al., 2008; Koen, et al., 2001) because it is often explorative, in the sense that activities at this stage are characterized by search and feasibility analyses.

In the survey, respondents were asked to give their views on nine statements covering a broad range of this topic: they were asked to indicate on a seven point scale, from “Totally disagree” (1) to “Totally agree” (7), with “Neutral” (4) in the middle. The submitted responses were analyzed using a factor analysis (principal component analysis) procedure identical to the one used in the analysis of exploration activities in the previous section, i.e. one separate analysis for each of the three categories of firms: Asian, Norwegian and Euro-American manufacturing firms. The results of these three separate analyses were put together, as shown in Table 8.2.

The results shown in Table 8.2 are not as clear-cut in terms of a contrast between Asian manufacturing firms on the one side, and Norwegian and Euro-American manufacturing firms on the other, as observed in Table 8.1. In fact, there are numerous aspects that are shared by all three categories of firms, indicating some degree of commonality in terms of decision-making and portfolio management practices and strategies among all the manufacturing firms that participated in the MINE survey. All the three categories of firms seem to have in common high priority related to practices and strategies that cover the following variables:

- Portfolio balanced with projects in different stages
- Selection committees at different levels choose projects
- Only a few projects are selected from many ideas
- Projects are restructured in a strategic perspective

This commonality may be interpreted as shared sector specific strategies and practices for manufacturing industries – something that all manufacturing firms seem to put emphasis on. However, in other aspects, the strategies and practices seem to diverge to an extent that may seem confusing. In Table 8.2, one may observe that there is a high positive correlation between each of the three last initial variables and the component with the highest per cent of total variance explained (component 1) for Asian manufacturing firms, while there is a high positive correlation between each of these three variables and successive components which explain progressively smaller portions of the total variance for Norwegian and Euro-American manufacturing firms. This indicates that, whereas Asian manufacturing firms in their dominant practice seem to give high priority to a strategy that empower middle managers to reallocate funding for projects and that also evaluate projects in a portfolio perspective and select these according to technology and product roadmap, in Norwegian and Euro-American manufacturing firms, these strategies and practices seem more pluralistic. This variety in strategies and practices could also be interpreted as Norwegian and Euro-American manufacturing firms being less coherent in terms of their strategies and practices when they make decisions on portfolio and innovation activities.

Table 8.2: Factor analysis of decision-making and portfolio management related to innovation

Variable	Asian firms		Norwegian firms				Euro-American firms			
	Component		Component				Component			
	1	2	1	2	3	4	1	2	3	4
Portfolio balanced with projects in different stages	.862	-.125	.734	.500	-.265	-.053	.847	.047	.146	.102
Selection committees at different levels choose projects	.825	-.041	.829	.188	.103	.082	.846	-.182	.131	.101
Only a few projects are selected from many ideas	.766	.121	.808	-.141	.073	.078	.790	.276	.004	-.045
Projects are restructured in a strategic perspective	.679	.412	.826	-.190	.105	-.002	.501	.644	-.004	.226
Policy of focusing funding on a few projects with high risks	.228	.852	.154	.011	-.093	.948	.005	.866	.152	-.032
Many unofficial projects are supported	.424	.722	.469	.205	.533	.440	.122	.377	.678	.052
Middle managers empowered to reallocate funding for projects	.622	.406	.144	.001	.934	-.137	.187	-.060	.857	.003
Projects are evaluated in a portfolio perspective	.756	.225	.398	.776	-.037	-.016	.307	.137	.323	.688
Projects are selected according to technology and product roadmap	.539	-.089	-.257	.850	.122	.061	.037	-.016	-.120	.896
Percent of variance explained	48,9	13,6	37	17,6	13,4	11,6	34,7	14,5	12,9	11,4
Number of iterations for rotation to converge	3		5				4			

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

In comparing what may be interpreted as more “weakly dominant” practices as seen in components 2, 3 and 4 in Table 8.2 for Norwegian and Euro-American manufacturing firms, the variables with high scores are placed in different components for these two categories of firms, giving support to the interpretation of diversity of strategies and practices. However, there is one interesting similarity between the Norwegian and Euro-American manufacturing firms in terms of component 3 (the component with the third highest per cent of total variance explained), which also has some commonality with Asian manufacturing firms in their component 2 (the component with the second highest per cent of total variance explained). This may be interpreted as a type of practice and strategy, although not so dominant, that gives authority and autonomy to middle managers, while simultaneously supporting many “unofficial projects”.

In summing up, the Asian manufacturing firms appear to have a more cohesive approach in terms of strategies and practices for making decisions related to portfolio management, as seen in component 1 (the component with the highest per cent of total variance explained) in Table 8.2, i.e. the dominant practice and strategy of Asian manufacturing firms. However, some aspects of this is shared with Norwegian and Euro-American manufacturing firms, and, as shown in Table 8.2, these aspects also constitute elements in the dominant strategy and practice of Norwegian and Euro-American manufacturing firms. Hence, there are some aspects that seem “universal”, as suggested earlier. However, in general, the Norwegian and Euro-American practices may be characterized as pluralistic because diversity seems to exist in terms of portfolio management and related priorities and decision

making. For this reason, one may be tempted to interpret this as Asian manufacturing firms adhering to one predominant “best practice”, however, among Norwegian and Euro-American manufacturing firms, there is greater variety in strategies and practices. A natural extension of this interpretation is to ask if this apparent cohesiveness of Asian manufacturing firms has contributed to their success. Although answering this question seems challenging, raising the question seems reasonable. The next section on policies and practices relevant for innovation projects will provide interesting information, but does not, unfortunately contribute to providing answers to the question raised above.

8.3 Policies and practices relevant for innovation projects

Once firms have made the crucial decisions on what kind of innovation projects or activities to support – and how to support and manage these processes and decisions – the next step is of course how to manage the projects or activities. The topics that are relevant in this phase are more on a strategic level, related to how leaders and managers view the innovation process; the basic nuts and bolts of project management are not so interesting in this context because they are more mundane and general, i.e. these issues are shared with other types of project work and not necessarily unique for innovation activities. In the MINE survey, informants were asked to give their opinion on eighteen statements regarding innovation projects, i.e. what kind of practices and strategies they follow. For this purpose they were asked to indicate on a seven point scale, from “Totally disagree” (1) to “Totally agree” (7), with “Neutral” (4) in the middle. Table 8.3 shows the eighteen statements that respondents were asked to consider and respond by giving indication of their opinion. The mean score to most of the statements were around 5, i.e. leaning slightly towards “Totally agree”; only two statements obtained means scores below 4, i.e. slightly away from “Neutral” towards the “Disagree”-end of the scale. This may indicate that respondents did not have strong feelings about the statements that were presented in the questionnaire; however, the variation in the responses does not indicate nonchalance, i.e. that the respondents just pressed the button in the middle of the questionnaire because of convenience. The submitted responses were analyzed using a factor analysis (principal component analysis) procedure identical to the one used in the analysis of exploration activities and the one used in the analysis of decision-making and portfolio management in the previous sections, i.e. one separate analysis for each of the three categories of firms. The results of these three separate analyses were put together, as shown in Table 8.3.

Table 8.3: Factor analysis of policies and practices relevant for innovation projects

Questions in the survey (6.3)	Asian firms				Norwegian firms						Non-Asian & non-Norwegian firms				
	Component				Component						Component				
	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5
Our innovations are combinations of ideas resulting from our previous projects	.241	.085	.757	-.095	.149	.028	-.041	.806	.204	.020	.084	.588	.156	-.220	.209
In the beginning, we carefully map the technical and market environment of a project	.462	.002	.560	.209	.836	.010	.181	.007	.225	.001	.172	.147	.844	.032	.014
Our concepts are based on extensive prior classification and prioritizing of user needs	.183	.359	.629	.088	.824	-.169	.064	.188	-.066	-.146	.247	.207	.720	.194	.030
For every innovation project, we produce a lot of new knowledge	.331	.462	.330	.054	.337	.256	-.106	.565	-.321	.100	.272	.469	.459	.205	-.016
We don't reinvent the wheel, we use available data, exemplars, models, and methods	.064	.352	.587	.090	.220	.043	.140	.689	.095	.152	-.042	.304	.244	.270	.674
We assemble our products from the latest modules and parts available on the market	.072	.607	.257	.085	.733	.060	.032	.239	-.004	.314	.412	.358	-.118	.024	.533
We often take advantage of knowledge we produced originally for a different purpose	.064	.513	.266	.625	.242	.077	.326	.123	.608	.107	.053	.749	.114	.110	-.003
We extensively reuse platforms and modules that our company has developed before	.147	.291	.481	.449	.101	.009	.855	.142	.090	-.015	.371	.607	.019	.115	.125
A module that we discard in one project is often useful in subsequent projects	.218	.671	.137	.115	.172	.133	.799	-.184	.207	.047	.092	.765	.044	.101	-.019
Very early, we integrate representatives of our key customers in the development team	.135	.792	-.002	.039	-.150	.223	.556	-.010	-.339	.568	.188	.194	.151	.782	.084
We try to benefit extensively from suppliers' experience in our innovation projects	.321	.737	.087	-.301	.079	-.019	-.019	.353	.174	.818	.326	.095	.386	.565	.281
We develop and test several concepts in parallel before selecting a product concept	.550	.477	-.105	.351	-.414	.759	.112	-.199	-.020	.122	.442	.146	.370	.418	-.427
We do a lot of partial experimentation to obtain data we use for building a prototype	.790	.250	-.003	.202	.123	.807	-.017	.297	.205	.118	.719	.167	.181	-.082	-.354
We simulate extensively the behavior of our product before building a full prototype	.836	.016	.096	.177	.091	.660	.580	.106	.127	-.275	.773	-.076	.068	.195	.054
We strive to develop a detailed causal model of the functioning of our products	.803	.139	.190	.071	.119	.663	.451	.136	-.003	-.449	.726	-.007	.330	-.080	.284
We focus on building up rich experience with the concrete functioning of the product	.749	.172	.228	-.216	.604	.300	.088	.230	.384	-.180	.632	.187	.342	-.220	.239
We go through several iterations that completely redefine the concept and architecture	.721	.201	.090	-.077	.120	.208	.062	.104	.855	.045	.733	.407	.045	.047	-.103
As early as we can, we ask key customers to test the prototype and give us feedback	.315	.049	.103	.673	.426	.524	-.080	-.044	.230	.412	.617	.111	-.168	.283	-.059
Percent of variance explained	36,3	10,7	7,7	6,5	27	16	10,3	8,4	7,4	5,6	32,7	10,4	8,2	6,4	6,2
Number of iterations for rotation to converge	5				19						5				

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

Table 8.3 suggests that Asian and Euro-American manufacturing firms have some commonality, in contrast to Norwegian manufacturing firms, which diverge from these two categories of firms. This may seem surprising, because the results of the two analyses presented earlier (Table 8.1 and Table 8.2) suggested a divide with Asian manufacturing firms on the one side and Norwegian and Euro-American manufacturing firms on the other. What emerges as dominant, in terms of strategies and practices in both Asian and Euro-American manufacturing firms, is a factor (component 1) which puts emphasis on the following elements:

- We develop and test several concepts in parallel before selecting a product concept
- We do a lot of partial experimentation to obtain data we use for building a prototype
- We simulate extensively the behavior of our product before building a full prototype
- We strive to develop a detailed causal model of the functioning of our products
- We focus on building up rich experience with the concrete functioning of the product
- We go through several iterations that completely redefine the concept and architecture,

In contrast, the Norwegian manufacturing firms, in their dominant strategy and practices (component 1), seem to put less emphasis on the elements listed above, although they also emphasize focus on building up rich experience with the concrete functioning of the product. Instead, their dominant strategies and practices are based on an emphasis of the following elements:

- In the beginning, we carefully map the technical and market environment of a project
- Our concepts are based on extensive prior classification and prioritizing of user needs
- We assemble our products from the latest modules and parts available on the market

Although these practices may be designated as dominant, this is weak compared to the dominant strategies and practices of Asian and Euro-American manufacturing firms. The impression that Table 8.3 presents for Norwegian manufacturing firms is indeed pluralism of strategies and practices, or alternatively, what may also be interpreted as fragmentation. Of the many strategies and practices in Norwegian manufacturing firms, the component 2, which is not dominant, has some resemblance with what was characterized as the dominant strategy and practice of Asian and Euro-American manufacturing firms.

In general, the plurality of strategies and practices that may be observed in Table 8.3 is highest with Norwegian manufacturing firms, followed by Euro-American and finally, Asian manufacturing firms. Needless to say, the result shown in table 8.3 could be a statistical artifact, but then this cannot explain why there is less variety of strategies and practices among Asian manufacturing firms compared to the two other categories of firms. This aspect again is congruent with the interpretation made earlier, that Asian manufacturing firms have a greater degree of cohesion in terms of strategies and practices that they use – in contrast to Norwegian manufacturing firms. As an extension of this, a natural question is to ask if this variety of strategies and practices reflect the phenomenon of “games of innovation”, i.e. Norwegian manufacturing firms participate in many different games of innovation, hence they will also adopt a greater variety of strategies and practices. This explanation does not seem plausible because if this was the case, this variety should also be reflected by a variety of strategies and practices in exploration activities and in

portfolio management and related decision-making, and, as soon will become evident, also in commercialization activities, but this is not the case. Furthermore, if this assumption was valid, then Asian and Euro-American firms would show up as having more pluralistic practices, similar to Norwegian firms.

8.4 Commercialization practices

The firms were asked to respond to ten statements related to their practices on commercialization of new products and services, i.e. how they think and work with making new products and services into innovations. In the survey, the respondents were asked to indicate on a seven point scale their views on statements, from “Totally agree” (1) to “Totally disagree” (7) in the other extreme, with the category “Neutral” (4) in the middle.

Table 8.4: Factor analysis of commercialization practices

Variable	Asian firms		Norwegian firms				Euro-American firms	
	Component		Component				Component	
	1	2	1	2	3	4	1	2
Strategic framework for commercialization:	.564	.536	.797	.035	-.146	-.082	.558	.445
Corporate entrepreneurship facilitate creation of new businesses	.234	.759	-.020	.059	.928	-.032	.190	.753
Champions are nurtured to facilitate transfer of innovations to business units	.408	.629	.634	-.327	.390	-.053	.641	.126
Innovation projects occasionally used for transforming the corporation	.190	.785	.077	.064	.028	.874	.701	-.273
Special corporate teams & funding to support new market entry	.555	.532	.736	.084	.036	.350	.778	-.059
Incentives to induce managers to develop innovative businesses	.831	.116	.314	.467	.561	.301	.426	.650
R&D finds best way of commercialization	.799	.136	.348	.732	.391	.167	.804	.020
New venture group specialized in developing new internal business	.816	.184	.719	.460	.071	-.033	.776	-.017
Businesses are expected to generate a % of revenues from new products	.860	.138	-.073	.817	-.095	-.221	.634	.314
Policy of encouraging spinouts led by our personnel	.817	-.045	.076	.700	.037	.477	.572	.370
Percent of variance explained	51,8	13,5	34,1	16,7	12,4	10,5	43,2	12,1
Number of iterations for rotation to converge	3		7				3	

Extraction Method: Principal Component Analysis.

Rotation Method: Quartimax with Kaiser Normalization.

The mean score for all the ten statements that they responded to was 3.7, which gives an indication that the “center of gravity” was “neutral”, with a slight dominance towards disagreement, however, the mean scores for the individual statements ranged from 4.45 to 2.76. This indicates that respondents gave answers based on their judgments of the questions. The

lowest score, i.e. the statement that respondents disagreed most with was “R&D has to find the best way to commercialize innovations internally and externally”. On the opposite end, the statement “Businesses are expected to generate a percentage of revenues from new products” obtained the highest mean score, i.e. closest to the “Totally agree” end of the scale. The submitted responses were analyzed using a factor analysis (principal component analysis) procedure identical to the one used in all the previous analyses, i.e. one separate analysis for each of the three categories of firms. The results of these three separate analyses were put together, as shown in table 8.4.

As shown in table 8.4, Asian manufacturing firms emerge with a factor (component 1) that seems strong. However, Euro-American manufacturing firms also have a strong, dominant strategy and practice. Although this is not as dominant as that of the Asian manufacturing firms, one may notice some degree of commonality between this and Asian manufacturing firms. Both the Asian and the Euro-American manufacturing firms put emphasis on the following elements:

- Special corporate teams & funding to support new market entry
- Incentives to induce managers to develop innovative businesses
- Businesses are expected to generate a % of revenues from new products

What distinguishes the Asian manufacturing firms from the Euro-American in terms of strategies and practices is that Asian manufacturing firms seem to give somewhat higher priority to:

- New venture groups specialized in developing new internal business,
- R&D for finding best way of commercialization

Euro-American manufacturing firms, in contrast, seem to give a slightly higher priority to encourage establishment of corporate entrepreneurship and using champions and these persons are nurtured in order to facilitate transfer of innovation to other business units in the firm. Somewhat in contrast to the Asian and Euro-American manufacturing firms, the dominant strategy and practice in Norwegian manufacturing firms is to put emphasis on the following elements:

- Strategic framework for commercialization, i.e. guidelines, plans and procedures
- Special corporate teams & funding to support new market entry
- New venture group specialized in developing new internal business

The profile of the dominant practice among Norwegian manufacturing firms is more “frugal”, i.e. they do not give high priority to as many variables or elements as done in Asian and Euro-American manufacturing firms. As shown in Table 8.4, Norwegian manufacturing firms seem to be more pluralistic in terms of strategies and practices compared to its Asian and Euro-American counterparts. This is seen in the number of less dominant practices, i.e. the number of components that emerged from the factor analysis. Looking closely at this pluralism as this unfolds in the various components, each component may be interpreted as “narrow” or “focused” in the sense that only a few aspects related to commercialization are given high priority, i.e. high scores.

The implication of the results shown in table 8.4 may be that Norwegian manufacturing firms, in terms of strategies and practices for commercialization, deviate from what seems to be dominant strategies and practices among Asian and Euro-American manufacturing firms. Although one should not ignore the possibility that this may be result of statistical artifact, one may be tempted to interpret this as a salient feature of how Nordic manufacturing firms set their priorities in terms of commercialization strategies and practices. This and related aspects will be discussed further in the next section.

8.5 Discussion

What has emerged from the comparative analyses presented in the sections above is that Asian, Norwegian and Euro-American manufacturing firms differ in many aspects related to practices in promoting innovation and the strategies these are embedded in. According the framework of games of innovation (Florice & Dougherty, 2007; Miller & Florice, 2007), this reflects differences in how firms perceive and act in terms of innovation practices, i.e. how they understand the rules and dynamics of the innovation game they are players in. However, the results obtained from the analyses show that these differences are not systematic in the sense that the three categories of firms used in the comparative analyses always differ in a similar way. On the contrary, the picture that has emerged is complex, indicating that the notion of a universal “best practice” and various quick fixes promoted by management gurus are not congruent with the way highly innovative firms promote innovation in their strategies and practices. Table 8.5 is an overview of the dominant strategies and practices identified in the comparative analyses presented earlier in this chapter.

The overview shown in table 8.5 provides an aggregate of the dominant practices and strategies in Asian, Norwegian and Euro-American manufacturing firms, based on the analyses presented earlier in this report. For this reason, a number of details and nuances that were presented and discussed earlier are not shown in the table. Still, the overview shows that the three categories of firms differ in many aspects.

Table 8.5: Overview of dominant strategies and practices used by Asian, Norwegian and Euro-American manufacturing firms based on the results of MINE survey

Topic of dominant strategy and practices	Asian firms	Norwegian firms	Euro-American firms	Comparative dimension
Exploration practices - exploring opportunities to innovate and searching for new ideas	Extrovert - emphasis on participation in industry networks, use of external experts, co-operation with university spin-offs, and also some interaction with key suppliers and customers	Introvert - emphasis on using in-house capability, staff mobility, give resources to employees	Introvert - emphasis on using in-house capability, staff mobility, give resources to employees, but also some interaction with key suppliers and customers	Asian firms extrovert - Norwegian and Euro-American firms more introvert and pluralistic
Decision making and portfolio management - management of the firms' innovation portfolio	Use of portfolio management, selection committees, priority to a few projects, but in addition empowerment of middle managers, project evaluation, use of technology and product roadmap	Use of portfolio management, selection committees, priority to a few projects	Use of portfolio management, selection committees, priority to a few projects	Commonality all firms: Use of portfolio management, selection committees, priority to a few projects. Norwegian and Euro-American firms diverge in other aspects - more pluralistic, i.e. many different strategies and practices
Policies and practices relevant for innovation projects - how innovation managers think about their innovation projects	Emphasis on product development process (testing, prototyping, quality assurance, etc.) and use of key customers to test prototypes	Emphasis on technical and market aspects of a project, user needs and feedback on the functioning of products	Emphasis on product development process (testing, prototyping, quality assurance, etc.) and use of key customers to test prototypes	Asian and Euro-American firms similar, Norwegian firms diverge from these
Commercialization practices - capturing values from commercialization.	Priority to support of new market entry, incentives to managers, use of R&D function and new venture groups, business unit targets, policy of encouraging spinouts	Use of champions and special corporate teams and new venture groups	Use of champions and special corporate teams and new venture groups, but also use of R&D function and new venture groups, business unit targets, policy of encouraging spinouts	Some commonality between Asian and Euro-American firms, but less use of champions in Asian firms. Norwegian firms divergent and pluralistic in comparison.

In research, but also in the craft of innovation, the attention has increasingly been set on the initiation and finalization of innovation activities, i.e. how to elicit and select ideas for product development, and how these, subsequent to product development process, are commercialized. The product development process itself – what happens or is done in-between initiation and finalization – is increasingly seen as uncomplicated, although this may involve many non-trivial technical and design challenges. Increasingly, product development has become professionalized

and routinized. However, finding and selecting the “right” idea for innovation activity and development is seen as crucial: No matter how excellent a product development is done, a poor idea will result in a poor product or service, i.e. a non-innovation. Equally important, commercialization is viewed as crucial for creating an innovation. One aspect of this is the classic problem in management perspective: How to “get the prototype out of the lab and into the markets”. In this perspective, i.e. the importance of initiation and finalization, the practices and strategies shown in Table 8.5, in the rows “Exploration practice” and “Commercialization” may be considered as paramount. As shown in Table 8.5, there are differences between Asian, Norwegian and Euro-American manufacturing firms in these respects, which will now be explored and discussed.

As already pointed out, perhaps the most clear-cut and profound difference between the three categories of firms may be seen in “Exploration practice”. In this, Asian manufacturing firms may be characterized as extrovert because they emphasize participation in industry networks, use of external experts and cooperation with university spin-offs. In addition, they give priority to interaction with key suppliers and customers. Although the latter is also a priority of Euro-American manufacturing firms, the strategy and practice of Asian manufacturing firms may be interpreted as being more oriented towards sourcing opportunities outside the firm, specifically search or surveillance directed towards what may be interpreted as advance knowledge communities. In contrast, Norwegian manufacturing firms – and also to a great extent Euro-American manufacturing firms – focus their attention on sources inside their firms, i.e. a practice and strategy of giving priority to developing the firms’ own (in-house) capability for market trend detection. This is aligned with a practice of moving employees around the firm (staff mobility) and by allocating time and other resources to the firms’ own employees. These practices are in accordance with what may be termed as the tenets of the “Nordic model”. However, as shown in detail in Table 8.1, these priorities are also shared by Euro-American manufacturing firms, which makes the label “Nordic model” inaccurate. Still, characterizing this as introvert may be justified, as a contrast to what seems to be an extrovert dominant strategy and practice of Asian manufacturing firms.

The implication of this interpretation may be that Asian manufacturing firms are much closer to scientific knowledge and technological expertise and related communities outside the firms in their exploration of ideas for innovation, compared to its Norwegian and Euro-American counterparts. Because of this, one may reasonably expect Asian manufacturing firms to have a greater exposure to relevant scientific and technological frontiers, compared to Norwegian and Euro-American manufacturing firms. For this reason, one may suggest that Asian manufacturing firms orient themselves towards searching for and obtaining advanced ideas for its innovation activities, more so than Norwegian and Euro-American manufacturing firms. In contrast, the latter seem to emphasize searching for ideas within their firms and among their own employees. This strategy and practice has, however, some followers among Asian manufacturing firms, but this is what may be termed a secondary practice or strategy, whereas in Euro-American and Norwegian manufacturing firms, this is dominant.

In general, one may suggest that Asian manufacturing firms have a dominant strategy and practice that increase its exposure for ideas that may be conducive to promotion of radical innovations. In contrast, Norwegian and Euro-American manufacturing firms have a dominant strategy and practice more oriented towards exploitation activities that will lead them towards incremental innovation as an outcome of their introvert orientation. Following March (1991), one could suggest that Asian manufacturing firms are more exploration oriented, in contrast to Norwegian and Euro-American manufacturing firms that seem more exploitation oriented. Because of the contrast between Asian manufacturing firms on the one side and more “occidental” manufacturing firms on the other, one may be tempted to ask if this divide reflect cultural factors, i.e. general norms and values of the society of the firms. This is an assumption in the theory of “innovation games” (Miller & Floricel, 2007). One may also point to framework conditions, e.g. industrial policy regimes in Korea and Taiwan that put great emphasis on scientific and technological research directed to development of an advanced industry.

In commercialization, the similarities and differences are more diverse; the clear pattern observed in exploration practices does not appear in commercialization strategy and practice. As shown in table 8.5, all three categories of firms have in common that they to some extent have adopted a strategic approach to commercialization, although this is more pronounced in Norwegian manufacturing firms. Table 8.5 also shows some commonality between Norwegian and Euro-American manufacturing firms in terms of giving priority to using champions for driving commercialization forward. This and the use of corporate entrepreneurship do not have high priority in the dominant practice and strategy of Asian manufacturing firms. Euro-American and Norwegian manufacturing firms are also similar because they favor use of corporate teams and establishment of new venture groups for commercialization, in their dominant strategy and practice. In their dominant practice, the R&D function in Asian manufacturing firms has a high priority, which is also the case for Euro-American manufacturing firms, but not Norwegian manufacturing firms. Asian manufacturing firms differ from Norwegian and Euro-American manufacturing firms because they encourage middle managers to develop innovative businesses in their dominant practice and strategy.

A salient feature of Norwegian manufacturing firms is that they use a number of different commercialization practices and that the dominant practice is comparatively weak. Hence, they may be characterized as pluralistic in terms of commercialization strategy and practice. In contrast, Asian and Euro-American manufacturing firms appear to be more stringent. The stringency and cohesiveness that Asian and Euro-American manufacturing firms exhibit in terms of their dominant commercialization strategy and practice raises the question of why Norwegian manufacturing firms are more pluralistic, not only in relationship to commercialization, but also in other domains related to innovation activities, as shown in the analyses of this report. The sample of Norwegian manufacturing firms is smaller than the other two categories of firms, so one could be tempted to suggest that the pluralism may be caused by statistical artifacts. Although this possibility should not be excluded, it is still hard to understand how this could impact this Norwegian outcome. A more plausible explanation could be that this reflects contextual factors such as adaptation to many different games of innovation. However, if this had been the case,

Asian and Euro-American manufacturing firms should also have more strategic pluralism, which is not the case for Asian manufacturing firms and only to some degree with Euro-American manufacturing firms. An alternative interpretation could be that the pluralism of Norwegian manufacturing firms reflects what may be called a Nordic work and industrial culture in which autonomy is seen as an asset. Hence, Norwegian manufacturing firms have a culture that is conducive to fostering pluralism, and, by implication, heterogeneity in strategy. This is of course a sympathetic interpretation. A more critical interpretation could perhaps suggest that the pluralism of Norwegian manufacturing firms mirror their lack of professional skills and weakness of managerial leadership in terms of innovation strategy, in spite of their high degree of innovation and profitability. This interpretation does not necessarily contradict the first one, but in an increasingly competitive and globalized world economy, the pluralism of Norwegian manufacturing firms may not be viable.

9 Conclusion, discussion and policy implications

9.1 Summary of findings

In this report, the results from the analyses of data from the MINE survey have been presented in a comparative perspective, i.e. a comparison of Asian manufacturing firms with Norwegian and “Euro-American” manufacturing firms. These three categories of firms and the procedures used in analyses were presented and explained in chapter 2. Below, the main findings from each topic presented in the report will be summarized, in the following order:

- Firm performance
- Perception of contextual factors
- Value creation capability of the firm
- Innovation awareness in the organization
- Innovation strategy processes and decision making
- Strategies and practices for innovation, with the following sub-topics:
 - o Exploration activities
 - o Decision-making and portfolio management
 - o Policies and practices relevant for innovation projects
 - o Commercialization practices

As explained in the introduction of this report and in chapter 2, the purpose of this report is to find out if Asian companies, which have enjoyed considerable success during the past decades in an increasingly globalized and competitive economy, differ in terms of their innovation processes and how they innovate – the way they think, plan and work with innovation.

Firm performance

In terms of performance, the tables presented in chapter 3 shows that the difference between the three categories of manufacturing firms is not large. However, within these slight variation, Asian manufacturing firms gave scores on their firms’ performance that were slightly better than Norwegian and Euro-American manufacturing firms. These differences become much less distinct when comparison is made of the sales growth and profitability. Asian and Norwegian firms seem to have obtained a higher annual growth rate over the last three years; they are in the range of 10-20 percent annual sales growth, which is respectable and good in terms of sales growth. Still, in terms of net profits from sales and average return on investment (ROI), respondents from Norwegian firms indicate that their ROI was highest; Asian firms reported highest average net profits on sales over the last years, slightly more than their Norwegian counterparts. An assumption in the design of the MINE questionnaire is that firm performance is an outcome, i.e. the “dependent” variable, of all the aspects that influence the innovation processes and strategy of the firm. The tables 3.1, 3.2 and 3.3 show that although all firms think that they are slightly better than their rivals in most of the dimensions which are relevant for characterizing success in business – and seem to enjoy a healthy level of profitability, some differences between the firms seem to exist, as pointed out by the statistical amplification presented in table 3.3.

This gives support to the assumption of the MINE project that the firms that participated in the survey have good track record in terms of innovation performance – and that this has contributed to their profitability. Although some differences between the various categories of firms may be observed, the general picture is that the respondent firms are successful in an innovation perspective. The question of how and why they differ in terms of innovation then becomes interesting in the global perspective adopted as the approach of this report. This was then the main topic in the rest of this report: Are there differences between the three categories, Asian, Norwegian and Euro-American firms in how they innovate? If so, what are these differences – and what do these imply in terms of the conceptual framework of games of innovation?

Perception of contextual factors

The topic of chapter 4 was how the firms that participated in the MINE survey perceived contextual factors, i.e. factors outside the firm that influence the firm. Factor analyses of the responses made show that although the differences between the three categories of firms are not sharp, there are nevertheless some differences which may be considered significant when comparing what may be termed as the dominant trend of firms, i.e. the first component that explains the largest percent of the variance:

- Compared to the other categories of firms in this analysis, Asian firms emerge as more *market oriented* because they put strong emphasis on the importance of customers, users, academia and the technological environment of their firm.
- In contrast, Norwegian manufacturing firms put greater emphasis on aspects that may be termed as a *technology oriented outlook*.
- Euro-American firms seem more fragmented, but in their dominant trend, they emphasize some of the same aspects as the ones emphasized by Asian manufacturing firms.

In attempting to interpret these observations, one may suggest that these differences indicate that Asian manufacturing firms are generally *more extrovert* in their orientation, compared to the other categories of firms. In contrast, Norwegian manufacturing firms seem to pay more attention and emphasize factors that may be considered as important with the technological regime that they belong to, i.e. a *more introvert orientation*. Euro-American manufacturing firms seem to be split between these two extremes, because they are more pluralistic.

In terms of which specific factors that influence innovation in the firms and the sector they operate in, the contrasts observed above are not so distinct. In fact, the results obtained by the factor analysis indicate what may be interpreted as some degree of consensus between the three groups of firms. All firms seem to share a common outlook in:

- Recognizing the importance of developing products that interconnect with other products, because this is considered important for creating value for their customers,
- Recognition of technical compatibility and interworking of products with others,
- Regulatory approval and IPR are not considered as important for the firms' innovation activities,
- The potential for economics of scale in production and the potential of harvesting economic benefits from process innovation is not given much emphasis,
- Economic constraints are considered important.

These commonalities indicate that in these aspects, their perception of the “game of innovation” is uniform, however, the firms diverge in other aspects, as pointed out earlier. The results from the analyses indicate that Asian firms attach much importance to the dynamics of technological development and competition in their sector. This is seen in the number of attributes in the profile of Asian firms (component 1) in that they, in contrast to Norwegian manufacturing firms and Euro-American firms, think that their products are constantly under attack from low-cost substitutes – and that their rivals are continually eroding their competitive advantage and challenging their positions. Furthermore, they think that their sector is in the process of significant, unanticipated developments, which will force unpredictable transformations upon the sector and redefine the boundaries of this. Hence, one may interpret this as an indicator of a high awareness and anticipation of competition, and the potential impacts on this on the structure and dynamics of their sector. This type of awareness is comparatively weak in Norwegian and Euro-American manufacturing firms. One may even be tempted to interpret this as a higher degree of complacency and introvert orientation.

Value creation capability of the firm

In chapter 5, the results of the factor analysis of capabilities needed for innovation were shown and analyzed. The results shown are interesting as cognitive maps, i.e. the importance firms attach to various innovation capability factors. These showed that Asian firms, by comparison with the other two categories for firms, appear as more coherent in their perception of capabilities needed for innovation. In fact, the results suggest that Asian firms converge in one dominant view – and one contrasting, minority view. In contrast, Norwegian and Euro-American manufacturing firms are much more pluralistic or diverse in what they consider as important innovation capabilities. Whereas Norwegian and Euro-American firms seem to put primary emphasis on a few capabilities, Asian emphasize numerous. In the latter, greatest emphasis is set on their firms’ capability to anticipate and solve customers’ problems and design solutions that enhance the full cycle of customer experience. Simultaneously, they put emphasis on quality of products, continuous introduction of novelties and product variety. These and related capabilities may be interpreted as Asian firms being *customer focused* in how they evaluate innovation capabilities. Asian firms also put emphasis on transforming academic research into useful products.

In contrast, Norwegian manufacturing firms, in the dominant component (component 1), put emphasis on capabilities that may be termed as *techno-economic focused*, such as quality and reliability of products and cost reduction. Euro-American firms, in their dominant component (component 1), seem to emphasize what may be termed as *product focused*, because they attach highest importance to low costs of products, continuous introduction of novelties and design of solutions aimed at enhancing customer experience. The capability of transforming academic research into useful products is viewed as less important in Euro-American firms, and, to some extent, also in Norwegian firms, however, Asian firms consider this important.

Innovation awareness in the organization

In terms of innovation awareness in the organization, which represents what may be termed as “innovation culture” or “innovation climate”, there are differences: Whereas Asian firms put more emphasis on both *interpretation and identification* of issues related to innovation awareness, Norwegian firms emphasize *interpretation and formal management processes* related to innovation awareness. In contrast, Euro-American firms had high scores on aspects that may be characterized as *communicative and action-oriented*. All firms have in common that they do not put much emphasis on “understanding”. One interpretation of the results presented on innovation awareness (table 6.1) is that Asian and Norwegian firms are similar in the emphasis they put on many aspects; Euro-American firms deviate for this. This may possibly be explained as Euro-American firms being more action-oriented and less analytical in their innovation awareness, compared to Asian and Norwegian firms. Asian and Norwegian firms may be interpreted as more analytical because of the emphasis they put on interpretation in their innovation awareness. However, Norwegian firms align this with formal management processes. Although Asian firms also seem to attach some importance to formal management processes, this is not the case for Euro-American firms. Asian firms align interpretation with people in the organization, instead of formal management processes as in Norwegian firms. The reason for this could be that Asian firms, to a greater extent than Norwegian and Euro-American firms, emphasize innovation awareness with individual employees in the organization. If valid, this contradicts the assumption that in Asian firms, a collectivistic corporate culture is strong, in contrast to Nordic (Norwegian) firms in which individualism is considered as a salient aspect of corporate or company culture.

Innovation strategy processes and decision making

In terms of innovation strategy processes and decision making, analyses in chapter 7 showed that all three categories are similar in many aspects:

- Innovation is *not* an important item on the agenda of top management meetings in the firms,
- Whether or not senior managers disagree over the best innovation strategy is *not* considered important,
- Senior managers *do not* discuss strategic directions with their employees frequently, and, reciprocally, employees rarely challenge senior managers’ understanding of their firm’s situation,
- Firms do not create new innovation capabilities without plans or strategies, nor do people related to manufacturing have authority to decide NPD.

Apart from these commonalities in the analyses of the results from this part of the survey, one may observe that heterogeneity is a salient aspect in terms on innovation strategy processes and decision making in innovative manufacturing firms. Hence, firms have a multitude of innovation strategy processes and modes of decision making related to this, as evident in the high number of components generated by the factor analysis of this topic, cf. table 7.1. Still, by comparing the components that had the highest percentage of variance explained (component 1), some aspects seem to be distinct:

- Asian firms give *NPD-teams a high degree of autonomy and power* over innovation strategy processes and decision making – and this is also associated with alignment of

people who build marketing capabilities and scientific and engineering capabilities in the firms.

- Euro-American firms are to *some extent similar to Asian*, but they do not have the alignment that Asian firms have made with people who build capabilities in terms of marketing and scientific and engineering capabilities.
- Norwegian firms, in contrast, *rely on BUs for innovation strategy processes and decision making* – and align this with senior managers in the organization who are formally assigned to support innovation processes. Although this pattern is seen in the “strongest” component (component 1), the second strongest component (component 2) has some similarity with the one observed as component 1 in Euro-American firms, which points to the aspect of heterogeneity.

Strategies and practices for innovation

The topic of innovation strategies and practices for innovation in chapter 8 covered four topics:

- Exploration activities
- Decision-making and portfolio management
- Policies and practices relevant for innovation projects
- Commercialization practices

Exploration activities: Perhaps the most clear-cut and profound difference between the three categories of firms may be seen in “Exploration practice”. In this, Asian manufacturing firms may be characterized as *extrovert* because they emphasize participation in industry networks, use of external experts and cooperation with university spin-offs. In addition, they give priority to interaction with key suppliers and customers. Although the latter is also a priority of Euro-American manufacturing firms, the strategy and practice of Asian manufacturing firms may be interpreted as being more oriented towards sourcing opportunities outside the firm, specifically search or surveillance directed towards what may be interpreted as advance knowledge communities. In contrast, Norwegian manufacturing firms – and also to a great extent Euro-American manufacturing firms – focus their attention on sources inside their firms, i.e. a practice and strategy of giving priority to developing the firms’ own (in-house) capability for market trend detection. This is aligned with a practice of moving employees around the firm (staff mobility) and by allocating time and other resources to the firms’ own employees. These practices are in accordance with what may be termed as the tenets of the “Nordic model”. However, as shown in detail in Table 8.1, these priorities are also shared by Euro-American manufacturing firms, which makes the label “Nordic model” less accurate. Still, characterizing this as *introvert* may be justified, as a contrast to what seems to be an extrovert dominant strategy and practice of Asian manufacturing firms.

Decision-making and portfolio management deals with how innovative manufacturing firms choose and give priority to various innovation projects, i.e. what kind of guidelines or rules they apply for making these types of decisions. The results shown in Table 8.2 are not as clear-cut in terms of a contrast between Asian manufacturing firms on the one side, and Norwegian and Euro-American manufacturing firms on the other, as observed in the topic of exploration activities. In

fact, there are numerous aspects that are shared by all three categories of firms, indicating some degree of commonality in terms of decision-making and portfolio management practices and strategies among all the manufacturing firms that participated in the MINE survey. This commonality may be interpreted as shared sectorial strategies and practices for manufacturing industries – something that all manufacturing firms seem to put emphasis on. However, in other aspects, the strategies and practices seem to diverge to an extent that may seem confusing. One may observe that in Asian manufacturing firms give high priority to a strategy that empower middle managers to reallocate funding for projects and that also evaluate projects in a portfolio perspective and select these according to technology and product roadmap. In Norwegian and Euro-American manufacturing firms, these strategies and practices seem more pluralistic. This variety in strategies and practices could also be interpreted as Norwegian and Euro-American manufacturing firms being less coherent in terms of their strategies and practices when they make decisions on portfolio and innovation activities. In general, Asian manufacturing firms appear to have a more cohesive approach in terms of strategies and practices for making decisions related to portfolio management. However, some aspects of this is shared with Norwegian and Euro-American manufacturing firms. Hence, there are some aspects that seem “universal”, however, in general, the Norwegian and Euro-American practices may be characterized as pluralistic because diversity seems to exist in terms of portfolio management and related priorities and decision making. For this reason, one may be tempted to interpret this as Asian manufacturing firms adhering to one predominant “best practice”, however, among Norwegian and Euro-American manufacturing firms, there is greater variety in strategies and practices.

Policies and practices relevant for innovation projects: Once firms have made the crucial decisions on what kind of innovation projects or activities to support – and how to support and manage these processes and decisions – the next step is of course how to manage the projects or activities. The results of the analysis (Table 8.3) suggests that Asian and Euro-American manufacturing firms have some commonality, in contrast to Norwegian manufacturing firms. What emerges as dominant, in terms of strategies and practices in both Asian and Euro-American manufacturing firms is that they is emphasis on a careful product selection process, an experimental approach as part of building a prototype, use of simulation and obtaining an understanding of the prospective product – and, finally, that this is done in an iterative processes.

In contrast, the Norwegian manufacturing firms, in their dominant strategy and practices (component 1), put more emphasis on mapping technical and market environment of a project, this being based on extensive prior classification and prioritizing of user needs – and using the latest modules and parts available on the market. Although these practices may be designated as dominant, this is weak compared to the dominant strategies and practices of Asian and Euro-American manufacturing firms. The impression that Table 8.3 presents for Norwegian manufacturing firms is indeed pluralism of strategies and practices, or alternatively, what may also be interpreted as fragmentation. However, in spite of these weak differences, it seems reasonable to characterize the dominant strategy of Asian and Euro-American manufacturing firms as being *rigorous and experimental in terms of product development*. The dominant strategy

of their Norwegian counterparts may be characterized as *context and object oriented*, the latter being similar to the concept of object orientation in software engineering.

Commercialization practices: In their commercialization practices, both the Asian and Euro-American manufacturing firms are similar in terms of elements that constitute their dominant strategy, which is comparatively *strong, cohesive and comprehensive*, compared to the Norwegian. However, there are some differences: Asian firms believe that commercialization should be promoted by giving incentives that are aimed at inducing managers to develop innovative businesses and that businesses are expected to generate a set percentage of revenues from new products. In contrast, Euro-American manufacturing firms give higher priority to using champions and these persons are nurtured in order to facilitate transfer of innovation to other business units in the firm, possibly at the expense of giving less priority to incentives to induce managers to develop innovative businesses. The profile of the dominant practice among Norwegian manufacturing firms is more *fragmented and frugal*, i.e. they do not give high priority to as many variables or elements as done in Asian and Euro-American manufacturing firms. Hence, Norwegian manufacturing firms, in terms of strategies and practices for commercialization, deviate from what seems to be dominant strategies and practices among Asian and Euro-American manufacturing firms. Norwegian manufacturing firms emphasize having a strategic framework for commercialization, i.e. guidelines, plans and procedures. This is combined with establishment of special corporate teams and funding to support new market entry and also establishment of new venture group specialized in developing new internal business.

Table 9.1: Overview - Dominant strategies and salient characteristics

Topic	Asian manufacturing firms	Norwegian manufacturing firms	Euro-American manufacturing firms	Comments
Firm performance (chapter 3)	Better than rivals	Better than rivals	Better than rivals	Asian slightly better overall performance
Perception of contextual factors (chapter 4)	Market oriented outlook, but also on competition and technological development	Technology oriented outlook	Market oriented outlook	Euro-American firms not as market oriented as Asian firms
Value creation capability of the firm (chapter 5)	Customer focused	Techno-economic focused	Product focused	High degree of commonality between the firms; differences slight
Innovation awareness in the organization (chapter 6)	Interpretation and identification emphasized, alignment to individuals	Interpretation and formal management processes emphasized	Communicative and action oriented awareness	Euro-American firms are distinctly different from Asian and Norwegian firms
Innovation strategy processes and decision making (chapter 7)	NPD-teams are given high autonomy and empowered	BU are in charge of NPD	Similar to Asian firms, but not so strong	Commonality: Innovation not high on agendas of top management
Strategies and practice for innovation – Exploration activities (chapter 8.1)	Extrovert	Introvert	Introvert	Clear-cut differences
Strategies and practice for innovation – Decision-making and portfolio management (chapter 8.2)	Empowerment of middle managers; emphasis on portfolio management	Similar to Asian, but pluralism salient	Similar to Asian, but pluralism salient	Many aspects shared by all firms, however, pluralism of strategies salient
Strategies and practice for innovation – Policies and practices (chapter 8.3)	Rigorous and experimental in approach to PD	Context and “object oriented” approach to PD	Rigorous and experimental in approach to PD	Many aspects shared – contrasts not so strong
Strategies and practice for innovation – Commercialization practices (chapter 8.4)	Strong, cohesive and comprehensive	Fragmented and frugal	Similar to the Asian, but not so pronounced	Norwegian firms deviate
“March scale” (March, 1991)	Comparatively exploration oriented	Clearly exploitation focus	Exploitation dominant, but not pronounced	See discussion chapter 9.2
“Ven scale” (Ven, et al., 1999)	More divergence oriented	Convergence main focus	Convergence main focus	See discussion chapter 9.2
“Games of Innovation-scale”(Miller & Floricel, 2007)	See discussion chapter 9.2	See discussion chapter 9.2	See discussion chapter 9.2	See discussion chapter 9.2

9.2 Discussion

The overview presented in Table 9.1 may serve as a point of departure for discussing the findings of the analyses presented in the chapters of this report – and their implications. Because of its minimalist format, the overview does not render justice to the great variety of nuances and complexity of the material that has been presented; in this sense, table 9.1 is rudimentary and somewhat simplistic. But still, table 9.1 may serve as a device for highlighting one essential topic for the discussion: What are the main differences between the three categories of firms? Are these differences significant for explaining the modus operandi, innovativeness and success of Asian firms in an increasingly globalized economic system? In order to approach these issues, the first step will be to identify what exactly, according to the material in this report, make Asian firms different.

Asian manufacturing firms that participated in the MINE survey differ from Norwegian and Euro-American manufacturing firms in these aspects:

- Asian firms exhibit a slightly *better overall performance* in terms of criteria used for business success.
- Asian firms are *more market oriented* in their outlook on contextual factors, and this is combined with a *high awareness of competition and technological development outside the firm*.
- Asian firms are slightly more *customer focused* in their understanding of the value creation capability of the firm.
- In terms of innovation awareness in the organization (“innovation culture” or “innovation climate” in the firm), Asian firms attach this to *individuals within the organization and their interpretations of innovation*.
- In Asian firm, *NPD-teams (New Product Development teams) are given high autonomy and are empowered* to make decisions that are related to innovation, i.e. innovation activities are delegated to specialist entities.
- Asian firms may be characterized as having an *extrovert outlook in their exploration activities*, i.e. the activities related to sourcing and selection of candidates for innovation activities, and their attention is focused on advanced knowledge communities and experts outside the firm.
- Asian firms, more so than the other two categories of firms, emphasize *empowerment of middle managers and use of portfolio management approach* in innovation activities.
- Asian firms emphasize the importance of using a *rigorous and experimental approach* at all stages of product development in order to secure success, in their policies and practices related to innovation activities.
- Asian firms, similar to Euro-American firms, appear to be *strong, cohesive and comprehensive* in terms of strategies and practice for innovation is on commercialization.

As already pointed out above, perhaps the most clear-cut and profound difference between the three categories of firms may be seen in “Exploration practice”. In this, Asian manufacturing firms may be characterized as extrovert because they emphasize participation in industry networks, use of external experts and cooperation with university spin-offs. In addition, they give priority to

interaction with key suppliers and customers. Although the latter is also a priority of Euro-American manufacturing firms, the strategy and practice of Asian manufacturing firms may be interpreted as being more oriented towards sourcing opportunities outside the firm, specifically search or surveillance directed towards what may be interpreted as advance knowledge communities. In contrast, Norwegian manufacturing firms – and also to a great extent Euro-American manufacturing firms – focus their attention on sources inside their firms, i.e. a practice and strategy of giving priority to developing the firms' own (in-house) capability for market trend detection. This is aligned with a practice of moving employees around the firm (staff mobility) and by allocating time and other resources to the firms' own employees. These practices are in accordance with what may be termed as the tenets of the "Nordic model". However, as shown in detail in Table 8.1, these priorities are also shared by Euro-American manufacturing firms, which makes the label "Nordic model" inaccurate. Still, characterizing this as introvert may be justified, as a contrast to what seems to be an extrovert dominant strategy and practice of Asian manufacturing firms.

The implication of this interpretation may be that Asian manufacturing firms are much closer to scientific knowledge and technological expertise and related communities outside the firms in their exploration of ideas for innovation, compared to its Norwegian and Euro-American counterparts. Because of this, one may reasonably expect Asian manufacturing firms to have a greater exposure to relevant scientific and technological frontiers, compared to Norwegian and Euro-American manufacturing firms. For this reason, one may suggest that Asian manufacturing firms orient themselves towards searching for and obtaining advanced ideas for its innovation activities, more so than Norwegian and Euro-American manufacturing firms. In contrast, the latter seem to emphasize searching for ideas within their firms and among their own employees. This strategy and practice has, however, some followers among Asian manufacturing firms, but this is what may be termed a secondary practice or strategy, whereas in Euro-American and Norwegian manufacturing firms, this is dominant.

In general, one may suggest that Asian manufacturing firms have a dominant strategy and practice that increase its exposure for ideas that may be conducive to promotion of radical innovations. In contrast, Norwegian and Euro-American manufacturing firms have a dominant strategy and practice more oriented towards exploitation activities that will lead them towards incremental innovation as an outcome of their introvert orientation. Following March (1991), one could suggest that Asian manufacturing firms are more exploration oriented, in contrast to Norwegian and Euro-American manufacturing firms that seem more exploitation oriented. Because of the contrast between Asian manufacturing firms on the one side and more "occidental" manufacturing firms on the other, one may be tempted to ask if this divide reflect cultural factors, i.e. general norms and values of the society of the firms. This is an assumption in the theory of "innovation games" (Miller & Floricel, 2007). One may also point to framework conditions, e.g. industrial policy regimes in Korea and Taiwan that put great emphasis on scientific and technological research directed to development of an advanced industry.

In commercialization, the similarities and differences are more diverse; the clear pattern observed in exploration practices does not appear in commercialization strategy and practice. As shown in

table 8.5, all three categories of firms have in common that they to some extent have adopted a strategic approach to commercialization, although this is more pronounced in Norwegian manufacturing firms. Table 8.5 also shows some commonality between Norwegian and Euro-American manufacturing firms in terms of giving priority to using champions for driving commercialization forward. This and the use of corporate entrepreneurship do not have high priority in the dominant practice and strategy of Asian manufacturing firms. Euro-American and Norwegian manufacturing firms are also similar because they favor use of corporate teams and establishment of new venture groups for commercialization in their dominant strategy and practice. In their dominant practice, the R&D function in Asian manufacturing firms has a high priority, which is also the case for Euro-American manufacturing firms, but not Norwegian manufacturing firms. Asian manufacturing firms differ from Norwegian and Euro-American manufacturing firms because they encourage middle managers to develop innovative businesses in their dominant practice and strategy.

A salient feature of Norwegian manufacturing firms is that they use a number of different commercialization practices and that the dominant practice is comparatively weak. Hence, they may be characterized as pluralistic in terms of commercialization strategy and practice. In contrast, Asian and Euro-American manufacturing firms appear to be more stringent. The stringency and cohesiveness that Asian and Euro-American manufacturing firms exhibit in terms of their dominant commercialization strategy and practice raises the question of why Norwegian manufacturing firms are more pluralistic, not only in relationship to commercialization, but also in other domains related to innovation activities, as shown in the analyses of this report. The sample of Norwegian manufacturing firms is smaller than the other two categories of firms, so one could be tempted to suggest that the pluralism may be caused by statistical artifacts. Although this possibility should not be excluded, it is still hard to understand how this could impact this Norwegian outcome. A more plausible explanation could be that this reflects contextual factors such as adaptation to many different games of innovation. However, if this had been the case, Asian and Euro-American manufacturing firms should also have more strategic pluralism, which is not the case for Asian manufacturing firms and only to some degree with Euro-American manufacturing firms. An alternative interpretation could be that the pluralism of Norwegian manufacturing firms reflects what may be called a Nordic work and industrial culture in which autonomy is seen as an asset. Hence, Norwegian manufacturing firms have a culture that is conducive to fostering pluralism, and, by implication, heterogeneity in strategy. This is of course a sympathetic interpretation. A more critical interpretation could perhaps suggest that the pluralism of Norwegian manufacturing firms mirror their lack of professional skills and weakness of managerial leadership in terms of innovation strategy, in spite of their high degree of innovation and profitability. This interpretation does not necessarily contradict the first one, but in an increasingly competitive and globalized world economy, the pluralism of Norwegian manufacturing firms may not be viable.

The interpretations and discussions above are based on a material, the MINE-survey, which does have limitations, as pointed out earlier in chapter 2. As such, the findings in this report should be treated with caution, and should not be considered as final. In fact, given the qualitative nature of

the empirical material and the sampling procedure, the data material has limitations in many directions: Statistical generalizations of the findings, although theoretically possible, have not been attempted because the assumptions that this would need would have been highly uncertain. Hence, no statistical generalizations were done. The categories of firms that were made for the purpose of the analyses in this report, specifically the category “Euro-American”, encompass a broad range of different firms in terms of corporate and industrial culture, e.g. there are differences between German firms and Canadian, one would assume, and on closer inspection, these differences may impact the findings that were presented in this report. The statements that informants were asked to consider in the questionnaire may sometimes have been difficult to understand or relate to. In addition, the questionnaire itself was long, making respondent fatigue a relevant topic, because the response rates in the questionnaire were lower at the end of the questionnaire compared to the beginning. All these aspects and others indicate that one should be cautious in terms of the findings presented in this report.

In spite of these precautions, the findings give support to raising new research questions for further research. There are two topics in the findings in this report that seem promising and relevant to probe further:

- Exploration activities, i.e. the fuzzy front-end of innovation (cf. chapter 8.1), and
- Commercialization (cf. chapter 8.4).

A point of departure for further research could be findings presented in this report – and replication of the approach used in the analyses, i.e. adoption of a comparative approach. In trying to understand the new dynamics of innovation and competition in globalized markets, innovation research needs to focus on the activities and performance of Asian firms, because at present and in the foreseeable future, Asian firms will be the leaders of this development.

9.3 Policy implications

The analyses in this report were motivated by an interest in finding out if the success of Asian firms in innovation may be explained by the way these firms think, plan and work with innovation activities. In the increasingly globalized and competitive markets, Asian firms have achieved considerable success during the last century, in particular since World War II. In the pre-WWII years, Japanese companies pioneered this in a number of product domains, e.g. in textile manufacturing industry. During the last decades, firms from People’s Republic of China, Korea and Taiwan have also become highly successful in the global markets – and many of these are highly innovative and technologically sophisticated, both in terms of product innovation, but also in process innovation, the latter explaining why the Asians often are able to produce at lower prices and higher quality.

The material and analyses presented in this report suggest that Asian manufacturing firms differ from their Norwegian and Euro-American counterparts in some aspects that are important in terms of innovation strategy and practices. Hence, one may ask if the findings presented in this report may contribute to a more satisfactory explanation of the success of Asian firms. The cautious interpreter of the findings would answer “no”. As pointed out in chapter 4 on firm

performance, Asian firms are slightly more successful in terms of business success. Hence, one may plausibly suggest that the findings merely show that there are numerous ways of obtaining success, i.e. a multitude of styles of playing the innovation game are feasible and successful. The number of components generated by the factor analyses would provide support to this type of interpretation.

Still, this is not a satisfactory explanation. The success of Asian firms begs for an explanation. Asian firms have been able to outcompete its rivals elsewhere because they are more innovative. Hence, there is “something” they do which somehow contributes to their competitive advantage in terms of innovation. The analyses in this report have identified a number of differences in the way Asian firms think, plan and act in terms of innovation activities. It seems fair to assume, given the success of Asian firms, that these distinct aspects somehow explain a more viable and successful strategy in terms long-term success. Exploration activities (cf. chapter 8.1) is perhaps the most clear-cut and strategically significant difference between Asian firms on the one hand, and Norwegian and Euro-American firms on the other hand. As explained earlier, this indicates that Asian firms put higher priority on sourcing advance knowledge *outside* their firms, hence, they are more *extrovert*, compared to their counterparts (and competitors) in Norway and the countries from which the Euro-American firms come from. Secondly, Asian firms put high trust on their own, specialized experts, such as R&D and NPD-teams; these are empowered and given a high degree of autonomy. In Norwegian firms, the business units (BUs) have control over NPD. This way of organizing innovation and related activities has a bias towards conservatism and status-quo, as many analysts have pointed out (Roussel, Saad, & Kash, 1991; Tirpak, et al., 2006), although it provides numerous, more short-term advantages in terms of spending and costs. Hence, in the long run, the Asian mode of innovation activities has many of the attributes associated with March’s concept of exploration (March, 1991). According to March, exploration as a strategy is risky and will fail in the long run, which makes exploitation the winner by default. March supports to his prediction, not by empirical evidence, but from findings generated by a computer based simulation exercise. However, the successes of Asian firms seem to contradict March, raising the academically interesting question of the predictive powers of this type of simulation: Maybe there is something wrong with the assumptions that were put into the model? However, March’s pessimistic prediction about exploration accords well with how many business school trained managers, economists and policy makers think about technology development and innovation. However, the success of Asian firms and their inclination towards a strategy of exploration may explain how they have succeeded.

Translating the findings in this report into policy advice is of course difficult. Following the cautious interpretation presented initially, there is really little to learn from the analyses in this report: Apart from observing that although some types of strategies and practices are has stronger support than others, pluralism is also strong. However, if policy makers in a country like Norway become convinced that Asian firms are successful because they are more exploration oriented and because of all the other attributes that make their way of doing innovation different from its competitors, then this should be translated into policy measures and instruments that give firms incentives to act more like Asian firms. To some extent this may be done by designing

framework conditions that encourage firms to become more explorative. Norwegian society is in a unique position to encourage firms to become “more Asian” because the state is a major owner of private sector firms in Norway. The governance of this substantial ownership is now done by an arm’s length, laissez-faire policy, i.e. the state has a passive role – and this is justified as a “professional” approach and operationalized by appointing officers to sit on boards, etc. of these private sector companies, basically as observers, i.e. they are expected to be passive. This is different from the role of government in Asian countries in its relationship to private sector companies, in particular on matters related to R&D and technology development.

The Norwegian government’s current “ownership policy” should be reconsidered, asking what should be done to make the companies owned or controlled by Norwegian society more innovation oriented and more successful in innovation activities? The findings in this report suggest that Asian companies do this in ways that are different from Norwegian and Euro-American companies. Policy should encourage development of strategies and practices that make Asian companies successful and competitive in the globalized markets. Unfortunately, in the present, somewhat complacent policy climate and ideological hegemonies that prevail, hoping for this type of policy rejuvenation would perhaps be utopian, however, if Asian firms continue to outcompete all others, then policy may be forced to reconsider, if they are capable of this mode of thinking. This may imply throwing away the political blinkers that policy makers are using now.

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Appendix 1: Calculation of statistical significance for firm performance

Table 3.1 shows the results of a statistical exercise designed to identify in which areas there are statistically significant differences between the three categories of firms in terms of the dimensions explored in Table 3.1 and Table 3.2. In each column in Table 3.3 we compare the mean values of the firm performance variables in Tables 3.1 and 3.2. We see for example from Table 3.1 that the mean value of the number of spin-offs and start-ups generated through innovation among Asian firms (4.4) is higher than the corresponding mean value among Norwegian firms (3.5). The question is whether the difference is significant or not? In the following we will use this firm performance variable as an example.

The fundamental question for this firm performance variable is whether the mean value of the number of spin-offs and start-ups generated through innovation is higher among the population of Asian firms than among the population of Norwegian firms? Suppose that this mean value for the population of Asian firms is μ_X , and that this mean value for the population of Norwegian firms is μ_Y . We are interesting in making inferences about the population parameters (μ_X, μ_Y). The question is whether we have the inequality $\mu_X > \mu_Y$ or not, i.e. whether this mean value for the population of Asian firms is higher than the corresponding value for the population of Norwegian firms?

In this case, however, we can only making inferences about these population parameters from an analysis of the sample data. Here we will use the method described in Bhattacharyya and Johnson (1977, Section 9.2) for independent random samples from the populations. The method can be described as follows: Suppose for this firm performance variable that we have the observations X_1, X_2, \dots, X_n for a sample of size n from the population of Asian firms (where the mean value of this firm performance variable is denoted by μ_X), and the observations Y_1, Y_2, \dots, Y_m for a sample of size m from the population of Norwegian firms (where the mean value of this firm performance variable is denoted by μ_Y). I.e., X_i is what respondent i among the sample of Asian firms answered about how many spin-offs and start-ups which were generated through innovation ($i = 1, 2, \dots, n$), Y_j is what respondent j among the sample of Norwegian firms answered about the corresponding number of spin-offs and start-ups ($j = 1, 2, \dots, m$), n is the total number of respondents among the sample of Asian firms who answered this question, and m is the total number of respondents among the sample of Norwegian firms who answered this question. In this case $n = 141$ and $m = 37$. The mean value of the observations X_1, X_2, \dots, X_n from the n Asian firms is $\bar{X} = (1/n) \sum_{i=1}^n X_i = 4.4$, and the mean value of the observations Y_1, Y_2, \dots, Y_m from the m Norwegian firms is $\bar{Y} = (1/m) \sum_{j=1}^m Y_j = 3.5$. The question is whether $\mu_X > \mu_Y$ holds or not? We see that $\bar{X} = 4.4$ is larger than $\bar{Y} = 3.5$, but the question is whether the difference is significant or not, and therefore whether we can claim that $\mu_X > \mu_Y$ holds?

Note that an important requirement for such a comparison between the population parameters μ_X and μ_Y is that the observations X_1, X_2, \dots, X_n is a random sample (of size n) from the

population of Asian firms, and that the observations Y_1, Y_2, \dots, Y_n is a random sample (of size m) from the population of Norwegian firms. A similar requirement must be satisfied for all the comparisons between the population parameters for the scores in Table 3.3. This requirement would not be satisfied if each of the three populations (Asian, Norwegian and Euro-American firms) covered all the firms in the region. However, in our case we have a strategic sample of firms from each of the populations. Each population therefore consists of the most innovative firms, and since each of the samples is approximately randomly drawn from this population, we can assume that this requirement will be satisfied.

Another important requirement is that the observations X_1, X_2, \dots, X_n from the population of Asian firms are independent of the observations Y_1, Y_2, \dots, Y_n from the population of Norwegian firms. More generally, we have to assume that the responses from the Asian firms are unrelated to the responses from the Norwegian firms, which is satisfied for all firm performance variables in Tables 3.1 and 3.2.

These are the only assumptions required when the sample sizes n and m are both large.¹⁸ An approximate $100(1 - \alpha)\%$ confidence interval for $\mu_X - \mu_Y$, for large sample inferences for $\mu_X - \mu_Y$, is given by

$$\bar{X} - \bar{Y} \pm z_{\alpha/2} \sqrt{\frac{S_X^2}{n} + \frac{S_Y^2}{m}},$$

where $z_{\alpha/2}$ is the upper $\alpha/2$ point in $N(0,1)$, and $S_X^2 = (1/(n - 1)) \sum_{i=1}^n (X_i - \bar{X})^2$ and $S_Y^2 = (1/(m - 1)) \sum_{j=1}^m (Y_j - \bar{Y})^2$ are the sample variances for Asian and Norwegian firms, respectively. We want to test the null hypothesis $H_0: \mu_X = \mu_Y$ against the alternative hypothesis $H_1: \mu_X \neq \mu_Y$. Alternatively, we could test either against the alternative hypothesis $H_1: \mu_X > \mu_Y$ (which is more relevant in this case) or the alternative hypothesis $H_1: \mu_X < \mu_Y$, but our alternative hypothesis $H_1: \mu_X \neq \mu_Y$ is of course more general. In testing this null hypothesis, the test statistic is:

$$Z = \frac{\bar{X} - \bar{Y}}{\sqrt{\frac{S_X^2}{n} + \frac{S_Y^2}{m}}}$$

which has approximately a $N(0,1)$ distribution under the null hypothesis. We find that $Z = -3.306$ for the mean value of the number of spin-offs and start-ups generated through innovation, and therefore the null hypothesis is rejected at the 1 % level (i.e. the level $\alpha = 0.01 = 1\%$) in favour of the alternative hypothesis. We have therefore marked the cell with “1 %” for this firm performance score in the column “Significance level” in Table 1.

¹⁸ Bhattacharyya and Johnson (1977, p. 295) emphasize that when both sample sizes n and m are greater than 25 or 30, which is satisfied for all firm performance scores in Tables 3.1 and 3.2, the assumptions concerning small samples can be greatly relaxed. When both sample sizes are small, we also have to assume that both population distributions are normal, and that the population variances are equal.

Table 1: Comparison of scores made by responding firms, statistical significance

How well is your firm doing, relative to competitors, in each of the following areas? Sales growth and profitability?	Difference Asian-Norwegian firms		Difference Asian-Euro-American firms		Difference Norwegian-Euro-American firms	
	Significance level satisfied at 1 or 5 %	Level at 1 or 5 %?	Significance level satisfied at 1 or 5 %	Level at 1 or 5 %?	Significance level satisfied at 1 or 5 %	Level at 1 or 5 %?
Growth rate of firm (or of the relevant SBU used in the survey)		No		No		No
Creation of customer value through innovation		No	5 %	Yes		No
Number of new businesses generated through innovation		No	5 %	Yes		No
Number of spin-offs and start-ups generated through innovation	1 %	Yes	1 %	Yes		No
Frequency of major new products releases	5 %	Yes		No		No
Proportion of revenues generated through new products		No		No		No
<i>Scale: 1=Negative; 2=0-5%; 3=5-10%, 4=10-20%; 5=20-40%; 6=40% and over</i>						
Average annual sale growth over the last 3 years		No	1 %	Yes	5 %	Yes
Average net profit on sales over the last 3 years		No	1 %	Yes		No
Average return on investment (ROI) over the last 3 years	10 %	Yes, higher	5 %	Yes	1 %	Yes

Alternatively, we may establish a confidence interval for the difference in the population mean scores, $\mu_X - \mu_Y$. An approximate $100(1 - \alpha)\% = 99\%$ confidence interval for $\mu_X - \mu_Y$ is $(-1.570, -0.195)$, where $z_{\alpha/2} = z_{0.01/2} = z_{0.005} = 2.575$. Since the confidence interval does not include zero, the null hypothesis is rejected at the 1 % level in favour of the alternative hypothesis. We therefore claim that the mean value of the number of spin-offs and start-ups

generated through innovation is higher among the population of Asian firms than among the population of Norwegian firms. Similar calculations may be established for all the other firm performance variables in Tables 3.1 and 3.2, and Table 3.3 shows the conclusions from these calculations.

An assumption in the design of the MINE questionnaire is that firm performance is an outcome, i.e. the “dependent” variable, of all the aspects that influence the innovation processes and strategy of the firm. The tables 3.1, 3.2 and 3.3 show that although all firms think that they are slightly better than their rivals in most of the dimensions which are relevant for characterizing success in business – and seem to enjoy a healthy level of profitability, some differences between the firms seem to exist, as pointed out by the statistical amplification presented in Table 3.1.

Appendix 2: MINE survey questionnaire



MINE Survey Norway

- How do firms organize their innovation activities?
- How do these relate to strategy, competitiveness and profitability?

MINE is a research project designed for exploring and analyzing these critical issues. The survey is undertaken in collaboration with the Federation of Norwegian Industries (Norsk Industri).

MINE is short for *Managing Innovation in the New Economy*. Companies are increasingly facing new and demanding challenges due to globalization and competition, rapid technological development and novel methods in new product development. The ability to innovate has become crucial to the company's future and profitability. This survey will provide insights and knowledge about how firms cope with and master innovations.

Until now, the MINE Survey has mainly been undertaken in USA and Canada. More than 1000 firms have participated so far by responding to this survey. This research has been undertaken by Ecole Polytechnique Montreal, in collaboration with the Industrial Research Institute of Washington D.C., with funding from the Research Council of Canada – Social Sciences and Humanities.

In Norway, the research is funded by the Research Council of Norway. The MINE Survey Norway is part of the research program "Vekstforsk".

MINE Survey Norway aims at obtaining response from approximately 100 Norwegian firms. By responding to the survey your company will obtain access to the results from the survey, i.e. be able to compare its innovation activities and strategies with the other companies that have responded to the survey, be this other Norwegian firms or firms in the same sector on a global level. We believe that this type of benchmarking also will contribute shaping national innovation policy and initiate more targeted policy measures.

Confidentiality and data storage

All data will be treated as strictly confidential, in accordance with the signed agreement between NIFU STEP and Norsk Industri. A copy of the agreement is available upon request.

Responding to the survey

By pressing the buttons "Next" or "Previous" at the bottom of each page, you may move around in the survey. To maneuver on a page, use either the mouse or tab-button.

You may exit and reenter the survey at any time - by pressing the "Next" - button all your answers will be stored. When and if you reenter the survey and want to make changes to the answers made earlier, you must also press "Next" in order to store these.

Please press the "submit" - button on the last page when you have finished. The survey will then be sent to NIFU STEP.

Definition of terms

Innovation refers to the entire range of activities, from producing radically new technologies to marginal improvement of existing products and from advanced research and discovery to product commercialization, which lead to the creation and use of new products, services and systems. We sometimes also refer specifically to new product development as a subset of these

innovation activities. Please also consider that a significant portion of innovation efforts in some companies is focused on cost reduction.

Product includes both physical artifacts, such as materials, devices, and systems, and services, methods, tools, production processes, knowledge, information and other goods that are sold, delivered to, executed and implemented for an external customer.

Corporate refers to the systemic perspective of the headquarters, where portfolios of activities and business models exist and where substantial economies of scope, synergies and internationalization can emerge.

A **business unit (BU)** serves distinct markets with products and technologies that form a unique business model. One BU often creates and captures value differently from other units. Some organizations have no central R&D and all effort resides in the BU; others have all R&D centrally located and sell off time to the BU. Still other organizations have a hybrid of the two.

A **sector** is an industry or a set of highly linked industries that produce a class of services or products such as pharmaceutical products, computing systems, automobiles, aluminum, telecommunications, banking, or engineering consulting.

The survey is aimed at senior innovation managers who balance various strategic elements. Many answers require subjective estimates based on your business experience. We encourage you to use supporting documents and facts to answer as objectively as possible, however, if this is difficult, we also appreciate your judgments. The survey is designed to be answered in about 45 minutes.

For more information on:

-NIFU STEP, see www.nifustep.no, or ask the following researchers:

- Helge Godø – tel 22 59 51 72, helge.godo@nifustep.no
- Sverre Herstad – tel 22 59 51 31, sverre.herstad@nifustep.no
- Trude Røsdal – tel 22 59 51 12, trude.rosdal@nifustep.no

Relevant links:

- MINE: se http://www.minesurvey.polymtl.ca/mine_program.htm
- Industrial Research Institute: <http://www.iriinc.org>

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I. THE CONTEXT OF INNOVATION IN YOUR SECTOR

How well the following statements describe your context?

a) Nature of customers and of their needs

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
Customers provide significant expertise about how our products operate	<input type="radio"/>						
The customers served by firms in our sector have very complex needs	<input type="radio"/>						

b) Nature and extent of scientific and technical knowledge production

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
Knowledge production in the academic fields relevant for our sector is very intense	<input type="radio"/>						
Our sector contributes a lot of data, ideas and papers to academic research	<input type="radio"/>						
Our sector continually integrates many new systems and equipment	<input type="radio"/>						
New knowledge results mainly from intense interactions between firms	<input type="radio"/>						
New technologies build on the latest technologies of other firms in the sector	<input type="radio"/>						
All firms in our sector rely on the same stable technological base	<input type="radio"/>						
New knowledge results from the gradual accumulation of experience inside firms	<input type="radio"/>						

c) Factors that influence innovation in your sector

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
Regulatory approval is a critical prerequisite for commercializing any new product	<input type="radio"/>						
Time and resources needed to obtain regulatory approval deter 'me too' innovations	<input type="radio"/>						
Intellectual property protection enables firms to capture all the value from innovations	<input type="radio"/>						
The technologies produced in our sector are used for a wide variety of applications	<input type="radio"/>						
We use many different technologies and technical solutions in our products	<input type="radio"/>						
Products must interconnect with other products or systems to have value for customers	<input type="radio"/>						
The operation of our products relies on the operation of many other technical systems	<input type="radio"/>						
Large unit cost reductions can be obtained by increasing the scale of operations	<input type="radio"/>						
Improving production processes brings much higher returns than product innovation	<input type="radio"/>						
Most of the products of our sector face severe cost constraints	<input type="radio"/>						

d) Resource inflows and growth in the sector

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
Governments allocate a lot of resources to support research and innovation	<input type="radio"/>						
Innovative startups have easy access to funding (seed money, venture capital, IPOs)	<input type="radio"/>						
Total sales of our sector grow very fast compared to other sectors	<input type="radio"/>						
Sales in recently opened niches within our sector grow extremely fast	<input type="radio"/>						

e) Strategic and competitive dynamics in the sector

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
The pace of change in our sector is very fast compared to other sectors	<input type="radio"/>						
Very often, new competitors enter the sector with innovative products	<input type="radio"/>						
The technological frontier advances very rapidly in our sector	<input type="radio"/>						
External factors are forcing unpredictable transformations in our sector	<input type="radio"/>						
The boundaries of our sector are undergoing a major redefinition	<input type="radio"/>						
Our sector is going through significant developments that nobody anticipated	<input type="radio"/>						
Established competitors constantly challenge our positions	<input type="radio"/>						
Myriads of actions by our rivals continually erode our advantage	<input type="radio"/>						
Our products are constantly under attack from low-cost substitutes	<input type="radio"/>						

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II. VALUE CREATION CAPABILITIES

Which of following capabilities are important for producing customer value in your sector?

	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7
Capability to transform the results of academic research into useful products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to legitimate products by obtaining regulatory approvals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to gain acceptance for products as factio standards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to spur the creation of complementary products around open architectures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to align with dominant solutions in order to avoid disruption for clients	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to engineer products with absolute reliability, safety, and security	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to continually reduce costs (including through supply chain design)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to continually improve the quality of products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to anticipate and solve customers' problems in special applications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to increase product variety while keeping customization costs low	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to continually introduce novelties (new products, releases, and functionalities)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capability to design solutions that enhance the full cycle of customer experience (product choice, transactions, use, service, disposal etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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III. YOUR FIRM'S INNOVATION STRATEGY

1. Sources of competitive advantage for your firm

How important are these sources of competitive advantage to your firm?

	In last five years							In next five years						
	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7
Superior technologies and know-how	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stronger organizational capabilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Better reputation with customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Favorable laws and regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ownership of rare tangible assets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Portfolio of valuable patents and copyrights	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Larger production and operation system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader multinational scope of the firm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Strategic moves over the last five years

a) Competitive moves

How important were the following moves in terms of strategic effort?

	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7
Invest more than competitors to become a technological leader	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gain market share via intense advertisement and channel control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aggressively acquire new businesses in growth areas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lead in cost reduction through economies of scale and supply chain design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invest in brands to increase customer confidence and loyalty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shape market evolution through strategic pricing and timing of market entries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Find viable market niches and occupy them with superior products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lobby governments and influence public opinion to promote your views	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aggressively protect intellectual property (suing, defensive patenting etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hire away the best available scientists or experts on the market	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Play the regulatory game strategically to accelerate approval processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Manipulate product architectures or standards to structure the industry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

b) Collaborative moves

How important were the following moves in terms of strategic effort?

	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7
Develop technology roadmaps in collaboration with other firms to reduce uncertainty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Actively license new technologies and share knowledge in order to grow markets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Partner with governments and competitors to develop new basic technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Build strategic alliances to develop products or standards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help suppliers and upstream partners to improve their products, logistics and service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Open product architecture to promote it as a standard and ensure its development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaborate with other firms in working groups that develop standards and norms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help the development of regulations and certification bodies to legitimate products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Support a network of third parties, developers and customers that use your products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invite partners and third party suppliers to develop complementary products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. How often do you revisit the following assumptions on which your strategy is based?

	Monthly	Quarterly	Every 6 months	Every year	Every few years
Who customers are and what they want?	<input type="radio"/>				
What are the key markets and revenue streams?	<input type="radio"/>				
How sustainable are the various revenue streams?	<input type="radio"/>				
What is the best mix of business units and operations?	<input type="radio"/>				
What is the best mix of capabilities and competencies?	<input type="radio"/>				

4. To what extent do you agree with the following statements about your strategic actions?

a) The essence of the strategic initiative you currently undertake

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We build a radically different source of competitive advantage	<input type="radio"/>						
We try to aggressively redefine the bases of competition in our sector	<input type="radio"/>						
We reinforce our current sources of competitive advantage	<input type="radio"/>						
The current strategic thrust continues our past strategic thrusts	<input type="radio"/>						

b) Your firm's pattern of strategic renewal over time

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
To remain competitive we regularly initiate strategic renewals	<input type="radio"/>						
We change our strategies only after we detect major changes in the context	<input type="radio"/>						
We repeatedly rebuild the bases of our competitive advantage	<input type="radio"/>						
We persist in renewing our strategy even after some initiative fails	<input type="radio"/>						

c) Your firm's strategic perspective for the long-term

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We always anticipate several moves ahead to avoid being locked in a bad position	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We proactively develop several parallel strategic paths and long term options	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We create an adaptive organization, capable to withstand any unexpected change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We cultivate our ability to respond swiftly to major competitive changes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. Investment in innovation and capabilities (includes both R&D and other activities)

a) R&D investment over sales (including corporate, SBU, and functional R&D)

b) Investment in innovation over and above R&D expenditures

Over and above R&D, your firm invests in the development of innovation capabilities such as market research, manufacturing process improvement, corporate strategic research, and internal process development capabilities. Compared to R&D expenditures, what does this non-R&D investment in capabilities represent?

<input type="radio"/> 0-5%
<input type="radio"/> 5-30%
<input type="radio"/> 30-70%
<input type="radio"/> 70-100%
<input type="radio"/> 100-150%
<input type="radio"/> > 150%

c) Proportion of the total time and energy of all employees in the firm devoted to innovation (in both R&D and non-R&D activities)

<input type="radio"/> < 1%
<input type="radio"/> 1-2%
<input type="radio"/> 2-5%
<input type="radio"/> 5-15%
<input type="radio"/> 15-30%
<input type="radio"/> 30-50%
<input type="radio"/> 50-75%
<input type="radio"/> 75-100%

d) Of the time and energy devoted to innovation, how much goes to each of the following sets of innovation and capability development activities?

Making corporate strategy for innovation: Creating, articulating, re-creating strategic vision and direction to guide innovation across firm
Building up organizational capabilities to support innovation: Developing, maintaining, and upgrading technology, IT, manufacturing, market assessment etc. to support innovation
Managing Business Unit Innovation: Incorporating new products into the business model(s), revitalizing the business via innovation, overseeing portfolios, platforms, assessing business priorities for innovation
Managing new product development (NPD) and other innovation projects to initiate, develop, and launch new products

Making corporate strategy for innovation	
Building up organizational capabilities to support innovation	
Managing Business Unit innovation	
Managing new product development (NPD) and other innovation projects to initiate, develop, and launch new products	
Total (must be 100%):	

e) What is the focus of your investment in building and improving organizational capabilities?

Scientific and engineering capabilities (new and existing disciplines)	
Marketing capabilities (assessing new opportunities, market research, figuring out customer needs, etc.)	
Capabilities to develop and improve manufacturing, logistic and operations systems (incl. cost reduction)	
Innovation processes and methods (cross-functional integration, new product development, etc.)	
Information technology and systems	
Total (must be 100%):	

f) Direction of investment

What percentage of your innovation funding goes to the following?

Research performed in corporate R&D labs	
Research performed in decentralized network of R&D labs (e.g. in SBU labs)	
Innovation embedded in other functional departments (projects and operational improvements)	
External venturing (corporate venture capital type investment)	
Innovation partnerships, alliances, and joint ventures	
Acquisition of technology firms, licenses and know-how	
Funding research in universities and government labs (e.g. SINTEF)	
Contracting out R&D and innovation activities	
Total (must be 100%):	

g) Types of innovation

Please allocate 100% of your firm's innovation effort among:

Radical innovations	
New platform development	
Small incremental improvements	
Cost reduction	
Total (must be 100%):	

h) How much of your innovation effort occurs in your home country versus other countries?

Domestic	
International	
Total (must be 100%):	

i) What do your customers buy?

Tangible goods/products	
Services	
Total (must be 100%):	

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IV. ORGANIZING FOR INNOVATION

1. How many people who work on innovation in your firm understand the following links?

	Few 1	2	3	Half 4	5	6	Everyone 7
How any new products they are working on fit with business strategy	<input type="radio"/>						
How technology programs they work on contribute to corporate and business goals	<input type="radio"/>						
What the priorities are among projects, programs and products	<input type="radio"/>						

2. How often do people from different functions work together to interpret the following information?

	Rarely 1	2	3	Sometimes 4	5	6	Regularly 7
Information regarding the company's overall strategy	<input type="radio"/>						
Information regarding all new capabilities the company might need for innovation	<input type="radio"/>						
Information regarding new product strategies in the business(es)	<input type="radio"/>						

3. To what extent can all those involved in innovation identify the following people?

	Few can 1	2	3	Half can 4	5	6	Most can 7
People who build (not just apply) long-term scientific and engineering capabilities	<input type="radio"/>						
People who build (not just apply) long-term marketing capabilities	<input type="radio"/>						
People who build (not just apply) long-term manufacturing capabilities	<input type="radio"/>						
People responsible for working on new product development projects in each unit.	<input type="radio"/>						

4. What fraction of people who work on innovation use the following rules to guide their action?

	Few 1	2	3	Half 4	5	6	Everyone 7
Articulate your specialized knowledge in ways that make sense to other specialties	<input type="radio"/>						
Understand the issues and constraints in other functions	<input type="radio"/>						
Deal with problems that occur in innovation projects by exploring a variety of options	<input type="radio"/>						
Take responsibility for the entire innovation project	<input type="radio"/>						

5. How well do the following statements regarding formal processes in your firm apply?

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We have formal management processes for learning from past projects and transferring lessons learned to new projects	<input type="radio"/>						
We have formal management processes for enabling functions to learn from each other	<input type="radio"/>						
We have formal management processes for assessing and improving capabilities in technology, NPD, marketing etc.	<input type="radio"/>						

6. Do you agree with the following statements about innovation in your firm?

a) Developing a corporate innovation strategy

Creating and articulating visions of the future and directions to guide innovation across the firm

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
New directions for the firm are on the agenda of every top management team meeting	<input type="radio"/>						
Senior managers often disagree over the best strategic direction(s) for the company	<input type="radio"/>						
Senior managers are formally assigned to improve processes that support innovation	<input type="radio"/>						
Senior managers discuss strategic directions with employees at least monthly	<input type="radio"/>						
Employees regularly challenge senior managers' understanding of our firm's situation	<input type="radio"/>						

b) Identifying and developing capabilities to innovate

Scientific, engineering, marketing and manufacturing expertise, innovation processes, information systems

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We come up with new capabilities before we know how they will be used for products	<input type="radio"/>						
People who build marketing capabilities decide which ones to develop, within strategic guidelines	<input type="radio"/>						
People who build scientific and engineering capabilities decide which ones to develop, within strategic guidelines	<input type="radio"/>						
People who build manufacturing capabilities decide which ones to develop, within strategic guidelines	<input type="radio"/>						

c) Managing business units for innovation

Incorporating new products into business model(s), revitalizing business via innovation, overseeing portfolios and priorities

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
All business unit (BU) managers regularly update their portfolios with new products	<input type="radio"/>						
BU managers keep R&D informed about new functionalities needed in products	<input type="radio"/>						
BU managers are free to decide how to implement their innovation strategies.	<input type="radio"/>						

d) Managing New Product Development (NPD) projects

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
NPD teams decide how to define their product concept, within strategic guidelines	<input type="radio"/>						
The same team controls the entire NPD process, from definition to commercialization	<input type="radio"/>						
NPD teams can pull in corporate or business resources (R&D, marketing) as needed	<input type="radio"/>						
R&D managers ensure that their people participate effectively on NPD teams	<input type="radio"/>						
Marketing managers ensure that their people participate effectively on NPD teams	<input type="radio"/>						
Manufacturing managers ensure that their people participate effectively on NPD teams	<input type="radio"/>						

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V. YOUR FIRM'S INNOVATION NETWORK

1. Your firm's positioning in value creation networks *Each firm tries to position itself in the network of value creation activities of a sector by defining its own value creation role in relation to other organizations in the network.*

Please indicate the extent to which you agree whether the following statements:

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We take new ideas and try to prove that they could become viable innovative products	<input type="radio"/>						
We take proven innovative concepts and bring them to market	<input type="radio"/>						
We provide information and databases to firms engaged in innovative activities	<input type="radio"/>						
We provide specialized services and advice to firms engaged in innovative activities	<input type="radio"/>						
We develop tools and methods that support and enhance research and engineering	<input type="radio"/>						
We are a system integrator—we use subsystems produced by others to create products	<input type="radio"/>						
We produce subsystems composed of multiple parts that we sell to system integrators	<input type="radio"/>						
We contribute modules to a complex architecture, along with other independent firms	<input type="radio"/>						
We supply specialized components or software to system and subsystem integrators	<input type="radio"/>						
We adapt complex systems to serve in the applications of specific customers	<input type="radio"/>						
We specialize in a given transformation stage within the value chain	<input type="radio"/>						
We produce equipment for production and operations	<input type="radio"/>						
We provide specialized services and ingredients to firms engaged in production	<input type="radio"/>						
We produce stand-alone products and services for the final customers	<input type="radio"/>						
We develop methods and systems that support and enhance operations	<input type="radio"/>						

2. Internalization/externalization of innovation activities

Innovation activities may be done inside or outside your firm. Inside, it can be done in central R&D facilities or distributed to BUs; outside, it can be done with partners or subcontracted.

For each activity listed below, please indicate the percentage performed by different entities. Please make sure that total equals 100%

Technological activities

	Central/ corporate R&D-labs %	R&D labs of BUs %	Other functional departments %	Autonomous project entities %	External partners %	Contractual outsourcing %	Total %
Research on future technologies and innovations							
Upgrading/acquiring expertise and knowledge							
Developing organizational innovation processes							
Technical/analytical support to current operations							

New product development activities

	Central/ corporate R&D-labs %	R&D labs of BUs %	Other functional departments %	Autonomous project entities %	External partners %	Contractual outsourcing %	Total %
Understanding and characterizing user needs							
Generating and defining product concepts							
Designing and engineering system architectures							
Designing and engineering subsystems and parts							
Designing production processes and supply chains							
Testing and validating prototypes or products							
Regulatory approval procedures							
Commercializing new products							
Developing product line extensions/adaptations							

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V. YOUR FIRM'S INNOVATION NETWORK (cont'd)

3. Network partners that play key enabling roles for innovation. Firms rely on partners such as government, universities, and non-profit organizations for innovation-enabling contributions.

Please indicate the importance for your firm of the innovation enabling-roles

	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7
Helps our firm learn about new technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helps our firm learn about new markets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provides our firm with business advice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identifies knowledgeable individuals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identifies partner firms and organizations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facilitates innovation involving multiple organizations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Promotes enabling standards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Undertakes innovative activities on our behalf	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forces us to innovate by changing regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forces us to innovate through social pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



V. YOUR FIRM'S INNOVATION NETWORK (cont'd)

3. Network partners that play key enabling roles for innovation. Firms rely on partners such as government, universities, and non-profit organizations for innovation-enabling contributions.

You indicated in the previous question that the following roles were important, please indicate what kind of organization performs the given role

	Other firm	Government department or agency	University	Non-profit research institute	Industry association	Scientific or professional association	Stakeholder group
Helps our firm learn about new technologies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helps our firm learn about new markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provides our firm with business advice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Identifies knowledgeable individuals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Identifies partner firms and organizations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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V. YOUR FIRM'S INNOVATION NETWORK (cont'd)

4. Please rank order the following criteria according to their importance in the design of specialized structures for innovation in your company. (1 = most to 6 = least important)

By functions	
By core capabilities	
By markets	
By product lines	
By projects	
By location	

5. Location of R&D labs in the innovation networks

How important are the following factors in deciding the location of your R&D labs?

	Not important 1	2	3	Somewhat important 4	5	6	Extremely important 7
Proximity to markets and clients	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Proximity to our business units	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Proximity to suppliers of components and complementary products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Proximity to other firms similar to ours	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Proximity to sources of scientific knowledge (e.g. universities)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Abundance of qualified research personnel and facilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

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VI. PRACTICES THAT YOUR FIRM USES TO MANAGE INNOVATION

Do you agree with the following statements regarding your firm's exploration practices?

1. Practices for exploring opportunities to innovate and searching for new ideas

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We maintain long-term internal programs for the discovery of new technologies	<input type="radio"/>						
We rely on in-house capabilities for the detection of market trends	<input type="radio"/>						
We often move staff from unit to unit to cross-fertilize ideas	<input type="radio"/>						
We give our employees resources and time to develop new ideas	<input type="radio"/>						
We interact with key suppliers and customers to figure out the evolution of the field	<input type="radio"/>						
We participate in industry networks (associations, standard bodies, conferences, etc.)	<input type="radio"/>						
We co-opt leading external experts (scientists, "gurus") to help us probe the future	<input type="radio"/>						
We interact with many university spin-offs to identify radically new ideas	<input type="radio"/>						

2. Practices for the management of the firm's innovation portfolio

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
We see our portfolio as a balanced pipeline of innovation projects in different stages	<input type="radio"/>						
We have a structured approach involving selection committees at different levels	<input type="radio"/>						
We start with many uncertain ideas and gradually select a few by reducing uncertainty	<input type="radio"/>						
Every project is a strategic initiative that we repeatedly restructure if possible	<input type="radio"/>						
Our funding is concentrated on a few big projects with a high degree of uncertainty	<input type="radio"/>						
Many unofficial projects are supported to challenge current strategy	<input type="radio"/>						
Middle managers are free to reallocate funds within a total envelope for innovation	<input type="radio"/>						
The evaluation of any project focuses on its relation to other projects in our portfolio	<input type="radio"/>						
Projects are selected only if they fit with our technology and product roadmap	<input type="radio"/>						

3. Please consider a few important projects that your firm completed recently

Do you agree with the following statements about your innovation projects?

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
Our innovations are combinations of ideas resulting from our previous projects	<input type="radio"/>						
In the beginning, we carefully map the technical and market environment of a project	<input type="radio"/>						
Our concepts are based on extensive prior classification and prioritizing of user needs	<input type="radio"/>						
For every innovation project, we produce a lot of new knowledge	<input type="radio"/>						
We don't reinvent the wheel, we use available data, exemplars, models, and methods	<input type="radio"/>						
We assemble our products from the latest modules and parts available on the market	<input type="radio"/>						
We often take advantage of knowledge we produced originally for a different purpose	<input type="radio"/>						
We extensively reuse platforms and modules that our company has developed before	<input type="radio"/>						
A module that we discard in one project is often useful in subsequent projects	<input type="radio"/>						
Very early, we integrate representatives of our key customers in the development team	<input type="radio"/>						
We try to benefit extensively from suppliers' experience in our innovation projects	<input type="radio"/>						
We develop and test several concepts in parallel before selecting a product concept	<input type="radio"/>						
We do a lot of partial experimentation to obtain data we use for building a prototype	<input type="radio"/>						
We simulate extensively the behavior of our product before building a full prototype	<input type="radio"/>						
We strive to develop a detailed causal model of the functioning of our products	<input type="radio"/>						
We focus on building up rich experience with the concrete functioning of the product	<input type="radio"/>						
We go through several iterations that completely redefine the concept and architecture	<input type="radio"/>						
As early as we can, we ask key customers to test the prototype and give us feedback	<input type="radio"/>						

4. Commercialization practices that aim to capture value from innovation

	Totally disagree 1	2	3	Neutral 4	5	6	Totally agree 7
Our innovations are combinations of ideas resulting from our previous projects	<input type="radio"/>						
In the beginning, we carefully map the technical and market environment of a project	<input type="radio"/>						
Our concepts are based on extensive prior classification and prioritizing of user needs	<input type="radio"/>						
For every innovation project, we produce a lot of new knowledge	<input type="radio"/>						
We don't reinvent the wheel, we use available data, exemplars, models, and methods	<input type="radio"/>						
We assemble our products from the latest modules and parts available on the market	<input type="radio"/>						
We often take advantage of knowledge we produced originally for a different purpose	<input type="radio"/>						
We extensively reuse platforms and modules that our company has developed before	<input type="radio"/>						
A module that we discard in one project is often useful in subsequent projects	<input type="radio"/>						
Very early, we integrate representatives of our key customers in the development team	<input type="radio"/>						
We try to benefit extensively from suppliers' experience in our innovation projects	<input type="radio"/>						
We develop and test several concepts in parallel before selecting a product concept	<input type="radio"/>						
We do a lot of partial experimentation to obtain data we use for building a prototype	<input type="radio"/>						
We simulate extensively the behavior of our product before building a full prototype	<input type="radio"/>						
We strive to develop a detailed causal model of the functioning of our products	<input type="radio"/>						
We focus on building up rich experience with the concrete functioning of the product	<input type="radio"/>						
We go through several iterations that completely redefine the concept and architecture	<input type="radio"/>						
As early as we can, we ask key customers to test the prototype and give us feedback	<input type="radio"/>						

4. Commercialization practices that aim to capture value from innovation



VII. FIRM PERFORMANCE

1. How well is your firm doing, relative to competitors, in each of the following areas?

	Worse than rivals 1	2	3	About equal 4	5	6	Better than rivals 7
The growth rate of our firm (or of the relevant SBU used for this survey)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creation of customer value through innovation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of new businesses generated through innovation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of spin-offs and start-ups generated through innovation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frequency of major new products releases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Proportion of revenues generated through new products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Sales growth

	Negative	0-5 %	5-10%	10-20%	20-40%	40% and over
Over the last 3 years what was your average annual sales growth?	<input type="radio"/>					

3. Profitability

	Negative	0-5 %	5-10%	10-20%	20-40%	40% and over
Over the last 3 years, what was your average net profit on sales?	<input type="radio"/>					
Over the last 3 years, what was your average return on investment (ROI)?	<input type="radio"/>					

4. Contribution of innovative products to profitability.

Of your total profits, what % would you attribute to products launched in the last 5 years?

5. Looking more closely at profits from new products

Please indicate how radical innovations, more innovative projects, and incremental innovations contribute to profits by dividing the total profits into the following four categories:

From radical innovations/breakthroughs	
From new platform/generation products	
From addition of new products within existing platforms/families	
From incremental innovations, improvement, adaptation and cost reduction	



VIII. COMPANY INFORMATION

Company name	kil
Number of employees	777
Total annual sales (NOK)	kjllkjll
Percentage of sales outside home country	999
What is the main sector in which you compete?	9999

What is your market share in the main business in which you compete?

Domestically	
Internationally	

How many serious competitors do you face?

Domestically	
Internationally	

Organizational structure

Is your firm:

<input type="radio"/> a) Single business
<input type="radio"/> b) Diversified

Nature of company ownership:

Is your company publicly traded?

<input type="radio"/> Yes
<input type="radio"/> No

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Thank you very much for your effort.

To **complete** the questionnaire and save your responses, please hit "**Submit**".

If you have any comments regarding other Important aspects of innovation or comments regarding this survey, you may provide them in the box below

Nordisk institutt for studier av
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