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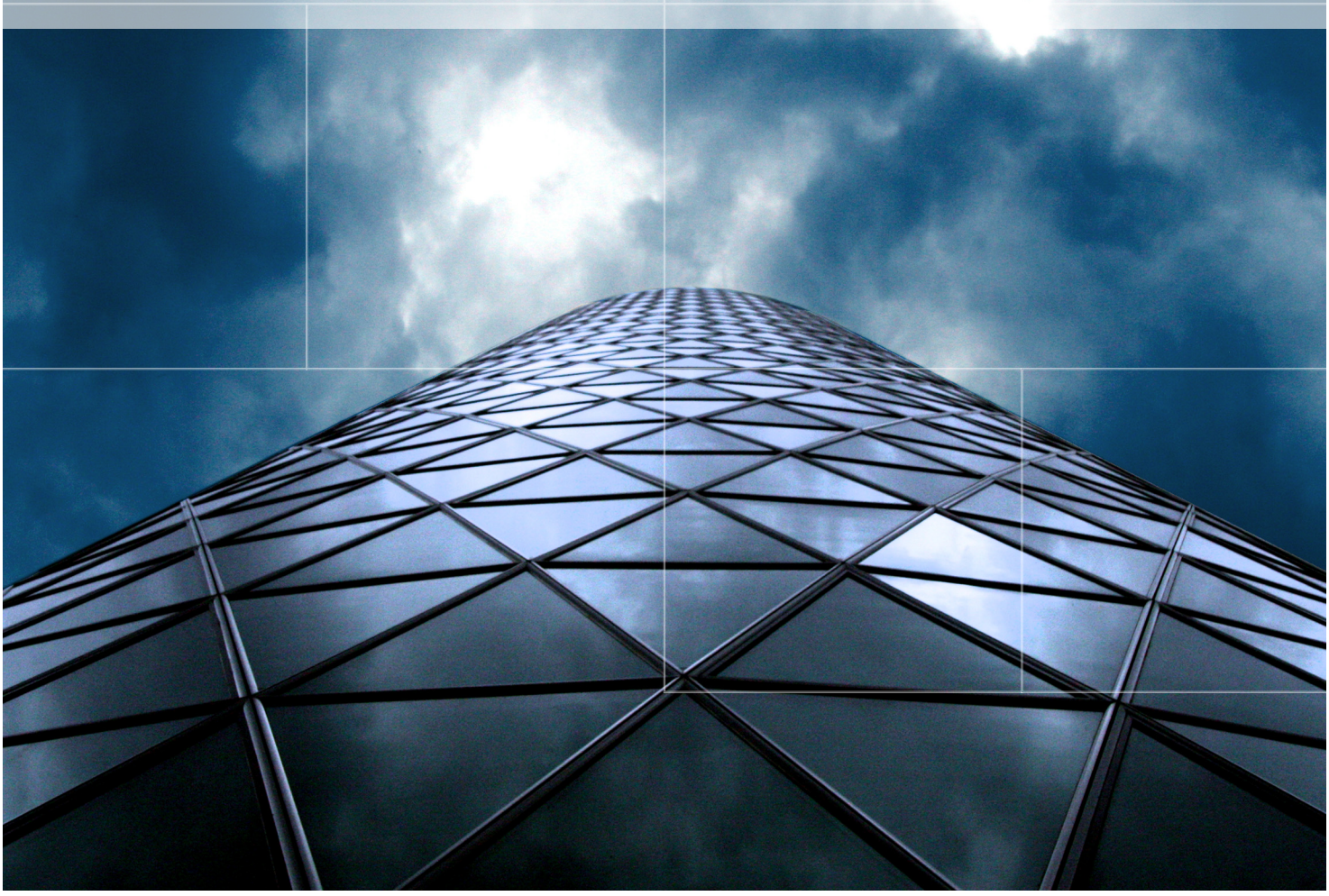
National innovation systems and domestic multinational corporations:

Key issues, dynamics and implications

Synthesis report from the DOMUS research project



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Title: Innovation and the role of domestic multinationals

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Abstract:
This project has investigated outward foreign direct investments from the Nordic economies, and analysed the role domestic multinational companies play in their respective Nordic home economies. The project consisted of a desktop study of existing research, a quantitative study of FDI flows and the innovation behaviour of multinationals, and a qualitative analysis based on interviews conducted with leading managers, researchers and owner respondents in 17 Nordic domestic multinationals.

Through this project, valuable insights into multinational corporate behaviour and strategy have been gained. The project explicitly addresses the home-base implications of corporate internationalisation, and provides a theoretical framework for understanding the conditions under which the foreign activities of such companies provide valuable knowledge inputs into the domestic innovation systems of the Nordic countries.

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Executive summary

The purpose of the project

DOMUS had as its stated objective to *'… study the role of large domestic multinationals (DOMs) in the national innovation system (NIS)'*. Three specific research questions where initially formulated:

1. Identify the factors that influence localization decisions of headquarter functions and other *strategic* (Benito et al 2002) activities, including R&D

2. Map the effects such companies have on the overall capabilities of their respective national innovation systems

3. Investigate the effects a multinational presence has on the home activities of DOMs

Corporate internationalisation raises critical questions concerning the conditions under which activities abroad may generate knowledge spill-over domestically – into the home-base NIS; and the conditions under which the knowledge intensive parts of corporate activities, and consequently the productive knowledge base, over time can be expected to follow simpler operations out the country of origin. These questions are by large unresolved in existing theoretical and empirical research, first and foremost as a result of a lacking theoretical framework (Narula and Zanfei 2005) that incorporate sound perspectives on both localizational decisions under different technological conditions (Andersson and Friberg 2005, Herstad et al 2006b); and the workings of the MNE as a research, development and innovation network in its own right.

Method

The research strategy of DOMUS has therefore to a large extent been explorative and qualitative; i.e. based on desktop study of existing research and analysis of data gathered through interviews in selected, Nordic DOMs. This has been supported by qualitative analysis based on Community Innovation Survey, conducted through the DOMUS predecessor FOTON (Ebersberger and Lööf 2005) and specifically for DOMUS (Ebersberger 2006, in Oksanen and Rilla (eds) 2006). There are several reasons why a qualitative research strategy has been chosen; the most important one being a combination of quantitative evidence readily available from FOTON and the need for explorative research to feed into general theory development. It is our clear opinion that, given the existing state of affairs at the research frontier, in-depth firm level analysis with the purpose of making *analytical* generalizations concerning basic socio-economic forces at play (Yin 1984, OECD 2006:65) must feed into general theory development which only then should be further refined and empirically validated using quantitative methods. What qualitative research lacks in empirical representativity it by far compensate for by allowing direct dialogue with representatives of the phenomena in question. It allows us to avoid 'black boxing' the core actors, firms. This particularly

applies when dealing with the generation, flow and accumulation of non-measurable resources – knowledge.

The project resulted in three different research module reports, presenting in detail the findings of each research module, and a synthesis report which draw on all the different modules in order to answer the research questions initially formulated.

Main conclusions

Concerning the first question, the project identified market access to be the main, overall driver of corporate internationalization. The project further point out that access to cheap factors of production at least historically appears to have been a driving force of fairly low importance. This conclusion, however, neglect the large diversity in motives and requirements that exist between different sectors.

The project further questioned the extent to which the internationalization of R&D and other knowledge-intensive activities are driven by the properties of the places in which MNEs invest (the so-called localization-specific advantages highlighted in the traditional understanding of MNEs). This question is raised on the background of mergers and acquisitions being the dominating mode of entry into a new market. Alternatively R&D abroad, in an acquired firm, could be considered an outcome of the in-house competencies of that acquired firm, and thus not a localization decision but a localization outcome. Evidence from interviewed companies clearly support the project in concluding that the internationalization of R&D, and in particular what is traditionally considered localization decisions, is a much more complex and differentiated process than what is assumed in the traditional theory of the multinational enterprise. As this assumption has been guiding most existing studies and policy, further research is needed to provide a clear answer to this question. This research need to account for industry branch differences between knowledge bases and consequently differences in availability of relevant knowledge in different places.

Answering research question number two, the project emphasized that domestic multinationals predominantly are key actors in their national innovation system, and hence that their activities have a large impact on these. This reinforces the relevance of research question number three, on which the project put its main emphasis.

On research question number three the project concluded that DOMs serve as global knowledge pipelines for the domestic innovation systems, but predominantly do so within sectors and technological fields in which the NIS is already specialized. These are the sectors in which the different economies are most likely to develop strong DOMs, the sectors on which those same DOMs are most likely to develop strong in-house competencies domestically while remaining embedded in linkages to external, domestic NIS actors – and the sectors and technological fields in which NIS as a whole most likely will be able to absorb externalities.

Research implications

The project propose a set of complementary studies to be conducted in order to utilise and further refine the theoretical perspectives developed by DOMUS, and to build on this to significantly increase our understanding of the dynamics and implications of corporate internationalisation. Specifically the project also suggested conducting a large study of the role of Nordic multinationals in Nordic economic integration.

Foreword

DOMUS – Innovation and the role of domestic multinationals – was conducted in the form of three research modules designed to provide complementary insights into Nordic corporate internationalization and the implications of this for domestic innovation systems (NIS). *Module* 1 consisted of a desktop study of existing research at the national levels (Friberg (ed) 2006); *module* 2 mapped DOM activities in the Nordic countries (Rilla and Oksanen (eds) 2006) and provided more in-depth quantitative analysis (Ebersberger 2006), whereas *module 3* consisted of qualitative analysis based on data gathered through interviews in selected Nordic DOMs (Herstad (ed) 2006).

This synthesis report will draw the different threads together. For this reason, it does not contain all data and analyses generated by the different country teams, for the different research modules. Detailed company or country level analyses are found in the module papers.

The report starts out by presenting and discussing research questions, and relevant theoretical perspectives (chapters 2 and 3). The empirical analysis will start at the most general level; i.e. with a country-by-country analysis of the factors that form the background of and resources for corporate internationalization in the Nordic economies (chapter 4). We then focus on presenting descriptive data and a synthesis of existing research findings (chapter 5). This is followed by a qualitative analysis based on company interviews conducted uniquely for this project, presented as a synthesis analysis for the findings from interviews in and background material from all in all 16 companies (chapter 6). This chapter will also present a patent data analysis illustrating the structure and output of global pipelines established by three case companies.

Moving to the more general level again, chapter 7 will build on both literature reviews, qualitative and quantitative evidence when addressing the specific research questions of DOMUS. Last but not least, in chapter 8 we discuss the policy implications of our findings, and in chapter 9 implications for future research. In this, we emphasize the importance of taking a broader view of polices than what is normally associated with "investment policies" in a narrow sense. We also argue how the ground laid by DOMUS should serve as the basis for conducting much-needed surveys aimed at mapping knowledge flows within and outside multinational organizations – MNEs.

Content

1. Introduction[1]

Internationalization of industrial activities in is not a new phenomenon, neither is internationalization of R&D. MNEs[2] such as Phillips (the Netherlands) and SKF (Sweden) had established R&D facilities abroad well before World War II (Swedenborg 1982, Andersson, Fredriksson and Svensson 1996). Whereas the pre-war MNE was characterized by selective R&D localization decisions and showed a high degree of cross-border co-ordination of such activities, the primary concern of the post-war MNE was production capacity and market access in an unprecedented demand-led business cycle upturn. R&D for new products, co-ordination and in-house synergies became a secondary issue, and first re-emerged as a strategic concern in the wake of the business cycle downturn in the 1970s (ibid).

The present picture is one where the proportion of corporate R&D performed outside domestic countries is increasing rapidly (Granstrand 1999, Zander 1999, Narula and Zanfei 2002, 2005). There is also evidence that technology sourcing appears as an increasingly important element in corporate internationalization (van Pottelsberghe de la Potterie and Lichtenberg 2001). Research further shows how large, multinational enterprises from e.g. Germany or Great Britain continue to account for a significant part of the private R&D in their respective home-bases (Narula and Zanfei 2002:323), and that such companies may remain heavily embedded in their national innovation systems even after extensive international expansion (Aanstad and Koch 2005, Ebersberger and Lööf 2005, Benito et al 2002, Doremus et al 1998). Through the activities of such companies, global production chains are administratively controlled. Global knowledge networks may be established, linking activities in different places to each other and increasing the speed of technology diffusion and innovation.

The main question that springs from the topic of corporate internationalization as a phenomenon is to what extent activities abroad are strengthening the home-base activities of companies, by boosting sales or compensating for domestic knowledge and technology supply limitations. Alternatively, the question is whether internationalisation is contributing to a hollowing out of home-base operations and consequently of the domestic national innovation systems – NIS – which form the basis for industrial development.

This in turn raises questions concerning the conditions under which activities abroad may generate knowledge spill-overs domestically – into the home-base NIS; and the conditions under which the knowledge intensive parts of corporate activities, and consequently the productive knowledge base, can be expected to be moved out of the home country over time. These questions are by large unresolved in existing theoretical and empirical research, first and foremost as a result of a lack of a theoretical framework (Narula and Zanfei 2005) that incorporate sound perspectives on both localizational decisions under different technological conditions (Andersson and Friberg 2005, Herstad et al 2006b); and the workings of the MNE as a research, development

[1] By Sverre Herstad, NIFU STEP, and Daniel Friberg, IKED

[2] MNEs: multinational enterprises

and innovation network in its own right. This necessitated a fairly explorative research strategy for DOMUS.

Whereas services, compared to manufacturing, used to be less prone to international trade and investment, many have now taken on configurations which enable storage and trade. Further, FDI[3] is subjected to sweeping organizational changes, in part induced by privatization and regulatory reforms combined with new means for managing information, research and innovation. The bulk consists of mergers and acquisitions (M&A), accompanied by a proliferation of strategic alliances. Greenfield establishments[4] are much more common in developing countries and also in East Asia, although companies from those regions are increasingly becoming active in M&A as well.

Compared to greenfield investments, M&A enable more rapid entry into foreign markets, direct control over specialised in-house competencies and more effective exploitation of existing linkages with domestic actors. Bringing changes to headquarters (HQs), M&A may have far-reaching implications for strategic business functions, such as R&D and procurement practices. M&A have been subjected to dramatic swings over time, however, and serious questions may be raised concerning their success. This mode of entry offers less flexibility in designing operations, and tends to be associated with challenges in terms of aligning and integrating existing organisations.

From the perspective of home-base economies, the key issues are dynamics and long term implications of internationalisation – for sustainable employment and economic growth, and therefore for national innovation systems. Existing research appear unable to draw the necessary implications (Middelfart and Heum 2002, Narula and Zanfei 2005). It is crucial to go beyond mappings of where different activities are located and why (see e.g. Grünfeld 2004 for an overview of the econometric literature), and establish a true non-atomistic *system* of understanding of the domestic multinational (see e.g. Gerybadze and Reger 1999:272), its institutional underpinnings at home and abroad, and the role of its external linkages in creating home and host technological spill-overs and feeding into or hollowing out national industrial knowledge bases[5].

In order for this to be possible, new theoretical interpretive schemes and analytical tools must be developed (see in particular Narula and Zanfei 2005:337-339). This challenge is reinforced by the growth of FDI in services, as the traditional approach of mapping size and location of systematic R&D activities is not directly applicable on these and other activities not predominantly generating productive knowledge nor innovating through such activities (see Herstad (ed) 2006 for case study examples such as Wilh Wilhelmsen Group, Aker Yards, Skanska, NCC and Ossur).

[3] FDI: Foreign direct investments

[4] I.e. the establishment of a new daughter company as opposed to a take-over of an existing local company

[5] See e.g. Kvinge 2002 for an overview of the literature and evidence on knowledge diffusion and spill-overs stemming from FDI.

2. Background, research questions and research approach[6]

In 2004, Nordic Innovation Centre financed a project titled 'Foreign take-overs in the Nordic Countries – brain drain or brain gain?' As part of this project, a quantitative analysis of the relationship between innovation behaviour and corporate ownership types was conduced, based on 'Community Innovation Survey' data for all five Nordic countries (Ebersberger and Lööf 2005).[7] The most outstanding and clear-cut finding of this analysis was the strong embeddedness of domestic multinational corporations (DOMs) in the national innovation systems of their respective home bases, measured in terms of utilization of domestic innovation system actors. This embeddedness was significantly stronger than identified for both nationally owned firms that had not yet internationalized, and foreign owned firms, and has since been confirmed by similar analysis of CIS data from other countries (Criscuolo et al 2005). Based directly on these findings, DOMUS has as its stated objective to *'… study the role of large domestic multinationals (DOMs) in the national innovation system (NIS)'*. Three specific research questions where initially formulated:

1. Identify the factors that influence localization decisions of headquarter functions and other *strategic* (Benito et al 2002) activities, including R&D

2. Map the effects such companies have on the overall capabilities of their respective national innovation systems

3. Investigate the effects a multinational presence has on the home activities of DOMs

These go directly into core welfare and growth issues in a globalizing world economy. They are challenging and unresolved in the literature; and not least are they targeting a phenomenon which in itself is slippery and highly differentiated between actors and national economies[8]. This only makes them even more important.

Since we already knew that Nordic DOMs remain heavily embedded in their national innovation systems, *mapping* the effects such companies have on the overall capabilities of NIS, research question number two, was initially re-interpreted as a question of mapping the *extent* and character of corporate internationalization in the Nordic countries.

If anything, the literature review presented in chapter 5 highlight how the most interesting, and unresolved, research question is number three. Existing research on home-base implications of corporate internationalization has pointed out that issues related to knowledge sourcing, knowledge *accumulation* and consequently R&D

[6] By Sverre Herstad, NIFU STEP
[7] For information about CIS, see http://cordis.europa.eu/innovation-smes/src/cis.htm
[8] See Herstad 2005 for a philosophy of science discussion on the problems of studying MNEs

localization are critical if long-term effects are to be identified. We have thus emphasized *'…opportunities for spillovers (…) between the MNE affiliate and its home country'* (Narula and Zanfei 2005:337), and the conditions under which they may occur.

The complexity of corporate internationalization

The analysis of corporate internationalization inevitably faces the problem of *open systems* – systems without a clearly defined universe of actors where those actors who comprise the universe at a given point in time themselves are likely to have changed their fundamental characteristics at a later point (Herstad, 2005). This can either be ignored, or as in DOMUS taken seriously as a basis for identifying possible long-term dynamics.

The interviewed companies have all experimented – and continue – to experiment with different relationships between domestic and international R&D; and both case evidence and broader research findings illustrate how even internationalization of basic production and supply functions are not necessarily a linear, straightforward process. One case company re-established production in Norway after outsourcing to China; and evidence from Sweden shows that whereas labour or unit cost considerations alone may drive outsourcing; total cost, flexibility *and knowledge* considerations may subsequently cause 'back-sourcing' of that same production (Eliasson and Eliasson 2005).

The position of the pendulum at any given point in time is therefore less interesting than the forces acting upon its movements. Policies attempting to avoid negative consequences of economic globalization, and feed on the possibilities it opens, must build on a thorough understanding of the latter. In the analysis below we have therefore focused less on providing general empirical answers on the state of affairs today, and put significant effort providing if not a full-fledged theory of dynamics, then at least the basic buildings blocks our research indicate that such a theory inevitably must consist of. For the analysis to have validity beyond specific cases or samples of firms, and serve as a basis for sound policy advice, we have below linked it explicitly to broader characteristics of home economic systems; in particular innovation and corporate governance systems.

Internationalization of R&D and localization decisions

There is a lot of inconclusive evidence as to what *general* factors that influence localization decisions of what we have re-named *strategic functions*. Access to markets emerges from many studies as the main explanatory variable behind internationalization in general, but its importance will necessarily vary between sectors. Recently, following the trend referred to as the internationalization of R&D (UN 2005), emphasis has been put on access to technological spill-overs as motive for establishing R&D abroad (see Grünfeld 2004).

The influential econometric literature on technological spill-overs as motive for or effect of FDI have however been unable to provide solid, general answers (Narula and

Zanfei 2005:338, Grünfeld 2004, Kvinge 2004, Harrison 1999, Friberg (red) 2006). In particular, several recent studies cast doubt on the prevalence of technological spill-overs from inward FDI in the EU-countries. Using different data sets, Lichtenberg and van Pottelsberghe de la Potterie (1996 and 1998), and Braconnier et al. (2001) found no evidence of significant spill-overs from FDI or from R&D established through inward FDI. The first two of these studies did however observe such benefits from *outward* FDI. In a more recent study of FDI flows between industrialised countries over twenty years, van Pottelsberghe de la Potterie and Lichtenberg (2001) found that *outward FDI makes a positive contribution to domestic total factor productivity.* Using a sample of 13 OECD countries covering 1983-1990, Xu and Wang (2000) similarly found evidence of reversed spill-overs from outward FDI to home countries, whereas no evidence was found of technological spill-overs from inward FDI (see Friberg (red) 2006)

There is a variety of different factors that influence corporate internationalization in general, and the localization of R&D and other strategic functions in particular. Some of these are firm specific; related only to properties of parent and subsidiary companies, some are sector specific and others again are related to the properties of home and host economies. *These must neither be confused, nor collapsed into one.* It is not given that all decisions to locate e.g. R&D in a specific place is a conscious *localization* decision – in the sense of being motivated by properties of a given *place* - it may simply follow, as a necessity, from an acquisition motivated solely by in-house competencies of acquired firm. The large acquisition-based activities in Norway by US multinational General Electric is a likely example of the latter; the same may very well apply to R&D conducted by General Motors in its Swedish Saab unit.

Companies may acquire other companies because they want to present in certain places; or they may be present in certain places because they have acquired firms which happen to be located there. It can not be taken for granted that the 'internationalization of R&D', measured as increasing proportions of national business R&D being controlled by foreign actors, is driven primarily by properties of the host economies – and the external networks of acquired firms. Mergers and acquisitions being the dominant forms taken by FDI between developed world countries points directly to the relevance of this question.

Centrifugal and centripetal forces

To the extent that properties of places as such drive internationalization through FDI, motives can vary from access to cheap inputs (raw material and labour), through customer proximity and size of markets to technological externalities and thus properties of host innovation systems. Such factors are all important, and can collectively be labelled the *centrifugal* forces of corporate internationalization. Their relative weight will however vary between individual companies, sectors and home economies.

Contradicting these there will exist *centripetal* forces that seemingly cause even large DOMs to remain embedded in their home bases. Following Narula (2002), we have attempted to identify the factors that cause inertia and lock-in with respect to localization of strategic functions. These factors can be either existing linkages to

research communities or key suppliers and partners domestically (i.e. place-specific factors), as emphasized by existing research, and/or simply the competencies accumulated in-house in domestic operations (i.e. organizational specific factors).

Hence, two counter-acting driving forces are at play; the characteristics and strengths of which will vary between sectors and locations. For instance, centrifugal forces specific to certain sectors may exist as e.g. a need to locate R&D in close proximity to production units or customers; whereas in-house competencies of domestic HQ, or dependence on domestic research facilities, may simultaneously represent strong centripetal forces. DOMs may find themselves in a situation where certain input prices imply that production cannot be located in close proximity to customers; and where R&D must still be conducted at home - and thus neither in proximity to customers nor production – for reasons related to the existence of key in-house competencies and external partners domestically.

Input prices may necessitate off-shoring of production (centrifugal), whereas co-location with production may be a prerequisite for R&D which at the same time is dependent on knowledge only available domestically – e.g. in-house. Both forces may be very strong; simultaneously necessitating a certain strategy of internationalization (centrifugal forces) and prohibiting or dramatically increasing the costs involved in the same (centripetal forces) – for different reasons. Our analysis of the internationalization patterns and organizational principles of different DOMs has clearly revealed how different companies struggle in dealing with these opposing forces, normally specific to the prevailing competitive and technological conditions of their respective sectors. These struggles may result in organizational set-ups and strategies of internationalization that fluctuate significantly within sectors, and diverge significantly between them.

If one accepts the latter argument of diversity in centrifugal forces at play, one similarly has to accept that it is very difficult to draw precise, general conclusions that have a minimum degree of validity in time and space – and therefore can serve as a basis for policy advice. We therefore take our focus of the more traditional emphasis on the centripetal forces of host systems. A main emphasis has therefore been put on how basic properties of home base economic systems provide certain basic resources, incentives and constraints for corporate internationalization. The institutional systems, production structures and innovation systems of the Nordic countries – their 'social systems of innovation and production' (Amable 2001) - serve as the basis for corporate internationalization, in the sense of representing technological and financial resources that companies can build on or attempt to escape through internationalization; consequently shaping the structure and strategy of DOMs (Ruigrok and Van Tulder 1995).

Research strategy and data sources

The research strategy of DOMUS has to a large extent been explorative and qualitative; i.e. based on desktop study of existing research and analysis of data gathered through interviews in selected, Nordic DOMs. This has been supported by qualitative analysis

based on Community Innovation Survey, conducted through the DOMUS predecessor FOTON (Ebersberger and Lööf 2005) and specifically for DOMUS (Ebersberger 2006).

There are several reasons why a qualitative research strategy has been chosen; the most important one being a combination of quantitative evidence readily available from FOTON and the need for explorative research to feed into general theory development. It is our clear opinion that, given the existing state of affairs at the research frontier, in-depth firm level analysis with the purpose of making *analytical* generalizations concerning basic socio-economic forces at play (Yin 1984, OECD 2006:65) must feed into general theory development which only then should be further refined and empirically validated using quantitative methods.

What qualitative research lacks in empirical representativity it by far compensate for by allowing direct dialogue with representatives of the phenomena in question. It allows us to avoid 'black boxing' the core actors, the firms. We must know what we want to measure, before we attempt to measure it. This particularly applies when dealing with the generation, flow and accumulation of non-measurable resources – knowledge - that necessitate using different indirect measures.

The purpose has not been to conduct full-fledged case studies of the different interviewed companies, but qualitative data analysis aimed at increasing our understanding of corporate internationalization as a phenomenon, its challenges for corporations and national economies – and thus dynamics and possible implications, primarily at the national level. Case studies are used as a key element in an exploratory rather than intensive research strategy. Hence, the different country case study paper of module 3 (Herstad ed. 2006) will not provide comprehensive analysis of the histories and internationalization patterns of the different case companies. Any attempt to do these companies full justice within the limitations of DOMUS would not have proven fruitful, and would also have been a significant deviation from the purpose of the project as a whole.

Interviewed companies are not empirically representative for any larger population of firms; nor have they been selected for that purpose. Rather, they have been selected based on expected information richness (Flyvbjerg 1991); their prospects for providing insights into the long-term dynamics of corporate internationalization, and related socio-economic processes within and surrounding domestic multinational corporations. This resulted in case firms being fairly mature experienced international actors within their respective national economies.

The building blocks

In general, the *channels* through which host-home knowledge transfers *can* occur – the *organizational* pipeline supplied by the MNE – needs to be conceptualized and examined carefully, both theoretically and empirically. This gives us the need for analytical tools based on theoretical perspectives covering the nature of knowledge and the characteristics of working inter-organizational knowledge networks.

Put simply, statements about flows of *information* within multinational corporate networks are bordering on tautological – they will by definition occur within a common ownership and control structure. However, information is not to the same as knowledge; access to information is not equal to an absorption, interpretation and understanding of that same information. Knowledge is, as opposed to information, always embedded in human beings. The fact that information exists somewhere is not equal to an actual transfer of that knowledge between human beings (Attewell 1996). The key questions are rather how these information flows are structured, for what purpose, and the extent to which they translate into learning and a mutual development of competences. In relation to this it is also important to understand where the resulting competences are accumulated, and how they are used as a basis for innovation processes, including future R&D projects.

We have substituted the narrow focus on R&D with a broader focus on *strategic activities*, those activities which by conscious design or by mere day-to-day operations generate and accumulate knowledge of strategic importance for the firm. This is consistent with the basic logic of the 'knowledge production function' (Griliches 1979, Criscuolo et al 2005) approach, where a distinction is made between the activity of 'doing R&D' and the broader knowledge base upon which the activity in the longer run must feed on – and thus to varying degrees remain organizationally integrated (Lazonick 1995) with.

It is also consistent with the so-called resource-based view of the firm (Langlois and Robertsen 1997); in which it is '…organizational differences, especially differences in abilities to gain from innovation, rather than differences in command over particular technologies, that are the source of durable, not easily imitable differences among firms' (Nelson 1991:72, Lazonick 2005:33) – and hence their competitive advantages**.** Strategic functions include R&D, but are very rarely limited to what is in corporate monitoring and accounting identified and reported as such. In the words of Icelandic DOM Ossur; 'nobody in our company believes that innovation only happens in the R&D department'. Our use of this distinction follows directly from the objective of not analyzing stand-alone innovation projects, but long-term implications of internationalization for competence sourcing and accumulation, domestically and abroad.

This allows us to account for industry branch differences with respect to where and how core knowledge production inherently occur; with what linkages between in-house functions and what networks externally, and consequently where the same knowledge is accumulated as 'core competencies'. It specifically allows us to recognize that low reported R&D may reflect such branch differences (see Herstad ed. 2006 and case analyses of in particular Aker Yards, Wilh Wilhelmsen and Skanska), not low knowledge or innovation intensity. We therefore define 'strategic activities' as those activities involved in the process of core competency learning and knowledge accumulation. This builds directly on the influential work by Keith Pavitt (1984), where it is argued that different industrial sectors are characterized by systematic knowledge base variations (Asheim and Gertler 2005, Fagerberg 2005, Tunzelmann and Acha 2005). They must rely on different knowledge sources internally and externally, ranging from universities through customers to shop-floor production departments, and

accumulate different types of knowledge internally, with differences in breadth, depth and degree of cross-disciplinarity – by means that span the whole range from learning-by-doing to formal study in research departments.

If the roots of innovation, as stated by a respondent in Rolls Royce Marine Norway, are found '…not in the R&D department alone but in the "good dialog" between marketing, R&D and production', and these therefore are inseparable both spatially and organizationally, all must be considered 'strategic' and internationalizing production could contribute to hollowing out R&D. The same applies if other functions than R&D, production or advanced marketing and after-sales services, are the prime source of personnel for later employment in research and development. If innovation, as in many so-called high-tech sectors, on the other hand take the form of software development isolated from hardware development and manufacturing, only the former can be considered strategic and outsourcing or offshoring the latter create no hollowing out.

Building on the distinction between strategic resources and operations we then conceptualize the channels through which spill-overs occur as a question of the relationship between key characteristics of involved knowledge bases, and the organizational principles of the MNE. We focus on the domestic multinational as a 'global knowledge and technology pipeline' (Bathelt et al 2004) for its domestic NIS, and attempt to unravel the structures and mechanisms that may contribute to both linking home and host R&D, and secure, reinforce or hollow out the latter.

3. The theoretical framework

Why FDI-based internationalization?

Following the OLI framework developed by Dunning (1988) internationalization may result when a firm

- possesses certain *Ownership Specific Advantages* (O),
- foreign host localizations contain certain *Localization Specific Advantages* (L), complementary to O, and
- the expected *Costs of FDI-based Internationalization* (I) do not exceed the costs of alternative strategies for utilizing L based on O.

Alternative strategies may include licensing of technology to independent producers abroad or exports from home-base production facilities.

Basically; firms are using their domestic NIS and domestic markets to develop distinct competencies, the full market value of which requires internationalization. In this perspective, the emergence and international expansion of DOMs are an inherent outcome of NIS strengths.

The simple line of reasoning of the OLI framework has been influential in macro-oriented research on FDI and FDI implications, and has served as the basis for developing the 'investment development paths' (IDP) as a tool for analyzing the FDI position of national economies (Kvinge 2002, Narula 1996), and for attempts at drawing host economy implications.

The main idea of the IDP approach is that *developing* countries serve mainly as FDI hosts based on basic localization specific advantages (e.g. cheap labour used for producing shoes, size of domestic markets for soft drinks). In this setting home-host technology transfers occur as the combined result of home-host technology gaps (initially large) and host absorptive capacity (initially low). As gap-induced transfers increases the absorptive capacity of the host and consequently decreases the same gap, the 'investment development path' inevitably ends up at the stage where 'large knowledge bases exist in both home and host country' (Kvinge 2002), no potential for further 'transfer' exist and the initial host start serving as a home base for its own MNEs.

Thus, whereas the IDP approach may be suitable for aggregate analysis of the role of FDI in economic transition under conditions of large home-host technology gaps (i.e. developing world studies), it is unable to say much analytically about the nature of intra-developed world FDI, technology transfers and complex technological development (Kvinge 2002) under conditions of diversity rather than gaps (Herstad 2005:75-86). As it implicitly presupposes no or limited learning in the home base of MNEs (i.e. the 'developed' home base country), it is unable to draw home-base implications of DOM activities. The interplay between developed economies can only be conceptualized as complex patterns of incoming and outgoing FDI based on specific regional or national historically contingent localization advantages, as well as related ownership advantages and weaknesses (ibid) and in-house competencies of acquired firms, and implications understood not as the existence or non-existence of technology transfers under conditions or large gaps but as the existence or non-existence of technological *synergies* under conditions of technological diversity.

What FDI-based internationalisation?

Based on the resource based view of the firm a distinction can be made between firm 'core competencies' (including but not limited to technological basis) and activities that are 'complementary' to these in the sense that they are necessary to exploit their market value but are not directly linked to core competence development as such (see e.g. Teece 2001 or Langlois and Robertsen 1995). From this follow the analytical distinction between 'operations' and 'strategic functions'. Operations are 'complementary' and include functions such as e.g. marketing, logistics and sales. 'Strategic' functions, on the other hand, involve key decision making (headquarters) and control (ownership), as well as those activities that form and reproduce the core technological knowledge of the firm – including R&D but not exclusively R&D departments.

The internationalization of 'operations' can be understood in the context of OLI and transaction cost theory (Williamson 1985, Coase 1936, 1991): A firm will establish

international 'operations' when location specific advantages exist abroad (i.e. a large market, cheap labour or access to raw materials) and the relative benefits of utilizing these by establishing own operations (thus eliminating transaction costs) exceed the costs of internationalization (establishing/purchasing a foreign facility, and running it). An assumption often made in the literature is that (expected) transaction costs increase when national borders are crossed, hence also increasing the likelihood of firms choosing to establish own operations abroad rather than use external partners.

Obviously, this line of reasoning is insufficient when it comes to explaining and drawing implications from firm localization of 'strategic assets'. It is therefore necessary to introduce the concepts of 'inertia' (Narula 2002) and 'embeddedness' (Granovetter 1992). Embeddedness restrains and focuses firm behaviour towards certain places, actors and hence innovation systems (Doysters and Verspagen 2004:564). It enables firms to build on and contribute to reproducing the specific territorial innovation system (IS) that formed the basis for their O (Ownership Specific Advantages), but in the process restrains firms from gaining access to other territorial innovation systems.

Inertia can thus be understood as either an outcome of the ability to successfully use the national IS as a basis for continuously deepening O and hence for internationalization (*technology exploitation*); or as revealing an inability to link up to foreign innovation systems more suited for supporting technologies and hence again O novel or complementary to the domestic IS (*technology sourcing*) (see Narula 2002:813-814 for a thorough discussion). In this it is important to note the tension between the low marginal cost of utilizing existing linkages (domestically, cf. the embeddedness argument), and the high marginal cost of establishing new ones (abroad) and integrating these within the corporate structure.

An apparent, implicit assumption in the literature is that embeddedness in *external* linkages is the prime cause of inertia. Consequently it neglects the role of accumulated domestic *in-house* – organisational and thus 'sticky' - competencies as a possible important factor in keeping certain activities at home. Enduring domestic external linkages may also be an *outcome* of the existence of strong in-house competencies domestically, rather than a cause. Thus organisational competencies may *cause* inertia. Internal R&D may for instance have to be conducted domestically as this is where you find the relevant human resources and networks of competencies.

This distinction is important when analysing both mature and immature firms and sectors. Mature firms and business sectors are likely to have developed very idiosyncratic in-house competencies that hinder them from moving out R&D and other knowledge intensive innovation activities.

The varieties of FDI-based internationalisation

Multinational organisations vary considerably in size, geographical configuration of activities and corporate organisational set-up. They represent, therefore, not one single distinct organisational model. The systematic differences between US, Continental European and Japanese MNEs with respect to organisational set-up, R&D location and

strategy is well established in the literature (Bartlett and Ghoshal 1998, Pauly and Reich 1997), the same applies to the distinction between large and small-country corporate internationalisation patterns. When combined, variations in configuration and organizational set-up translate into substantial variations as to expected impact of their activity on both home and host economic systems (Herstad 2005).

An influential attempt at synthesizing and developing a coherent theoretical framework for understanding differences in firm internationalization strategies is found in Ruigrok and van Tulder (1995). The starting point of this and later works such as Doremus et al (1998 or Whitley (red) (1999) is that multinationals must be seen as linked to larger 'industrial complexes' – complex networks of partner and transaction relations governed to a large extent not by rational choice but by routines, expectations, power relations and institutional constraints. Such relations include transaction 'within the value chain', e.g. with suppliers upstream and customers or distributors downstream, as well as relations 'outside the (physical) value chain' – with employees, creditors, owners and state or regional authorities. These constitute 'bargaining relations' (Ruigrok and van Tulder 1995) set within certain 'institutional frameworks (e.g. Whitley 1999) that channel firm behaviour in certain directions.

Classic examples include how Japanese multinationals traditionally have been reluctant in their internationalization strategy because of large, irreversible investments in domestic workforce competencies, networks of dedicated suppliers and large-scale in-house R&D.

US MNEs have been aggressive internationalisers of 'operations' as harsh domestic inter-firm and industrial relations (Storper 1997, Wever 1995) to a larger degree limit their commitment to national supplier networks and competencies embedded in the domestic workforce. In accordance with this, they are bold movers into novel sectors and unfamiliar business environments (Tainio 2004). Simultaneously they are also revealing *a distinct preference towards conducting R&D at home*, based on established, in-house R&D departments and domestic networks towards universities and research institutes.

MNEs from small, open economies such as the Nordic countries have faced limited domestic markets and have early been forced to expand into international markets. These have, as opposite to US or UK MNEs, overwhelmingly been backed by large dedicated blocks of owners (Fukao 1995, Steen Thomsen 1997, Doremus et al 1998, Collin 1998, Lane 2001, Whitley 2001) and remain selective if not reluctant in internationalizing strategic assets such as ownership and R&D. All MNEs are shown to be 'inert', but in different aspects of their activities and resources – and for different reasons.

Diversity in unit localization translates into potential diversity in knowledge inputs (Forsgren 1997). Put simply; 'by having different assets in different industrial contexts, a firm's ability to capture new ideas about products and processes increase' (ibid: 71). This of course in particular applies to localization of own R&D functions in proximity to external research communities, or localization of sales or production units in proximity to demanding customers. There is however a second and crucial element in

this: The ability of the company to transfer *knowledge* from one part of the organization to another, to *organisationally integrate* (Lazonick 2005, Lazonick and O'Sullivan 1998) foreign operations or R&D with home-base R&D.

This is fundamentally a question of how the MNE is organized at the corporate level, and what strategic emphasis which is put on establishing networks of inter-unit interactive learning. According to Forsgren (1997) this leaves us with the following fundamental trade-off: The greater the variation in the different subsidiaries' business contexts (and types of operations abroad), the higher the prospects for tapping into or creating new knowledge somewhere within the MNE. Greater variation, however, increases the costs of integration (Nooteboom 2001). Thus, ceterus paribus, the greater the variation in the business contexts, the more difficult it will be to exploit this new knowledge on a more general basis within the corporation. And the higher the (potential) costs of integration, the less likely it is that the MNE will attempt integrating units beyond e.g. common support functions or financial reporting structures, creating 'differentiated networks' (Nohria and Ghoshal 1997) managed as investment portfolios with few inter-unit linkages.

Last but not least it follows from this that the more corporate strategic emphasis is put on being present in a variety of business contexts, and/or on applying an aggressive acquisition and disposal strategy, the less strategic emphasis can be put on investments in inter-unit integration – and the poorer the communicative skills of the MNE will be. Forsgren (1997) has labelled this trade-off between diversity and synergy as the 'advantage paradox of the multinational corporation'. In this it is important note that MNEs operate under budget constraints that are in the last instance defined by how the MNE itself is monitored and controlled, based on what strategic objectives (i.e. the corporate governance system).

The literature has attempted to deal with the changing organisational character of multinationals, and claimed the existence of different organisational models such as the *transnational* firm (Bartlett and Ghoshal 1989), the *multifocal* firm (Doz 1986), the *heterarchy* (Hedlund 1986) or *global production networks* (Ernst, 2000). Others argue that the existence of a trend reversing the decentralisation of production and R&D referred to by the former strand of literature; replacing the *transnational* networking corporation with a more traditional multinational and hierarchical model (Gerybadze and Reger 1999:272), and still others claim that complementary to focusing on formal organisational structures – i.e. what is attempted achieved – one should focus on how and the extent to which the underlying social basis for real network formation (Herstad, 2005) is achieved. A similar line of reasoning is found e.g. in Persaud (2005).

Two tools for classifying fundamental corporate organisational characteristics can the useful in shedding light on this. On the one hand Herstad (2005) develops a simple distinction between multinationals as industrial systems or portfolios. On the other hand, Bartlett and Ghoshal (1998) distinguish between subsidiary-HQ communication and co-ordination through centralization, formalization or socialization (see table 1).

Portfolios are characterized by functionally independent units, evaluated based on their individual contribution to the financial objectives of the parent company. They are

therefore normally governed through formalization, i.e. by applying pre-specified budget constraints on individual subsidiary R&D. These units are to meet pre-specified financial (or technological) performance indicator requirements individually and continuously.

They first key here is unit individualization; in the sense that there is a lack of investments in cross-subsidiary integration and of incentives for the individual subsidiary to engage actively in knowledge transfer and development within the group. The second key is minimized parent company commitment to individual units; thus enabling easier subsidiary entry-exit on the part of the parent company.

Portfolios and aggressive international acquisition-based growth can thus be expected to go hand in hand, and lead to either highly centralised R&D (technology exploitation) or extremely decentralized R&D (technology sourcing) with little or no inter-unit linkages and HQ co-ordination.

Table 1: Basic principles for co-ordination in MNEs (Bartlett and Ghoshal 1998:186-191)

	Formalisation	**Centralisation**	**Socialisation**
Defining characteristics	Decentralisation of decision making combined with standardised performance measurement systems, focused on individual unit rather than system performance (Morgan 2001).	Direct action and intervention by HQ management groups, based on intensive communication with subsidiaries.	Careful recruitment, development and acculturation of key decision making and technology personnel; routines and shared corporate world-views enable decentralisation without co-ordination problems. Strong and broad corporate in-house labour markets important to embed 'company way' or doing things, and enable knowledge flows (Granstrand and Sjölander 1994, Persaud 2005)
Main strengths	Economies of scale when system is established. Reduces administrative costs; eases decision making. Few investments in integration following acquisition; minimizes losses if subsidiaries are divested.	Relatively easy to establish; co-ordination of information flows within corporate groups.	Flexibility and communication. Overcomes inflexibility and segmentation of formalisation, and HQ information overload generated by centralisation
Main problems	Fixed costs of establishing the system. Ability to adapt to specific unit technology	Extremely costly to operate efficiently. Information overload on HQ when international	Challenging to establish and maintain Require long-term *consistent* management attention

	or market requirements; serve as surrogate for informed decision making. Unit segmentation following from focus on individual performance	organisation grows; easily becomes hybrid of formalisation when size and complexity decouple HQ and subsidiaries.	and financial backing. Sensitive to mode of corporate control.
Pipeline implications	Communication by performance indicators alone severely reduces knowledge flow between HQ and subsidiaries. Unit segmentation reduces knowledge flow between subsidiaries.	Strong feedback of knowledge from subsidiaries to HQ. Hierarchy may reduce networking between subsidiaries.	Prospects for strong network formation both hierarchically and horizontally within the MNE. Mobility of personnel and common interpretative schemes nurture mobility of knowledge (Bathelt et al 2004)

Industrial systems, on the other hand, are characterized by control and co-ordination through either socialization or centralization (Bartlett and Ghoshal 1998), and investments in harnessing inter-subsidiary functional or technological synergies (see e.g. Granstrand and Sjölander 1994). The latter implies that units are evaluated based on their contribution to larger corporate production or knowledge networks, rather than based on their individual performances. Industrial systems by definition facilitate knowledge exchange and interactive learning between units, and hence also by definition represent a larger potential for activities abroad to link up with and trigger externalities into home base NIS.

In this it is important to note that industrial systems require large-scale investments in integration when established or extended with new operations. Further, they costs of control and co-ordination through either centralization or socialization are far higher than the alternative of formalization. The formation of well-functioning corporate networks therefore require significant investments (Bathelt et al 2004), and may therefore severely depress returns over some time. Moreover, this strategy poses strong challenges with respect to monitoring, evaluation and co-ordination, and raises questions concerning the financial pre-requisites for the formation of industrial systems.

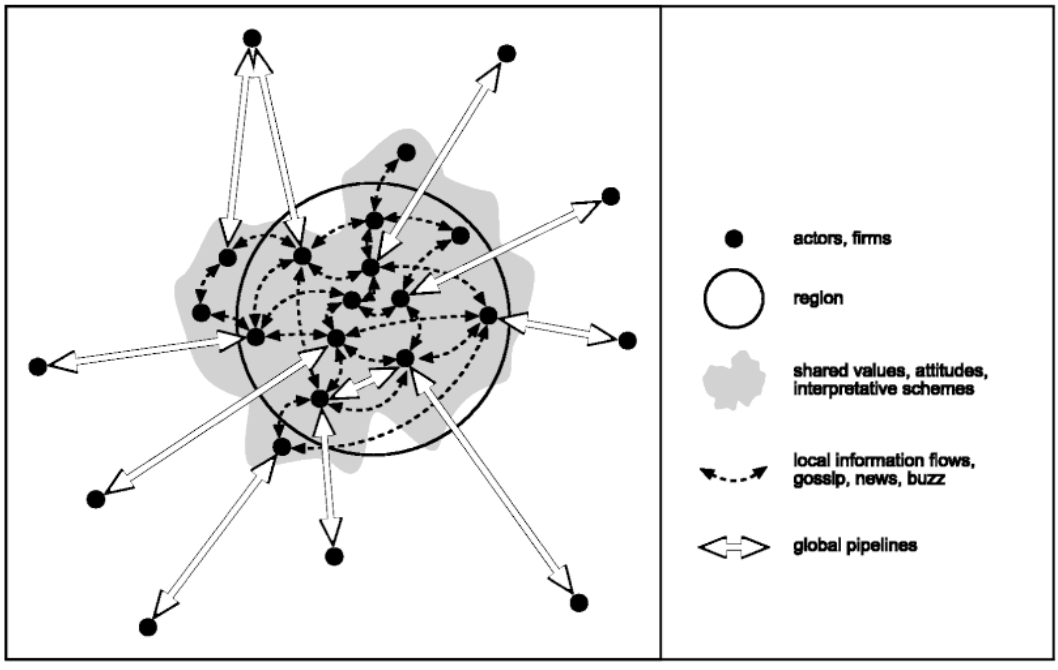
A general tendency to 'black box' firms and put excessive emphasis on macro level mapping of R&D locations (Gerybadze and Reger 1999:272) has however translated into a neglect of such difficulties in – and costs of – establishing the 'corporate innovation network' assumed to be a given outcome of common ownership.

Domestic embeddedness and global pipelines

From the perspective of the corporation, the existence of corporate networks – and thus pipelines for inter-unit knowledge transfers – are directly linked to how the parent company attempt to resolve the 'advantage paradox'; the trade-off between on the one hand being linked to a variety of territorial innovation systems by operating with a broad geographical configuration of activities; and on the other hand achieving the degree of integration and internal coherentness necessary to harness synergies between units in different places, and knowledge tapped from such places. Thus, they are contingent on solving the possible trade-offs between diversity in external linkages (presence in many places); intensity in external linkages (embeddedness of subsidiaries in host NIS) and the ability to harness synergies by developing corporate in-house networks where knowledge gained through subsidiaries abroad can be explored on a larger scale.

From the broader NIS perspective, the functioning of DOMs as global pipelines are *in addition* contingent on DOM linkages to innovation system actors domestically; either directly through e.g. alliances or user-producer relationships or indirectly through the labour market; on the character of these linkages and on the absorptive capacity of the domestic system. In sum, the functioning of DOMs as global knowledge pipelines for their respective domestic innovation systems are therefore contingent on the existence and depth of three separate interfaces (see figure 1).

Figure 1: Innovation systems and global pipelines (source: Bathelt et al 2004:46)



Home and host external system interface

Two strong forces are at play in defining breadth and depth in home and host external innovation systems linkages:

i) lock-in to home-base system actors, which may or may not be technologically efficient (Narula 2002:798); and
ii) ii) the high costs of becoming 'embedded' into foreign systems of innovation.

Firms are constrained by resource limitations. The marginal cost of further utilisation of domestic R&D resources and networks is low, and the marginal costs related to establishing such linkages abroad may very well be very high, in particular for greenfield investments.

Furthermore, maintaining more than one facility with the necessary level of researchers and physical capital to secure absorptive capacity requires that relevant locations offer superior technological resources that cannot be obtained by other means (ibid) – or that the knowledge absorption function can be linked to other income generating activities such as sales or market-adaptation oriented R&D.

Organisational interfaces

Narula and Zanfei (2005:334) explicitly point out: 'It is not sufficient for foreign affiliates to internalize spillovers if it cannot make these available to the rest of the MNE', home-base activities included. Following research such as Blanc and Sierra (1999) and Bartlett and Ghoshal (1998) they go on to argue that

> 'a dispersion of R&D activities across the globe requires extensive co-ordination (…) complex linkages, both within the firm and between external networks and internal networks, require complex coordination if they are to provide optimal benefits. Such co-ordination requires expertise, managerial and financial resources'.

Similar insights are found in Bathelt et al (2004), who argue that

> 'to successfully establish a global pipeline (…) requires the development of a shared institutional context which enables joint problem-solving, learning and knowledge creation. Knowledge flows through pipelines are not automatic, and participation is not free'.

Herstad (2005) uses in-depth company evidence to link networking intensity to corporate principles for co-ordination and monitoring (see table 1, Herstad 2005:188-201), and a later survey similarly uses quantitative analysis to argue that there is a clear relationship between such principles and inter-unit network formation (Persaud 2005).

Strategic functions and the characteristics of knowledge bases

The activity of 'doing R&D' is both channelled by and must feed on larger corporate knowledge bases; the containing functions of which in any given case define what functions that are 'strategic' and what functions that are mere operations. These knowledge bases may have characteristics that create friction on the ability of companies to communicate knowledge outward, on the ability of companies to relocate

R&D and on the ability of companies to absorb knowledge from outside – from what partner organisations.

Attempting to understand the role of pipelines, and the localisation of strategic functions more generally, necessitate a rational analytical understanding of the concept 'knowledge' itself. Two simple but important distinctions will be made in the following. The first is between firm specific and generic knowledge; i.e. between knowledge that exist primarily within certain specific organizational settings and knowledge readily available from e.g. universities or through the labour market. The second is related to this, and is between analytic and synthetic knowledge (Asheim and Gertler 2005)[9]:

> 'These types entails different mixes of tacit and codified knowledge (…) they also imply reliance on different qualifications and skills, reliance on different organizations and institutions, as well as contrasting innovation challenges and pressures' (Asheim and Gertler 2005:295).

Importantly, they also imply different codification possibilities and limits (ibid).

Analytic knowledge is scientific knowledge, generated through learning processes that follows paths defined independently of industrial sectors or individual firms, but to varying degrees reproduced within tight linkages between e.g. universities and industries reliant on analytic knowledge bases. Prime examples of this are found in biotechnology, information technology and pharmaceuticals (Asheim and Gertler 2005). The generation of analytic knowledge is based on the application of widely shared and understood scientific principles and methods; knowledge processes are more formally organized (e.g. in R&D departments) and outcomes tend to be fairly easy to codify (Asheim and Gertler 2005). The combination of shared scientific principles and a high degree of codification substantially eases communication across geographical and social space; between subsidiaries and HQ and between both these and external research communities abroad or at home.

The generation of synthetic knowledge, on the other hand, follow learning paths defined not by disciplines but by sectors or solely by individual firms; and has a defining characteristic in that it crosses disciplinary divides in order to solve given, practical problems or obtain a certain pre-specified function in a product. Asheim and Gertler (2005) describe how synthetic knowledge "... is created less in a deductive process or through abstraction than through inductive testing, experimentation, computer-simulations and practical work".

The firm or larger region surrounding it serve as a containing social structure or focusing device for interaction patterns and learning processes that are very specific not to scientific disciplines but to the specific practical problems sought solved. According to Asheim and Gertler (2005) shipbuilding is a clear example of an activity based on a

9 Note that neither the distinction analytic vs. synthetic knowledge nor the distinction generic vs. specific knowledge in themselves refer to distinctions such as high-tech industries or low-tech industries or degrees of knowledge intensity. They refer to the structure and character of knowledge bases, not actual technological content.

synthetic knowledge bases. The strong emphasis on learning-by-doing, and thus on tacit knowledge, and the lack of a common, generic scientific reference frame implies that communication across geographical and social space is much more difficult for synthetic knowledge than for analytical. This is reinforced because synthetic knowledge bases to a large extent are collective knowledge bases, tied to interaction patterns between people, rather than as for analytical knowledge bases being constituted by the sum of individual experts within their respective fields[10].

An additional important factor highlighted by these distinctions are the degree to which new personnel, be it R&D or production personnel, easily can be sourced from the labour market or whether large investments in firm- or sector-specific knowledge is required to make them 'insiders' in the communities in question (Herstad 2005). This in turn has implications as to the degree of which strategic functions may easily be expanded into new places, or relocated from the home-base. It has also implications for the extent to which competencies readily available in labour markets abroad serve as a centrifugal force, pushing R&D out. For firms operating on the basis of analytic knowledge, locating R&D activities in close proximity to leading universities and vibrant research staff labour markets make very much sense; but it does not necessarily make sense at all for firms operating on the basis of specialized, synthetic knowledge not developed at such universities or available in such markets.

The ultimate rationale for highlighting these distinctions is that *the nature of knowledge involved* in itself generate varying degrees of 'inertia' in corporate R&D location; that different properties of the core knowledge of a certain firm or sector represent different prospects for sourcing that knowledge in different places – domestically or abroad; and last but not least because the nature of knowledge places varying demands on the nature of the *organizational* pipeline of the MNE if synergies are to be harnessed. Tacitness of knowledge require deep personal interaction, willingness to share and trial-and-error in identifying possible synergies; and it requires large investments in employee skills if R&D facilities are to be built bottom-up abroad. This is challenging over large geographical distances.

Conversely we also argue that the characteristics of the organizational pipelines that are established by multinationals to a very large degree influence on what synergies or host-home knowledge transfers that can occur, and hence on the prospects of externalities into the home-base NIS.

Table 2: Hypothesis on the relationship between nature of knowledge bases, firm localization and global pipeline formation.

[10] In Herstad (2005) this is illustrated with reference to the differences in knowledge bases between biotechnology firms Axis Shield and the anonymous robotics developer and producer named ATT Industries. Whereas the former stresses how communication with external parties is eased by the fact that *'we all speak the same professional language'* (analytical knowledge'), the ATT unit stresses how such communication is extremely difficult and time-consuming because '*what we do is so specialised, it integrated elements from physics, chemistry, mechanics, electronics and ICT. Co-operating is difficult; ; people have to sit on top of each other for long periods of time to make it work, to understand what this is all about'* (synthetic knowledge).

	Analytical knowledge	Synthetic knowledge
Inertia in home-base R&D (stickiness of knowledge)	Relatively low, contingent on availability of researchers from education system and importance of external networks domestically.	High. Sticky in-house competencies create severe inertia, reinforced significantly by external networks to the extent that such exist.
Ease of establishment of R&D abroad	Easy given relevant location-specific advantages (se below). Few investments in firm-specific skills	Difficult. Large investments in building up necessary in-house competencies abroad, if not acquisition
Main localization factors R&D	Proximity to universities and leading research institutes, vibrant and flexible labour markets for high quality researchers	Customer proximity, in-house competencies of acquired firms, proximity to other strategic functions (production, marketing), specialized complementary capabilities, expected stability of research staff
Home-host knowledge networks	Easily established, codified knowledge, common professional language/reference frame	Difficult to establish, require large investments in inter-unit integration, networks costly to run (extensive travelling, large project teams)
Home-base NIS absorptive capacity	Contingent on the existence of general, academic 'epistemic communities' domestically, with linkages to home-base operations of DOM	Contingent on the existence of co-specialized knowledge bases externally, specialized universities/colleges, suppliers etc.

4. The societal background of Nordic corporate internationalisation[11]

Not surprisingly limited domestic markets are highlighted as an extremely important driver of Nordic corporate internationalization. Nordic consumption markets are limited by population size (although also characterized by high purchasing power resulting from high GDP per capita levels and strong systems for income distribution). The markets for public infrastructure investments are necessarily limited; so is the scope for using public procurement through e.g. defence contracts to boost technological and industrial development, as in the US. Corporate internationalization in the Nordic economies must always be understood against this general background.

We start with the general argument that national corporate governance system provide the *capital resource and strategic competence base* of corporate internationalization (Lazonick 2005, Thomsen 1997, Ruigrok and van Tulder 1995), whereas NIS provide the *knowledge and technology resource base* of the same (Narula 1996). Thus, we follow Doremus et al (1998:144) in conceptualizing MNE activity as

> '…a process through which still-national corporations, and the innovation and investment systems in which they remain embedded, are inserted into one another's home markets'.

Both national corporate governance systems and national innovation systems vary significantly across the Nordic countries (see e.g. Rose and Mejer 2003, Thomson and Rose 2002, Bøhren and Ødegaard 2000, 2001, Ekeland 2002, Det Økonomiske Råd 1999, Högfeldt 2004, Collin 1998, Collin and Bengtsson 2000)

Corporate structure is shaped by corporate strategy, and corporate strategy is shaped by the decision making structure of the corporation. This, in turn, reflects the strategic objectives of owners, commitment (Lazonick 2005) and principles for monitoring, evaluating and disciplining the corporation (Porter (red) 1992).

The strategic objectives of private corporations span a range from the indefinite long-term survival of companies (e.g. ownership and control by foundations in Denmark) to the maximization of the quarter-to-quarter financial market capitalization of the same (e.g. fragmented ownership by non-committed institutional agents investing on behalf of even more fragmented principals, as common in the US or UK). Hence, it is not surprising that the growing literature on the specificities of national systems of corporate governance argue that the strategy and structure of domestic multinational corporations must partially be understood as products of the systems of corporate financing, ownership and control they emerge out of.

These systems define the national alternatives to foreign ownership, and therefore the existence of companies as domestic multinationals.

[11] This chapter builds directly on contributions from the different national teams. For full versions of country analysis, see Friberg (red) (2006) for literature reviews, Rilla and Oksanen (red) (2006) for descriptive data.

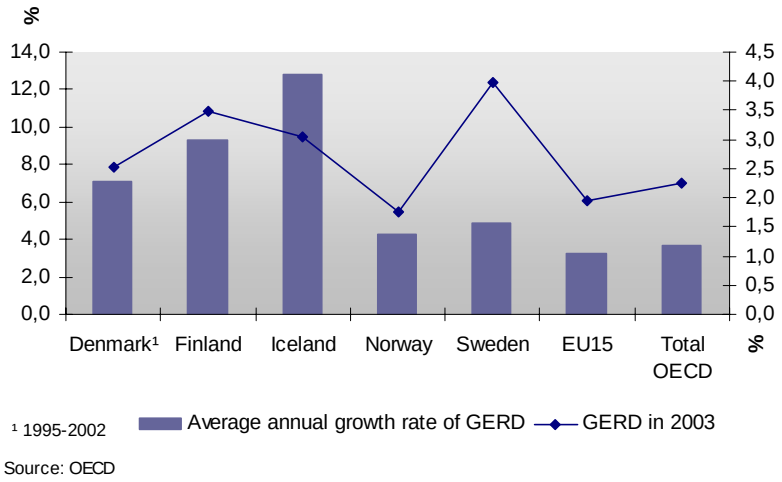
Company ownership in the Nordic economies is characterized by the very distinct role of bank groups as committed industrial owners in Sweden and Iceland; the high degree of family or foundation ownership in Danish industry and the very distinct interplay between strong but passive state ownership and weak private, active ownership Norway (Norwegian Ministry of Finance 2005, Bøhren and Ødegaard 2000). Characteristics also include the early and conscious direct exposure of Finnish Nokia to the US equity market (Tainio et al 2001); and the high degree of foreign direct and portfolio ownership among Finnish public companies that has caused observers to ask questions concerning a possible, fundamental transformation of the Finnish system (ibid).

Similarly, following from the OLI framework presented above, the *national innovation system*, or regional sub-systems, either forms the basis for the development of ownership specific advantages, utilized on a larger scale through internationalization, or set limitations on what ownership specific advantages that firms can develop and refine in interaction with NIS actors. The properties of NIS further define national absorptive capacity; i.e. the ability to absorb, diffuse, interpret, refine or find new usages for knowledge filtered back home by the global pipeline of multinational corporations.

The Nordic economies

Figure 2 below show general country expenditures on research and development (GERD) by country in 2003, and the 1995-2002 growth rate. All Nordic countries with the exception of Norway show EU15 and OECD average levels, whereas all countries including Norway display higher than averages growth rates. Finland and Iceland in particular stand out both with high 2003 GERD levels and very high growth rates for the period; whereas a distinctive feature of the Swedish economy is the highest 2003 GERD level compared to the second lowest period growth rate (Rilla and Oksanen (red) 2006). Norway show both low 2003 levels and low period growth rates, a picture in part explained by an industrial structure dominated by inherently low R&D intensity activities (Aanstad et al 2005).

Figure 2: Evolution of GERD in selected OECD countries, average annual growth rate 1995-2003 or latest available year.



A large share of R&D activity is performed by business enterprises**.** Table 3 reveals that business R&D intensity (BERD) in all Nordic Countries, except Norway, was well above OECD average in 2003. Particularly, Swedish and Finnish companies' share of expenditure on R&D activities of value added was relatively high. Iceland has on the other hand encountered the most intense growth in BERD since 1995 (Rilla and Oksanen (red) 2006).

Table 3: Business R&D intensity[12], 2003 or latest available year.

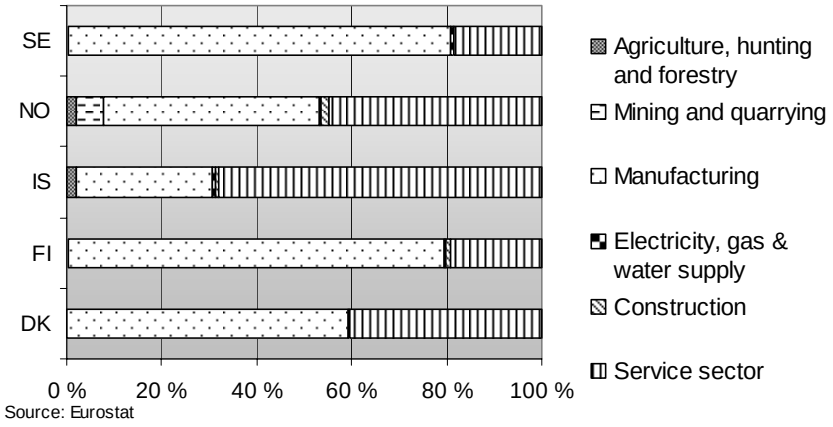
	Business enterprise R&D intensity in 2003
Denmark (2002)	2,82
Finland	3,68
Iceland	2,76
Sweden	4,71
Norway	1,49
EU15	1,82
OECD	2,14

Source: OECD

The distribution of BERD within the Nordic countries shows that Swedish business R&D primarily is conducted in the manufacturing sector, whereas the service sector emerges as particularly strong in Iceland and relatively strong in Norway. A more detailed sectoral analysis is provided in the country chapters below.

[12] Business enterprise sector R&D expenditure as a percentage of value added in industry.

Figure 3: R&D expenditure by selected economic activity (NACE) in the business enterprise sector in 2003[13].



Source: Eurostat

Both BERD and GERD indicators of course reflect the general industrial structures of the Nordic economies; which in turn is reflected in the sectoral distribution of FDI outflow from the different economies. This will be elaborated below.

Norway

The Norwegian industrial system can be described as a dual structure consisting of the large-firm tier that dominate Norwegian exports, and a SME tier that generate the overwhelming part of Norwegian employment (Tranøy 2004, Spilling 2000).

Whereas a distinction between a large firm and a small firm tier is not uncommon in developed countries, the distinctiveness of Norwegian system is related to

a) the dominance of state ownership in the former tier,
b) the emphasis on natural resource based activities in the same; and
c) the lack of 'high-tech' locomotives such as Ericsson (Sweden) or Nokia (Finland).

Natural resource specialisation extends beyond mere petroleum specialisation and into both energy-intensive process industries such as metals, historically nurtured by cheap hydroelectricity, fisheries, aquaculture and pulp and paper. All these are industries inherently characterised more by process than product innovations, and as a result it is often argued that the Norwegian NIS is distinctively geared towards supporting such innovations (Narula 2002, Herstad and Asheim, 2003). Total exports account for some 41 per cent of GDP; exports of crude and natural gas alone for some 31 per cent of GDP

[13] The low share of services may occur in some countries due to the limited coverage of service industries in R&D surveys and measurement difficulties associated with services.

and exports of manufactured products for only 11 per cent. GDP per capita and productivity levels are very high in international comparison.

Table 4: Patterns of corporate ownership and control in Norwegian public firms

a) Ownership in listed companies, Oslo Stock Exchange
(Source: Ekeland 2001)

	Share of quoted stock
Public sector	39
Domestic individuals	6
Financial institutions	12
Domestic industrial actors	13
Foreigners (portfolio investments, direct investments in listed companies only)	28

b) Direct state holdings in ten largest OSE listed companies, May 2003
(Source: Engelstad et al 2003:46)

	Percentage of OSE market capitalization	Percentage state holdings[14]
Statoil	27	81,8 0,4
Norsk Hydro	17,5	43,2 4,0
Telenor	10,1	77,7 2,6
Orkla	5,4	11,6
DNB Holding	5,3	47,8
Gjensidige NOR[15]	4,2	1,8
Norske Skog	2,8	8,3
Tomra Systems	1,7	9,9
Bergesen D.Y	1,6	7,1
Elkem	1,5	7,9

Distinctive institutional features include

- a comparably weak and state-dominated banking system, historically unable to play the co-ordinating roles of the national banking systems in Sweden or Finland (Halvorsen et al 1996);
- the lack of a strong system of private industrial ownership (Bøhren and Ødegaard 2001, 2002, Dagens Næringsliv Oktober 13th 2005, Herstad 2005)
- weak markets for 'venture capital' (Baygan 2002).

[14] In the cases of Statoil, Hydro and Telenor state holdings are divided between different holding actors, in particular different ministries and the public pension fund Folketrygdfondet.
[15] DNB and Gjensidige NOR merged in 2003, reducing the public holding in the merged company to 34 %.

These characteristics are reflected in data on ownership as e.g. the relationship between few large blocks of concentrated, private ownership, and high levels of state and foreign portfolio ownership on Oslo Stock Exchange (see table 4, and Herstad 2005:89-93 for an overview). In both Nordic and European comparison ownership by families, individual capitalists or other industrial actors (cross-ownership) is limited. Last but not least rigidities in external labour markets and a compressed wage formation (Bosch 1997, Soskice 1999) have traditionally relied on distinctively *internal learning strategies* – in-house accumulation of competencies - rather than *external learning strategies* – sourcing of competencies in labour markets according to need. This has supported knowledge specialisation within individuals firms, but also nurtured conservatism and strong path dependencies (Bosch 1997)

There are few economies in the world that are so clearly specialised, and it is plausible to argue that low measured private sector R&D investments at least in part is a reflection of the contrast between on the one hand a very large number of small firms in sectors that inevitably will invest comparatively smaller proportions of turnover or profits in R&D, and on the other the unique position of Norway as a large exporter of a standardised product that, contrary to the normal situation for such products, is sold without additional investments in product diversification (incremental product innovations) and marketing and at high world market prices (e.g. crude and natural gas).

It is further important to keep in mind that whereas Norwegian GERD is below EU averages, R&D investments per capita is significantly above both EU15 and EU25 averages[16]. The same applies to number of R&D personnel pr. 1000 employed. On the other hand, business enterprise R&D personnel relative to total industry employment show below-EU25 average values.

Employment in medium high-tech or high-tech industries is approximately 60 per cent of EU average for the whole period, hence in part explaining lower-than-average scores on business R&D personnel. The number of science and engineering graduates is below EU15 average, whereas available data indicate a clear strength on lifelong learning. Not surprisingly large firms show the highest degree of co-operation with public research. Large firms operating with dedicated R&D departments have a larger capacity to absorb academic knowledge, and will hence more easily co-operate with academic institutions. This can be expected to reflect in the specialisation of the latter and thus, given the character of the Norwegian large firm tier, contribute to isolating the SME tier from university or research institute interaction (se below on group a) vs. group b) DOMs)

Sweden

On the whole, Sweden is renowned for a generally skilled and innovative work force. The presence of high-calibre industries and firms serves as a breeding ground for the continued attraction of inward FDI and upgrading of existing operations. The pool of scientists and researchers active in extensive private R&D-facilities, domestic and

[16] foustat.nifustep.no/nifu/index.jsp

foreign-owned, as well as in the academic community, continues to represent a great source of new ideas and opportunities.

Sweden has relatively small industrial research institutes, e.g., to promote technology diffusion to SMEs. The university sector, which is highly dominating in the public R&D effort, displays acknowledged academic strengths as measured by, e.g., scientific publications[17]. Its role in industrial production and regional innovation systems is subject to debate, however. Whereas universities have been meeting growing demands from the government to promote industrial links and favourable societal impacts, its effectiveness in doing so, and also in balancing the strive for scientific progress and education with the cultivation of such links, is unclear.

Individual ownership on the stock exchange diminished gradually relative to institutional ownership from 1945 to the mid-1980s. This was driven by a combination of deepening financial markets, the rise of professional portfolio managers, taxation of wealth, capital gains, and dividends by individuals. From 1989 to 2000, the next phase followed as the share of foreign ownership increased from 7 percent to slightly above 40 percent (Henrekson and Jakobsson, 2003) While part of an international trend, Sweden became one of those countries in which the business sector underwent the most rapid transfer towards foreign ownership. However, a very distinct and enduring feature of the Swedish economy is the large share of both listed and unlisted stock controlled directly or indirectly by the two main bank groups; the so-called Wallenberg sphere through Skandinaviska Enskilda Banken, and Handelsbanken AB (Collin 1998, Collin and Bengtsson 2000) (see table 5). Many well-known Swedish domestic multinationals, including ABB, Electrolux, Atlas Copco, Ericsson, Saab and Volvo have been or remain in control by either one of these groups (see Högfeldt 2004)

[17] Since decades, Sweden has a greater number of scientific publications per capita than all other countries, except for Switzerland, especially in engineering and medical science. Studies of references, on the other hand, indicate a certain weakening impact since the early 1980s relative to countries such as the United States, Denmark and the Netherlands (Andersson, Asplund and Henrekson, 2004).

Table 5: Total market value on Stockholm Stock Exchange (SSE) controlled[18] by Wallenberg or Handelsbanken (SHB), 1986-2000) (Source: Högfeldt 2004)

Year	Value under Wallenberg or SHB control	Market value of SSE (CEIFs excluded)	% of SSE Value under Wallenberg or SHB Control	Personal Investments on SSE by the Wallenbergs and SHB	Personal Investments as % of SSE value	Control/ Capital
1986	214167	405505	47.6	14467	3.2	14.8
1987	188426	402100	42.9	12659	2.9	14.9
1988	284120	566403	46.0	20589	3.3	13.8
1989	378846	701360	48.9	27034	3.5	14.0
1990	275475	504560	50.3	21935	4.0	12.6
1991	294597	516247	53.4	14691	2.7	20.1
1992	310584	505439	56.8	15459	2.8	20.1
1993	561866	831846	62.9	32699	3.7	17.2
1994	560923	964558	54.6	28911	2.8	19.4
1995	702468	1137772	58.1	36073	3.0	19.5
1996	1004736	1743868	54.4	52806	2.9	19.0
1997	1340257	1984227	63.4	66426	3.1	20.2
1998	1341042	2249611	56.6	63944	2.7	21.0
1999	2088542	3644555	55.0	96148	2.5	21.7
2000	1632428	3134973	49.3	69707	2.2	23.4

Although foreign control of domestic industry used to be restricted, production expanded abroad. FDI outflows vastly outweighed inflows until the early 1990s. Following regulatory reforms, and the announcement of Swedish membership in the European Union, inflows increased strongly and, since 1994, have largely been on par with the outflows. In recent years, both have declined, with the outflows again dominating in 2003 and 2004 (Andersson and Friberg, 2005).

As of today, Sweden remains a world performer in R&D expenditure, although there was a decline from 4.3 to 4.0 percent of GDP between 2001 and 2003. Some 75 percent of R&D expenses are conducted by the private sector, which is where the cutbacks have taken place. Furthermore, in 2003, 45 percent of R&D in Sweden was performed by foreign-owned companies, which represents and increase with 4 percentage points since 2001. The strong foreign presence emanates from acquisitions of R&D intensive companies, but also subsequent expansion of these activities (ITPS 2005*b*). The extent to which foreign R&D is driven by advantages of exploiting R&D results in Sweden, and to what extent the motive is rather associated with technology sourcing, is an open question which will deserve strong attention in years to come (Andersson and Friberg, 2005).

Denmark

A distinctive institutional feature of the Danish economy is the role of non-profit private foundations as industrial owners (Steen Thomsen and Rose 2002), accounting for a non-trivial share of even listed stock. For instance, Rose and Mejer (2003) found that such foundations in 1999 controlled approximately 13% of the stock quoted on Copenhagen Stock Exchange, down from 17% in 1996, and that 19 out of 100 largest Danish firms

[18] Sum of firm equity values in firms where Investor (Wallenberg) or Industrivärlden (SHB) is part of the controlling block, i.e. the largest voting block. Note that value controlled therefore is defined broader than actual ownership of stock

have foundations as majority owners. This is very high in international comparison (see table 6). Another distinctive feature is the role of individual or family ownership among stock exchange quoted firms (Thomsen and Pedersen 1995).

Table 6: Foundation majority ownership among 100 largest firms

Denmark	Sweden	Germany	Netherlands	Other Europe	USA	Japan
19	2	5	1	0	0	0

Source: Thomsen (1999).

The latter is not surprising, given that Danish industry is dominated by many small and medium sized companies. Industrial development has been described as based on learning, understood both as companies' ability to absorb new knowledge, and as a result of cooperation between suppliers and customers about product and process development.

However, more formalised R&D activities have increased in recent years, primarily in the private sector, and constitute an increasing share of GDP. Thus R&D based innovation seems to be increasing, at least measured using R&D input as proxy for innovation. Though large companies in the literature are assumed in general to have a larger R&D intensity (R&D related to revenues) than smaller companies, this statement applies mostly within sectors: Large companies are more likely to have R&D departments and formal R&D than smaller companies. For example, the Danish food industry's large companies carry out more formal R&D than the small ones, but the reason for the relatively large and increasing share of total private R&D in Danish food companies is due to a number of large food companies, playing a significant role in the economy. And as will be mentioned also later, a number of R&D intensive companies in for example the pharmaceutical sector have a much higher R&D intensity than the large pharmaceutical companies.

According to the CFA, 2003, companies with more than 1000 employees have a share of private sector's R&D expenditure of between 45-49 per cent between 1993 and 2003 (with the exception of 2001 and 2002, when they had less than 40 per cent) (CFA, 2003). Furthermore, in 2003, nearly half of the R&D expenditure in the private sector was used in 56 companies with more than 1000 employees. Approximately 25 per cent of R&D took place in 180 companies with between 250 and 999 employees, and 2608 companies with less than 250 employees had 25 per cent of the total R&D expenditure.

Companies with less than 50 employees have increased their share of R&D expenditure between 1993 and 2003. A guess might be that the number of small R&D intensive high technology companies or these companies' R&D activities has grown in recent years. These companies include spin offs from large companies and from universities, which to some extent respond to a number of new state- or semi-state financing initiatives (The Growth Fund, for example). Their decreasing share in 2003 compared to the two earlier years, are explained by the CFA, 2003 as related to the outgrowth of some companies from this size category.

Approximately 30 per cent of Danish R&D is carried out in the public sector. Of this research a large and increasing share – 75 per cent in 2003 – is carried out at institutions of higher education, the rest in public research institutions and in private, non-commercial institutions. An increasing share of financing comes from external sources; relatively little, 3 per cent according to CFA, 2003, comes from private companies. An increasing share of R&D is determined by private actors, and the share of R&D in natural, technical, agricultural and veterinary and health sciences increasing, since little R&D within social science and humanities is carried out in the private sector. (Organisational changes, new marketing strategies etc. are rarely reported as based on company research.) The High Technology Fund and The Basic Research Fund are such examples (see annex 1), as well as some of the strategic initiatives within ITC, biotechnology and nanotechnology. R&D activities have increased, primarily as a consequence of increasing R&D in the private sector which has increased and now constitutes about 70 per cent of total R&D compared to a share of 57 per cent in 1995.

With regard to the industrial distribution of R&D between sectors, an increasing share of R&D expenditure goes to services and to the financial sector, and there has been a decrease in the share of R&D expenditure in the manufacturing sector. Changes take place also in the manufacturing sector. *An increasing share of R&D in the manufacturing sector goes into pharmaceutical R&D and into the food and beverage industry.* This can be compared to an increase in the chemical industry's (to which the pharmaceutical industry belongs) revenue, constituting app. 8 per cent of the industry's revenues in 1993 but over 10 per cent in 2004. In comparison the food, beverage and tobacco industries had over 30 per cent of industry revenues in 1993 but only 26 per cent in 2004.

An important counterweight to the relatively low R&D intensity in the Danish set-up is the high unemployment compensation and flexible labour market. The financial system has been developed with several institutions for getting financial resources for knowledge based entrepreneurs.

The increasing share of external sources financing the R&D in the public sector points in the direction of an emphasis on industrially applicable R&D. The main share of external sources go to natural science, technical sciences, health sciences and agricultural and veterinary sciences, thus to areas in which the technical innovative industry may most directly benefit from it.

Finland

The business sector in Finland can be considered rather concentrated seen from an international perspective, as large domestic multinational enterprises play a significant role in the national economy. The total number of enterprises in Finland has been on the increase since 1995 and currently there are more companies than ever before. The majority of companies (around 99.8 per cent in 2004) are classified as small and medium sized enterprises — employing less than 250 employees in 2004. The concentration of business activity comes from the fact that the 159 largest companies by

turnover stood for 41 per cent of the total turnover of the enterprise sector in 2002 (Oksanen & Kutinlahti *Annual Innovation Policy Trends and Appraisal Report Finland 2004-2005*).

The Finnish economy is dominated by three industrial cornerstones; information and communication technology, forest and engineering industries. In addition, a handful of large and increasingly multinational companies within these fields stand for a lion's share of R&D expenditures and export to name just a few indicators.

In fact Nokia Corporation alone covers a significant share of industry R&D expenditure and export in Finland. Nokia's size and global market position in telecommunication and mobile phones make it a unique player in the Finnish innovation system; Nokia's share was 32% of the total R&D expenditure and just under one-half of all private sector R&D in 2004. According to an estimate (Ali-Yrkkö and Hermans, 2002) excluding Nokia's share of total R&D expenditure would have decreased Finland's R&D intensity by one percentage point to 2.4 per cent at that time.

In international comparison, Finland is third in the world after Sweden and Israel in R&D expenditures in terms of percentage of GDP, with total R&D expenditure amounting to about 3.52 per cent of GDP in 2005 (Statistics Finland estimate). Most of this work, close to 70 per cent, is nowadays carried out by businesses.

Iceland

The industrial system in Iceland has been going through rapid changes in the past years. During the last decade of the 20th century, the Icelandic economy moved from being “a closed populistic economy to an open market economy” (Jónsson, 2005: 181). Per capita income has risen from being 10% higher than the OECD average in 1995 to being approximately 20% higher in 2003.

The main factors influencing this development are changes in the fisheries in the 80’s and early 90’s, Iceland’s entrance into EEA in 1992 and the privatisation of the state banks that started in 1998. Since the change of the century, a handful of enterprises have become fully-fledged participants in the international market, with considerable investment abroad. This is reflected in a huge increase in FDI outwards flow in the last years. Between 2003 and 2004 the FDI flow abroad increased sevenfold, from 370 million dollars to 2 594 million dollars.

The change is even more dramatic when looking further back. A decade ago the outward FDI flow only averaged 11 million dollars a year (UNCTAD, 2005). Excluding the fisheries that have had subsidiaries abroad for decades, the internationalisation of Icelandic enterprises is thus very recent and little is yet known of its long-term effects.

The Icelandic economy is characterised by dense networks of cross ownership, with the three main banks in positions very similar to those held by SEB and Handelsbanken AB in Sweden. In particular we note that there appear to be a pattern of banks such as Islandsbanki in combined roles as both creditors to and large owners of large, Icelandic

firms. This indicates that Icelandic DOMs are backed by committed, patient capital when internationalising, and can be in direct dialogue with owners throughout this process.

At present the Icelandic economy is under great impact from greenfield investments in aluminium production in Iceland and large public investments in power stations providing the aluminium industry with electricity. Partly due to these projects, the recent average GDP-growth in Iceland is well over the EU-25 average of 0, 9%. The average is expected to be around 5% for the years 2004-2006. Unemployment is low, and expected to be 1-2% in 2006. There has been considerable inflation pressure, with rising price levels and wages. In order to restrain inflation the Central Bank of Iceland has kept the interest rates high which have led to an increase in capital inflow, especially because foreign investors have seen Icelandic bonds with the high interest rate as profitable investment. Furthermore, the national currency's exchange rate is high resulting in decreasing value of exports. Historically, the labour participation rate in Iceland has been high, with long working-hours, high participation of women and late retirement (around the age of 70).

In the past years, much effort has been made in broadening and differentiating the industry base traditionally dependent on the fisheries. Although it is still somewhat narrow, these efforts have proven to be successful, which can be seen in the declining importance of the fisheries that currently account for only 10% of the GDP. Private services are the most important industry sector, accounting for one fourth of the GDP (European Trend Chart on Innovation 2005).

In general there is a strong entrepreneurial spirit in Iceland. One out of nine Icelanders is entrepreneurially active, which is the highest proportion in Europe according to the Global Entrepreneurship Monitor (GEM). Entrepreneurship and rapid decision-making is encouraged by comparatively little bureaucracy and accessibility to key people. Furthermore, the Icelandic NIS is considered transparent and interconnected with close informal ties between different actors. As a nation of "do-ers" ideas or often quickly put into action, albeit sometimes without the necessary preparation or knowledge of management and marketing (Finnbjörnsson and Verbeek 2005; Hansson et al. 2002).

There has been a noteworthy increase in public and private expenditure on research and development in the last decade in Iceland, especially since the establishment of a new Science and Technology Policy Council in 2003, with representation from five ministers. Since 2002, Iceland's GERD has amounted to around 3% of GDP putting it in the fourth place of OECD countries in total R&D expenditures as a share of GDP. *However, it is important to note that a considerable share of the increase can be traced to one single company deCode Genetics (in biopharmaceuticals*). Of European countries, the number of R&D personnel per 1000 is only higher in Finland. Despite this, Iceland is still lagging behind in the number of science and engineering graduates, only reaching 80% of the EU25 average. Participation in life-long learning is among the highest in Europe (ETCI 2005).

The fishing, agriculture and energy sector have been reducing their share in GERD in the last 25 years, from being responsible for half of all R&D expenditures in 1977 to

only 16.3% in 2003. At the same time R&D expenditures in the health sectors grew from being 4% of the whole lot in 1977 to accounting for one third. In a policy paper covering main policy issues for 2004-2007, The Ministries of Industry and Commerce stresses increased support for R&D and innovation (Meginstefnumið iðnaðar- og viðskiptaráðherra árin 2004-2007). As an example of measures taken in the last years is a simplification of tax rules and lowering of tax percentages. Furthermore, Iceland has recently become a member of the European Patent Convention (EPC) (ibid). There has, however, very little systematic research been done to support policy making in the field. This also applies to globalisation of the Icelandic economy in general. It has also been noted that Iceland still lacks a policy for high-tech innovation (Hardarson, 2003: 43).

5. Corporate internationalisation: Descriptive statistics and literature reviews[19]

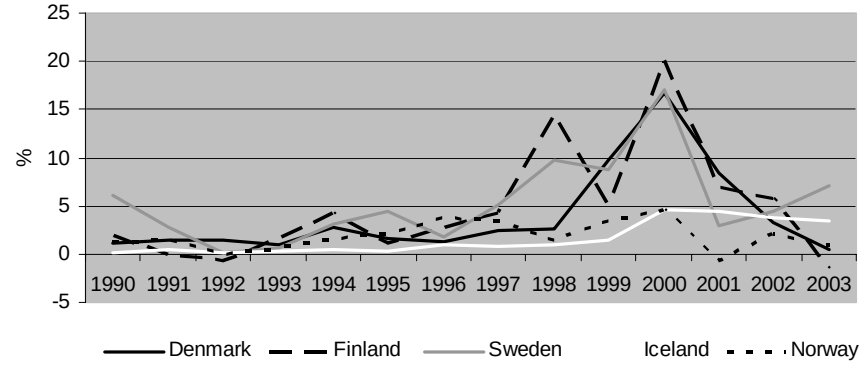
In the following we provide descriptive statistics on outward FDI from the Nordic countries. This is based on data directly available from the different national banks, and sources such UNCTAD or OECD. Based on Community innovation survey data we also provide descriptive data on the character of domestic multinational corporations (see Ebersberger, 2006 for technical details). We then for each of the Nordic countries provide data on outward FDI by sector, linked to the main findings of previous research on corporate internationalisation from the respective economies.

Outward FDI and domestic multinational in a Nordic perspective

FDI as a percentage of GDP has gradually increased in every Nordic Country since 1995. A clear upturn can be observed in 2000-2001 for the Scandinavian countries, followed by a consequent decline. Icelandic FDI makes a similar jump, but stays fairly stable at a new, high level. It should be noted that the Nordic economies are small, and therefore single large investment may be seen as a peak in statistics. It should also be noted that the period in question cover the ICT market capitalisation boom and consequent burst. These figures should be interpreted with caution, keeping both small size of economies and financial market situation in mind (Rilla and Oksanen (red) 2006).

[19] The mapping statistics in this chapter, including comments and analysis, is taken from Rilla and Oksanen (red) (2006), and is thus based on individual country team contributions. The literature review presented in this chapter is taken from Friberg (red) (2006); again based on country team contributions. The CIS data analysis presented is taken from Ebersberger (2006).

Figure 4: Outward foreign direct investment[20] as percentage of GDP in the Nordic Countries 1990-2003.



Source: Unctad

In the case of Finland outward investments have exceeded incoming investments most strikingly during the past ten years. Denmark has attracted more inward investments than outward investments over 1995-2004 while Norwegian in- and outward investments have stayed nearly in balance. The Icelandic net outflow in the period is high in comparison to the size of the economy.

[20] FDI outflows comprise capital provided (either directly or through other related enterprises) by a foreign direct investor to a FDI enterprise, or capital received by a foreign direct investor from a FDI enterprise. FDI includes the three following components: equity capital, reinvested earnings and intra-company loans. 1) Equity capital is the foreign direct investor's purchase of shares of an enterprise in a country other than that of its residence; 2) Reinvested earnings comprise the direct investor's share (in proportion to direct equity participation) of earnings not distributed as dividends by affiliates or earnings not remitted to the direct investor. Such retained profits by affiliates are reinvested, and 3) Intra-company loans or intra-company debt transactions refer to short- or long-term borrowing and lending of funds between direct investors (parent enterprises) and affiliate enterprises.
Data on FDI flows are presented on net bases (capital transactions' credits less debits between direct investors and their foreign affiliates). Net decreases in assets or net increases in liabilities are recorded as credits (with a positive sign), while net increases in assets or net decreases in liabilities are recorded as debits (with a negative sign). Hence, FDI flows with a negative sign indicate that at least one of the three components of FDI is negative and not offset by positive amounts of the remaining components. These are called reverse investment or disinvestment. (http://stats.unctad.org/FDI/TableViewer/summary.aspx)

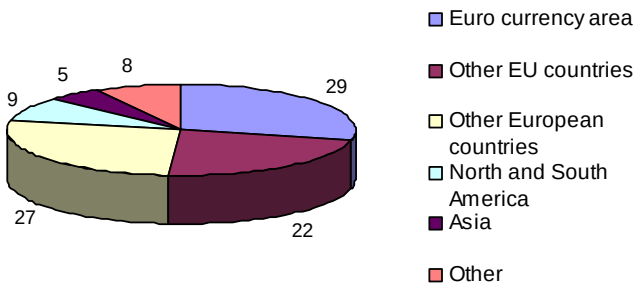
Table 7: Cumulative FDI flows in selected OECD countries 1995-2004.

	Net outflows (USD billion)
Denmark	-10,4
Iceland	2,5
Finland	22,6
Norway	0,5
Sweden	8,1

Source: OECD

Figure 5 shows that the geographical destination of Danish outward FDI predominantly is other European countries. The major share of investments in developing countries are going to a limited number of countries, to China, Hong Kong, Brazil, Mexico and Singapore (UNCTAD 2005: 7), and the increase in developing world FDI is mainly related to an increase in China. In the Danish Confederation of Industries' (DI) survey (2003), it is found that more than half of the most important production in the 49 most important production facilities abroad are located in high income countries (DI 2003: 38). The overall picture, as DI also notes, is however a clear indication that other factors than production costs are the prime centrifugal forces (Rilla and Oksanen (red) 2006).

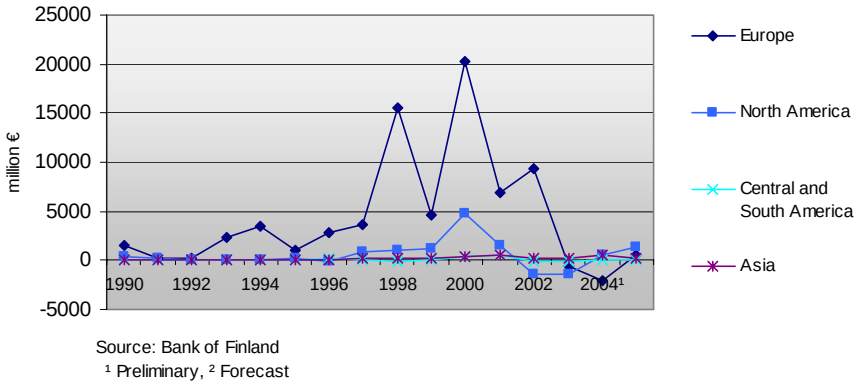
Figure 5: FDI flows abroad by geographical destination 2003 in percentage, Denmark.



Source: Danish National Bank, 2004

Finnish outward FDI is similarly oriented towards Europe and North America. The Bank of Finland's estimated FDI net flow figures in 2005 indicate that large share of Finnish investments are going to the Netherlands and Sweden, as has been already over the past years. Increasing part of investments is heading to Asia, China in particular but capital flows to Asia are still fairly modest.

Figure 6: Direct investment net capital outflow by geographical region 1990-2005 in million Euro, Finland.

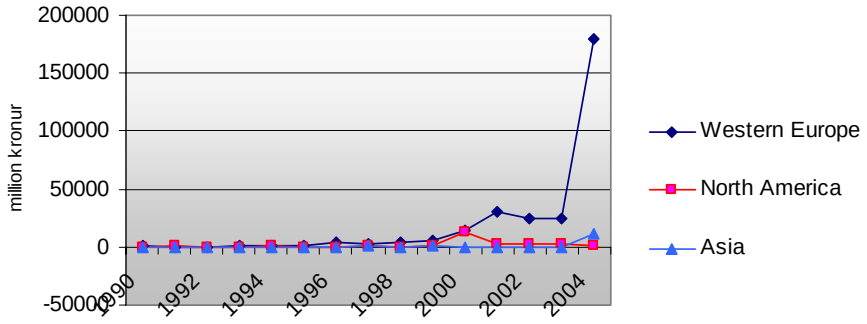


Source: Bank of Finland
¹ Preliminary, ² Forecast

The peak in Finnish outward investments in Europe and North America in 2001 is most likely caused by a limited number of large acquisitions, for instance the Stora Enso EUR 4, 9 million acquisitions of American Consolidated Papers.

The outward FDI in Iceland have clearly increased in 2000s and most of the capital is invested in Western Europe (Figure 4). According statistics from Central Bank of Iceland (December 2005), the most important destination for Icelandic foreign investments is Denmark, constituting approximately half of outgoing investments in 2004. The UK is another important target economy for Icelandic FDI. Investments to Asia have increased considerably in 2004 compared to previous years, but are moderate in comparison to European investments. The Icelandic investments to Denmark have primarily occurred in the service sector – one of the largest deals in 2004 being acquisition of one of the most famous department stores in Denmark.

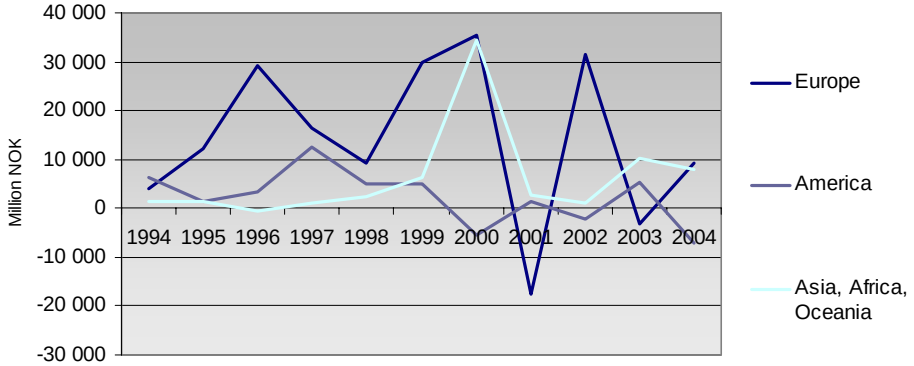
Figure 7: FDI abroad in net flows by geographical destination 1990-2004 in million kronur, Iceland.



Source: Central Bank of Iceland

Norwegian and Swedish enterprises also predominantly invest in Europe, as Figures 5 and 6 below indicate. Among the European countries, neighbouring country Sweden and the United Kingdom have received the largest share of Norwegian FDI over the past years. Investments to Asia, Africa and Oceania have been stronger than investments in the US since the beginning of 2000 (figure 8). The 2001 peak and 2002 drop in Asian investments are to a large extent explained by FDI to e.g. Thailand, Malaysia, Bangladesh, Singapore and Hong Kong by Norwegian state-controlled DOM Telenor (see Aftenposten September 8th, 2000[21])

Figure 8: FDI net flow by selected countries 1994-2004 in million NOK, Norway.

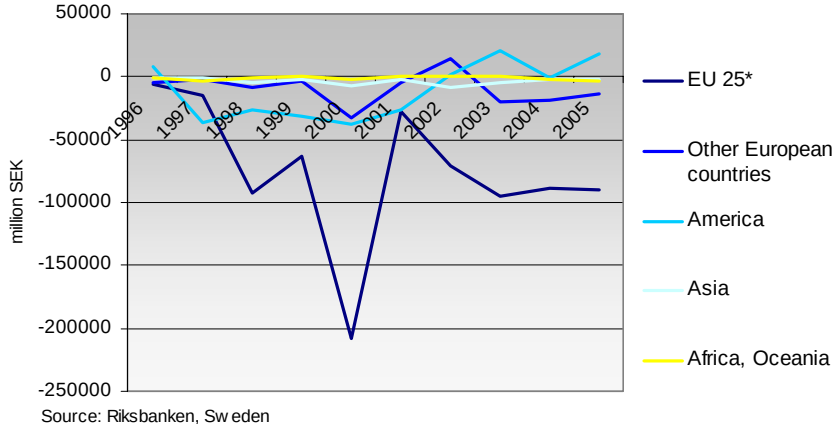


Source: Norges Bank

[21] Telenors tigerbrøl, by Roar Valderhaug

The single most important destination country for Swedish FDI in 2005 was the United Kingdom, while other important countries the same year include Switzerland, Denmark and Norway. The US has also been important investment destination for Sweden over the years. Figure 9 shows how production in Sweden has increasingly been expanding abroad, peaking in 2000, followed by a global economic slump when the information technology bubble burst, plunging FDI expansion down to a minimum in 2001. This can be reflected in the global inward FDI flows that went down 41 % in that same year.

Figure 9: Swedish direct investments abroad by geographical destination, net flows in million SEK[22] 1996-2005



Source: Riksbanken, Sweden

Note: *For practical reasons, even in earlier periods this item represents the total for the present EU member states.

There are some indications of an increasing emphasis on Asian countries in general and China in particular, as destination of FDI. However, at present the picture remains where FDI predominantly take the form of acquisitions in other European countries. Again we find a clear indication that basic input costs are not the prime divers of corporate internationalisation.

Internationalisation of strategic functions

Data on the internationalisation of R&D is limited, and to the extent such exist this is only rarely comparable between countries. A comparable indicator can be constructed based on patenting data. Table 8 refers to the internationalisation of technology

[22] A negative sign denotes a net outflow (Swedish investments abroad exceed Swedish disinvestments abroad) while a positive sign (inflow) represents net Swedish disinvestment abroad. Figures for a particular country may have to be omitted for reasons of secrecy. As of October 1997 the concept of direct investment includes short-term loan transactions between direct investment companies; for earlier periods these transactions are included in Balance of Payments under item "Other investment".

measured by cross-border ownership of *inventions*[23] in the Nordic Countries. Patents give relevant information on countries' technological performance, and are used in several studies concerning internationalisation of research and development. Activities of MNEs are increasingly leading to cross-border ownership of patents: the patent application is made by MNE whereas the actual inventors are employees of foreign subsidiary (OECD 2005, 134).

Table 8: Cross-border ownership of inventions 1999-2001[24].

	Foreign ownership of domestic inventions[25]	Domestic ownership of inventions made abroad[26]
Denmark	23,3	15,9
Finland	8,8	24,4
Iceland	48,2	27,5
Norway	23,6	19,3
Sweden	18,2	27,4
OECD average	14,6	15,0
EU15	11,3	7,6
United States	12,1	17,3

Source: OECD

All Nordic economies have above EU15 average scores on both domestic ownership of patents abroad, and on foreign ownership of domestic patents. Thus, in general the national innovation systems of the Nordic economies appear to have strong, international linkages. The Swedish, Finnish and Icelandic economies emerge as particularly strong performers with respect to domestic ownership of inventions abroad; and it is particularly interesting to note that the strength of the two former economies in developing DOMs appear to show as an asymmetrical relationship between foreign ownership of domestic innovations (well-below EU15 and OECD average in Finland) and domestic ownership of patents abroad (well-above the same averages).

There are few thorough comparative Nordic studies of corporate internationalisation from the firm level perspective, an important exception being Benito et al (2002) and their study of Danish, Finnish and Norwegian large-firm internationalisation patterns. Their main finding is striking; strategic functions remain home-base oriented and only one corporation in the sample is identified as having moved its corporate HQ abroad[27].

[23] The definitions of inventions and innovations differ in that only the latter require successful commercialisation of a new technology.
[24] Priority years.
[25] Share of patent applications to the European Patent Office (EPO) owned by foreign residents in total patents invented domestically.
[26] Share of patent applications to the EPO invented abroad in total patents owned by country residents.
[27] Former Kvaerner, during the international expansion under former CEO Erik Tønseth. Kvaerner is now part of the Aker Group, and headquartered in Oslo.

The ten largest Norwegian DOMs do however show higher degrees of internationalisation than the largest DOMs from Denmark and Finland when measured as share of *division* HQs abroad and share of R&D abroad; but lower degrees of internationalisation of equity. The latter is not surprising, given on the one hand the role of foreign equity in the Finnish economy and on the other hand take-over blocking state ownership in Norwegian DOMs.

The degree of internationalisation of equity is also found to be low in Denmark. This is neither surprising given the role of individual ownership and foundation ownership in the Danish economy. Thus, Benito et al (2002) conclude that while 'operations' are increasingly internationalised, firm strategic resources remain embedded in their respective home countries. Note that this strengthens the argument that home-base system of corporate governance continue to influence firms even after extensive internationalisation.

Additional evidence from Sweden however suggests that while 7-8 percent of Sweden's 250 largest firms had their HQs abroad at the start of the decade, by 2000 the ratio had increased to close to 30 percent (NUTEK, 2000). Foreign-owned companies accounted for the bulk of the outflow (Oksanen and Rilla (red) 2006).

The character of domestic multinational enterprises

Having provided a broad descriptive country overview of FDI we then turn the focus towards describing domestic multinational enterprises from the Nordic economies. Within the different ownership groups we distinguish between all companies and innovation active companies. Innovation active companies are companies which have reported the successful introduction of a product innovation or a process innovation. Companies are also regarded as innovating if they reported an abandoned or an ongoing innovation project. The distribution of the different company ownership types in the country sample of all companies and in the country sample of all innovation active companies is given in table 9 below. It shows the distribution of ownership types to be rather comparable between the total sample in the analysis and the sub-sample of innovation active companies. The table also suggest that the Finnish data set contains more domestic multi-nationals than each of the other Nordic country's data sets, i.e. as 11% of the total sample is DOMs. This can of course be interpreted as a partial explanation for the comparably high Finnish score on domestic ownership of innovation abroad. In general the table shows that whereas DOMs account for only 2-5% of the total company sample, except from in Finland, they are overrepresented in the group of innovative companies.

Table 9: Distribution of CIS analysis sample (source: Ebersberger 2006)

Ownership class	*Denmark*		*Finland*		*Iceland*		*Norway*		*Sweden*	
	Total	*Innov*	*Total*	*Innov*	*Total*	*Innov*	*Total*	*Innov*	*Total*	*Innov*
DU	68%	64%	66%	59%	73%	68%	67%	67%	63%	55%
DM	6%	10%	11%	18%	2%	4%	2%	5%	5%	9%
NO	10%	10%	9%	9%	7%	7%	10%	10%	12%	12%
Other FO	17%	17%	14%	14%	18%	21%	21%	19%	20%	23%
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Note: Composition of the total data set is given in the column 'total'. 'Innov' indicates the sub-sample of innovating companies

Table 10 gives the mean size of the company types in the sample, and shows that multinationals are substantially larger than all other company groups. *Taken together these two findings indicate that they play major roles in their respective national innovation systems.*

Table 10: Size and sales of company groups (source: Ebersberger 2006)

	Denmark		*Finland*		*Iceland*		*Norway*		*Sweden*	
	Size	*Sales*	*Size*	*Sales*	*Size*	*Sales*	*Size*	*Sales*	*Size*	*Sales*
DU	292	9.9	316	9.4	75	8.8	149	11.4	276	11.4
DM	1975	11.2	1835	11.3	181	10.1	406	12.4	1 277	13.2
NO	187	10.0	165	9.5	55	8.8	206	11.8	304	12.1

Note: The table reports the averages of the firm characteristics size and sales. Size is measured by employment. Sales, labor productivity, exports and investments in tangible goods are given in logs

Table 11 show labour productivity and exports for the different ownership groups. We in particular emphasise that subsidiaries of DOMs for all Nordic countries show substantially higher export shares than do both subsidiaries of corporations from other Nordic countries, and subsidiaries of uninational corporate groups. This could be interpreted in part as an outcome of these subsidiaries being better linked to international operations set up for the purpose of supporting such exports. In an essence it means that the multinational companies (DOMs) and their subsidiaries (NOs) are not only multinational in terms of ownership (i.e. formally) but also pursue multinational operations (i.e. functionally).

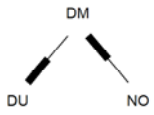
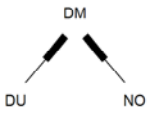
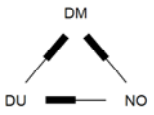
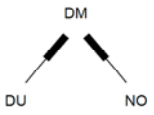
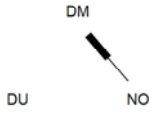
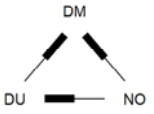
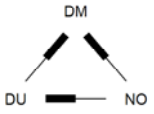
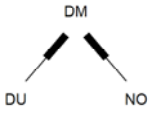
Table 11: Productivity and exports (source: Ebersberger 2006)

	Denmark		*Finland*		*Iceland*		*Norway*		*Sweden*	
	Lp	*Exp*	*Lp*	*Exp*	*Lp*	*Exp*	*Lp*	*Exp*	*Lp*	*Exp*
DU	5.18	1.03	4.85	2.27	5.09	0.90	7.22	2.57	5.01	1.87
DM	4.97	1.77	5.25	4.06	4.94	2.44	7.42	6.13	5.17	3.62
NO	5.33	1.51	5.12	3.06	5.28	2.98	7.43	2.81	5.32	3.06

Note: Labor productivity (Lp) is sales per employee in 1000 Euro (Norway: Norwegian crowns) displayed as logarithms. Exports (Exp) are exports per employee in 1000 Euro (Norway: Norwegian crowns). As the labor productivity the exports are also be displayed in logs.

In table 12 statistically significant differences between ownership groups with respect to innovation investments and the use of public funding are indicated by lines where the thick end points towards the group showing the highest values. No lines indicate that there are no significant differences. The data uses relevant control variables such as company size and sector (see Ebersberger 2006 for technical details). It shows that multinationals in all Nordic countries (Iceland not included for technical reasons) invest significantly more in innovation than do both other company groups. For all countries except Denmark we also find that they use domestic public innovation funding to a significantly larger extent than both other groups; in Denmark the difference is only significant compared to subsidiaries of corporations from other Nordic countries.

Table 12: Innovation investments and public funding (source: Ebersberger 2006)

	Denmark	*Finland*	*Norway*	*Sweden*
Innovation investment				
Public funding				

Source: Estimations from Ebersberger and Lööf (2005a, 2005b, 2005c) and Ebersberger, Lööf and Oksanen (2005) and own computations.

We also, importantly, note that either we find no difference between subsidiaries of uninational corporate groups and subsidiaries of corporate groups from other Nordic

countries; or the difference is as in the cases of Finland and Norway in favour of domestic uninationals. This provides a certain indication that the public funding element of national innovation systems are of minor importance as motive for incoming FDI.

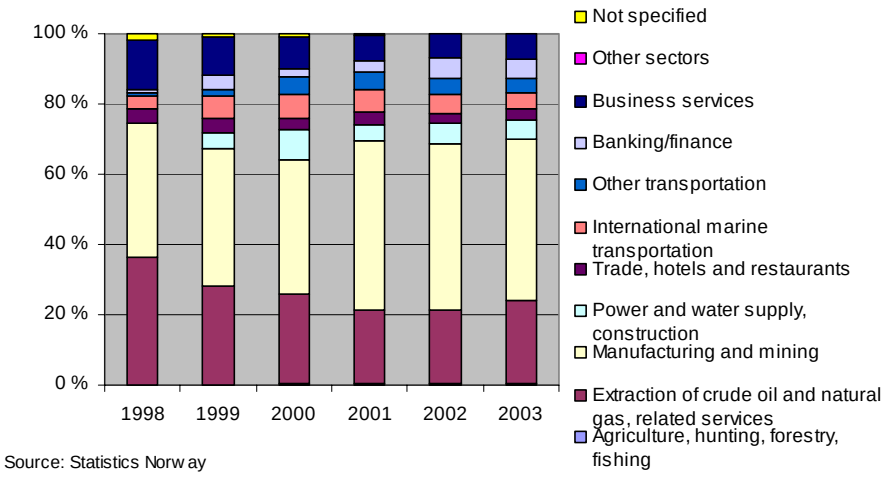
Norway

Selfors (1999) found that internationalized Norwegian manufacturing firms on average are far more R&D intensive than uninational firms, but remain distinctively focused on home-base R&D: While 75 per cent of the turnover in the sample stemmed from markets abroad, only 30 per cent of corporate R&D is identified as conducted in foreign subsidiaries.

Narula (2002) is based on a sample of the 35 largest Norwegian DOMs, and uses the OLI reasoning to distinguish between a) companies building on NIS strengths, such as natural resource based companies (Hydro, Statoil) or former state monopoly companies i.e. Telenor), and b) companies trying to escape NIS limitations, namely smaller companies oriented more towards emerging technologies. Approximately half of the companies are found in each group. Narula (2002) finds that Norwegian firms in what is identified as group a) above tend to concentrate R&D at home as a result of existing IS embeddedness and a relatively good 'fit' between SI specialisation and group a) product markets. Only 5 per cent of corporate R&D staff is in this group located abroad. Inertia is also observed for group b) firms, but this is arguably not so much the result of existing lock-in to national IS as the result of the difficulties inherent in identifying and establishing linkages to sources of relevant competencies abroad, and thus escapes the limitations of this system as identified above. Hence, group b) firms also tend to keep R&D functions at home, but less so as 29 per cent of group b) research staff is located abroad. Even in absolute terms this group has almost three times as many R&D employees abroad as group a) firms. These differences are particularly striking as group a) firms on average are several times larger than group b) firms, and as group b) firms only account for 10 per cent of the sample turnover.

Figure 10 illustrate the stock of Norwegian outward FDI, by sector. The two dominant sectors are extraction of crude oil and natural gas, and manufacturing and mining. The reason for a strong performance in the former is obvious, whereas an important explanation for the strength in the latter is found in the activities of a few large Norwegian DOMs such as Norske Skog (pulp and paper), the large non-petroleum related activities of Norsk Hydro (aluminium, fertilizers) and the Aker Group (now including former Kvaerner). The share of FDI in business services has decreased during the period 1998-2003.

Figure 10: Outward FDI by sector, stock. 1998-2003 in Norway.



Source: Statistics Norway

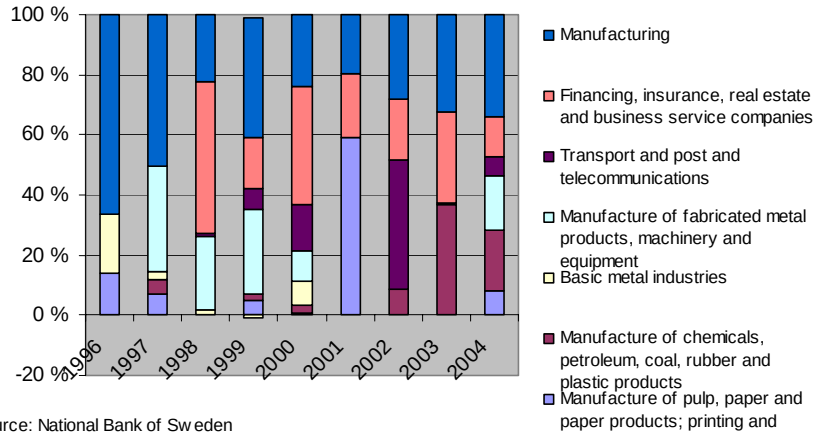
The DOMUS desktop study (Friberg (red) 2006) showed that implications of corporate internationalisation for industrial development in general, and the innovation system in particular, are unresolved in existing research. Middelfart and Heum (2002) point out that '*…of vital importance in the longer run is what dynamic processes foreign presence induces in domestic industry'* (ibid: 149). They do not, however, provide any empirical evidence on such dynamic processes. Neither do they provide any theoretical arguments concerning what they are or tools for analysing them, apart from indicating that a part of this picture is localisation decisions concerning R&D. Narula (2002:813-814) is neither particularly clear on the implications of 'inertia' in R&D location in group a) firms, nor on the implications of group b) attempts at internationalising R&D.

Sweden

MNEs today represent 10 per cent of all companies in Sweden, but make out as much as 90 per cent of the R&D divided equally between Foreign-owned and Domestic Enterprises. Half of all R&D carried out by Swedish MNEs is carried out abroad. Only the Netherlands internationalised R&D (ITPS 2003) to the same extent, and in Swedish companies a notable shift has occurred as 81 percent of their purchased R&D came from abroad in 2003. Most of this was undertaken within the company group, which represents an increase by 10 percent as compared to 2001 (SCB 2003; 2004).

Figure 11 below shows the sectoral composition of Swedish outward FDI for the years 1998-2004. The general picture is not surprising, given the contribution of the manufacturing sector to BERD identified above. (Note that since Swedish FDI by sector division is presented in capital flow not as stock value, year-to-year fluctuations resulting from individual, large acquisitions will be larger than in stock data).

Figure 11: Outward FDI flows by sector as percentage of total outward FDI 1996-2004 in Sweden.



Source: National Bank of Sweden

The relationship between expansion of production abroad and activities at home has been examined in a number of studies. Early work, such as Swedenborg (1982) concluded on complementary effects, notably as the setup of production units in foreign countries led to the expansion of exports from home and thus strengthened home operations as well. This relationship tended to dominate until the early 1980s. At this time, outward FDI further expanded whereas costs and conditions for investment worsened in Sweden. Svensson (1993) found that exports from foreign affiliates started to replace exports from home, which eventually led to substitution effects. The observed changes over time in the relationship between expansion abroad and firm activity at home pointed to the significant of changing economic conditions in different countries, along with the importance of changes in firm strategies.

In contrast to production, R&D facilities in the MNEs have not only kept up but also expanded further in Sweden. The future viability of research does however require consideration. In particular, questions have been raised concerning the extent to which R&D can evolve strongly if production continues to move out, cf. the discussion on where the long-term line between operations and strategic functions is located. Andersson (1998) examined the presence of driving forces towards complementarity versus substitution between foreign and domestic R&D activities, and found evidence of both kinds of effects among Swedish MNEs.

Existing research emphasise that HQs are of particular interest as they are strategically important and often include R&D. As for factors determining the location of HQs, reliable regulatory regimes, transparency, access to management support, proximity to political decisions and to financial services, customers and suppliers, information density, wages and general economic conditions, are all argued to be important. Taxes,

notably conditions for transfer pricing and personal tax rates[28], geographical distance and efficient communications, followed by proximity to customers and attractive regulatory regimes, have been rated greatly important in the case of HQ localisation decisions (Braunerhjelm 2003; ISA, 2001). This holds true both for the group HQ and at the sub-unit HQ level. Some studies identified foreign ownership, international activity (e.g. employees abroad), income taxes, and the importance of foreign customers to exert a significant influence on HQ re-localisation (Birkinshaw et al., 2003). In the case of Sweden, EU membership also exerted a significant influence in recent years. Proximity to R&D matters especially for technology-intensive firms whereas that factor appears unimportant for service-oriented companies.

In the case where HQs moved from Sweden, Hanson (2004) found notably infrastructure and income taxes to exert a significant influence on the choice of location. Special considerations are needed for examining the determinants of HQ location. Norgren (1995) noted that the share of foreign R&D which aims to develop new products and processes, rather than adapt to existing ones, increased from 25 to 60 percent between 1980 and 1990.

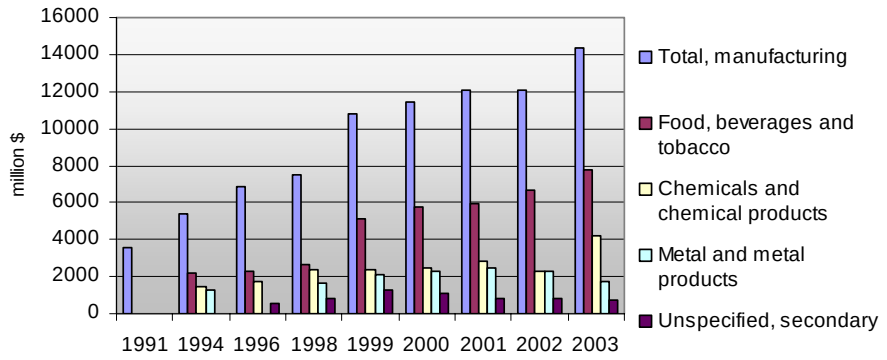
Denmark

Danish multinational companies with international activities are not new phenomena. Since especially the late 1800s, Denmark has had a number of multinationals with affiliates abroad, all having developed into large industries within their field: F.L. Cement company, the East Asiatic Company trading and shipping company, The Great Northern Telegraph Company, A.P Møller Shipping and from the 1960s also oil, retail etc.

The FDI stocks of Danish companies have increased in all sectors in the 1990s and have amounted to 78646 million dollars in 2003. The FDI stocks in the primary sector increased relatively most, but FDI stocks abroad in the primary sector are still very modest. FDI stocks in the tertiary sector, according to UNCTAD (2005), constituted more than 2/3 in 2003 (and also in 1991). But as mentioned elsewhere, some of the industry categorisation may be a little surprising with for example wind mill companies categorised as tertiary sector actors. In 2003 finance constituted more than 3/4 of the FDI stocks in the tertiary sector, and has risen far more than other activities in the sector. In 1991, FDI in finances constituted 43 % of FDI stocks in the tertiary sector. Of these other activities, trade and transport in 2003 constituted 11 and 12 percent, respectively, percentages which in 1991 were 38 and 13.

[28] Taxes on management are particularly important for the location of HQ. Country variation in this respect exerts a distinct influence of ownership nationality on the placing of HQs. In the Swedish case, this is the most important variable for explaining HQ localisation (Strandell and Lööf, 2003).

Figure 12: FDI stocks abroad in manufacturing sector 1991-2003, in million $, Denmark.



Source: Unctad

Note: Data is available only on certain years.

In the manufacturing sector, FDI stocks abroad are dominated by the food, beverage and tobacco sector, which in 2003 constituted more than 50% of FDI stocks (Fig. 9). The second largest is the chemical industry, *including pharmaceuticals*, which constituted 29% of FDI stocks, and third was metal and metal products with 12%. Of these, chemical industry is far the largest regarding R&D, having both the largest R&D intensity and the largest share of R&D in the private sector. Though the food industry has had a large share and increasing share of the private R&D in Denmark, the R&D intensity is relatively low.

More than half of the employment in foreign affiliates is in the EU-15 countries, and only 2% are in Chinese affiliates. Furthermore, 61% of the employment in foreign affiliates is found in the service and transport sector compared to only 28% in manufacturing (Statistics Denmark, 2006). DI, 2003 finds a relative increase of FDI in production compared to sales, though sales activities still dominate the foreign direct investment flows. Both DI, 2003, Statistics Denmark 2006, and Maskell et al., 2005, find increasing investments in R&D activities abroad as well as in Denmark.

The tendency to move strategic activities abroad have been noted to be modest in Denmark so far (Benito et al., 2002). The analysis by the Confederation of Danish Industries organisation, Dansk Industri and the Copenhagen Business School (2003) focuses on the employment consequences of establishing affiliates abroad, and on the organisational changes in the internationalising companies. In the report Danish companies' establishment of affiliates abroad were analysed. According to The Danish Council for Trade and Industry (Danmarks Erhvervsråd) and The Commission for Future Growth (Tænketanken Fremtidens Vækst), the main conclusion is that Denmark does not in general loose jobs as a consequence of internationalisation and that Danish

companies in general become increasingly international with regard to organisation, employment and turnover.

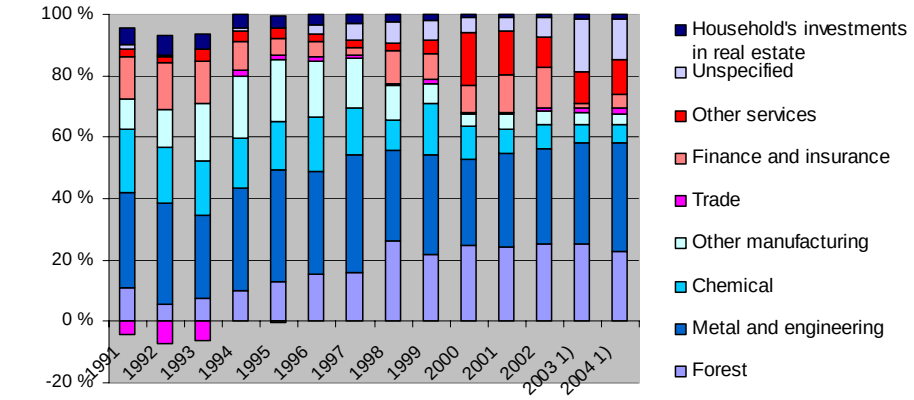
Finland

Finnish companies started to internationalise rather late their activities. This holds true also with firms' R&D activities abroad if compared to markets and productions. Nevertheless, in line with general trend the R&D operations have also internationalised at a growing rate during recent years. (Loivo 2004, 41)

In the past only a few Finnish multinationals have founded R&D and innovation centres abroad through new greenfield investments — Nokia Corporation being the most active one. Foreign R&D centres have often ended up in the hands of Finnish firms through acquisitions of production capacity/markets abroad. Seeing from another angle it seems to be easier for companies to cut down R&D activities abroad than in their country of origin. According to Lovio it is typical for Finnish MNEs to have a Finnish led R&D committee which target, among others, is to profile and organise company's research and development work and R&D co-operation with partners. (Interview with professor Lovio in 22.10.2005)

The metal and engineering industry, which includes Nokia and other electronics companies, has proportionally invested abroad the most since 1991 (Figure 10), not surprisingly followed by the forest industry. In the beginning of 1990s the foreign investments in trade were on a negative side. Reasons for negative values might constitute either of foreign companies' inward investments exceeding Finnish companies' outward investments or domestic companies' foreign divestments, or both. Foreign investments in the forest sector have grown significantly since the late 1990s, in ten years time the outward stock has tripled. The increase is due to opening new plants especially in Latin American countries and foreign acquisitions in industrialised countries. Investments in the chemical industry have though declined during the 21st century. The companies in the Finnish chemical industry have divested their foreign operations in the recent past.

Figure 13: FDI abroad, share of stock by sector[29] 1991-2004 in Finland.



Source: Bank of Finland
1) Preliminary

In his interviews with company representatives Lovio (2004, 52-53) identified altogether five main explanations/reasons for the existence of foreign R&D units of Finnish companies. An R&D unit abroad was seen to:

- Provide support for local marketing and production, and help in solving immediate problems.
- Offer "a tool" for localization of technology (processes and products) in a more demanding sense.
- Assist utilization of foreign expertise.
- Provide a channel for utilization of good R&D resources (on the basis of lower costs, lack of Finnish experts or on the basis of world-leading expertise).
- Strengthening the company's overall presence in the host country (may want to be present in a country that is central to the development of the technology. The Host country may also more or less explicitly to require foreign companies to run R&D facilities alongside of production plants.

Lovio marks that '*…the existence of Finnish companies' R&D units abroad is usually not based only on one but on a combination of the reasons mentioned above'*. Lovio underlines in this context that often there *'is no viable domestic alternative to foreign research. The Evolution of foreign R&D operations is a natural and inevitable consequence of the internationalization of the companies' business and production'*. The data gathered and used within the MEFIS-project show that over 40 per cent of all industrial R&D of the Finnish corporations covered was in recent years (2001-2004) carried out abroad. This figure is according to researchers, however, clearly smaller than the share of foreign based production or marketing activities. Ali-Yrkkö, Lovio and Ylä-

[29] Sector of direct investor.

Anttila (2004, 5) however stresses that *"increasing foreign R&D does not imply the active relocation of R&D units"*. Rather, in several cases it has been an outcome of mergers and acquisitions and reflects a need to have a certain amount of R&D resources close to production and markets.

Palmberg and Pajarinen (2004) have used patenting data of large multinationals to study the internationalisation of R&D of Finnish MNEs. They focus on if and how the phenomenon is reflected in firms' innovating activities at foreign location seen through inventive output. Patenting data is used also to shed light on the nature of the innovating activities of the multinationals at their foreign locations. Palmberg and Pajarinen found that the patenting activity of Finnish MNEs abroad has increased steadily over the period (1980-1999) analysed.

Based on their analysis Palmberg and Pajarinen (2004, 24) comment the theoretical debate about nature of the foreign R&D activities of MNEs — i.e. the extent to which R&D operations abroad are driven by technology exploitation or technology sourcing. They conclude that the mere fact that Finnish multinationals patent at their foreign locations suggests to the dominance of the technology sourcing type. Results show that foreign patents of Finnish multinationals tend to be characterised by broader technological roots to complementary technological fields, and thus be of the more original and home-base augmenting type. The originality indicator applied (Jaffe and Trajtenberg 2002) was significantly higher for patents with first inventor at the foreign affiliations when compared with those with Finnish inventors.

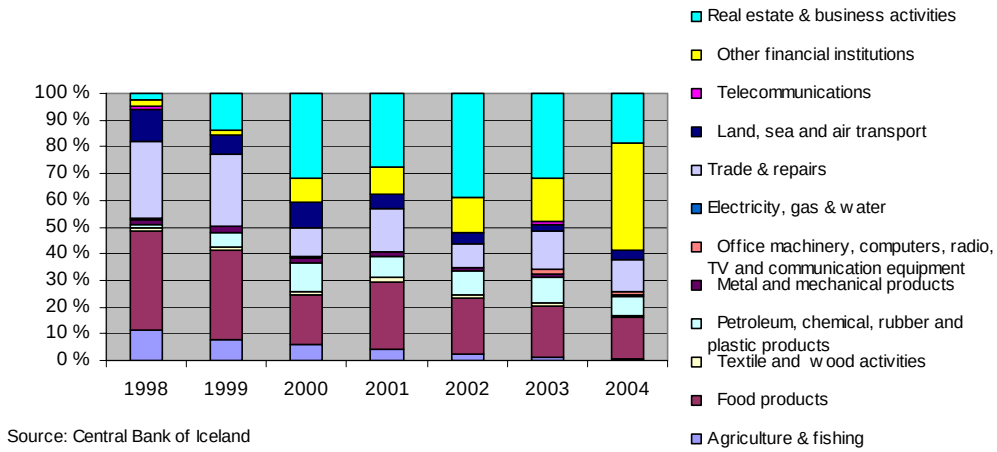
Historically all the significant Finnish industrial clusters have developed thanks to certain few locomotive companies. This concerns not only production but also markets: in numerous cases other companies in cluster/production chain have often followed the locomotive firms in their international expansion. A study including interviews among seven Finnish ICT companies at their China offices convincingly shows that companies are often following (domestic) locomotive firms/customers to abroad. Large customer companies also except today that their partners (i.e. contract manufacturers and subcontractors) are able to provide services around the globe. (Lampinen in Ali-Yrkkö, Lindström et al., 2004)

In recent international comparisons the Finnish innovation system has been praised for extensive networking between different actors and university-industry contacts and co-operation. This is arguably a key channel through which domestic MNEs experience and gathered know-how from abroad may trickle in to the surrounding innovation environment. For instance, Ali-Yrkkö and Hermans (2004, 116-117) point out that Nokia Corporations co-operation with domestic universities and research institutes has provided a platform for diffusion of know-how to various parties. According to the researchers *"…the exchange of information has been mutual, that is, in many projects the know-how has diffused from universities to Nokia and vice versa. The same concerns the partner companies of Nokia. The latest theoretical knowledge has been passed on to Nokia and other companies through universities"*

Iceland

The seafood industry continued to dominate Icelandic outward FDI until the late 1990s. Today tertiary sector industries, in particular finance but also real estate, are the most investment intensive, see figure 14**.** In 1998 these generated only 1171 million kronur in outward foreign investments, an amount that had grown to 143 265 million kronur in 2004.

Figure 14: Outward FDI share of stock by industry 1998-2004 in Iceland.



Source: Central Bank of Iceland

There exists little formal knowledge of the impact of internationalisation of Icelandic DOMs on the NIS. In a recent book Sigfússon and Thorbergsson (2005) build on interviews with executives of six of the largest Icelandic companies, that have in common to hold operations in London, in order to answer questions about the aims of Icelandic enterprises' foreign investment and expansion. The executives mention several impacts they feel internationalisation has had on the domestic scene:

- The knowledge and experience abroad is "nourishment" for domestic activities. *Still there is more to be done to increase the knowledge flow* (ibid: 30).
- In the UK, different units within the company are more specialised and, therefore, often more professional than in Iceland. The professional material produced in the UK makes the operations in Iceland more professional as well (ibid: 30-31).
- New methods are introduced. One example is reliability analysis that was unknown in Iceland a short time ago (ibid: 31).
- Managers Icelandic DOMs that have been successful in London feel they have been able to have a positive influence on their business associates in London. This has resulted in positive changes in communications between actors (ibid: 31).

- By working abroad, managers gain a new perspective on the Icelandic business environment and are better able to spot the weak points to make suggestions for change (ibid: 31).

6. Inside the pipeline: Company-level analysis[30]

The purpose of the following is to take an initial step into the 'black box' of multinational enterprises. We want to investigate the conditions under which knowledge flows occur within the corporate network, and the challenges faced by companies when attempting to nurture such knowledge flows. The analysis will follow the step-by-step logic applied when conducting firm interviews; provide information on the underlying theoretical rationale for focusing on the different aspects and elements covered; and provide a thorough analysis of how the findings can be related to the research questions initially asked.

At this point we stress the general motivation for doing qualitative analysis. It is to dray out essences and contribute building blocks to a theory on the dynamics of internationalisation and the conditions under which outflow-initiated technological spill-overs may occur, not to provide empirically valid answers to the question of the extent to which such occur in different economies – at present. For detailed analysis of each individual country case company we refer to the case study report (Herstad (red) (2006b).

Case company backgrounds and characteristics

We have above argued that corporate internationalisation must be understood against a broader background of national innovation and institutional system characteristics; e.g. the industrial specialisation of national economies and the structure of the 'industrial complexes' individual internationalising firms are a part of – in particular the financial resources and strategic competencies represented by their ownership structures.

We thus ask the extent to which the case study companies are backed by committed, competent owners – as can be expected given the traditional pattern of corporate ownership in the Nordic economies (Rose and Mejer 2003) – or by non-committed financial market actors; and focus on the implications of this for international structure and strategy. The principle rationale for this is simple; international expansion and consequent organisational development are *strategic* decisions by definition taken by – or on behalf of – owners; requiring financial backing susceptible to the approval of the same owners.

We also focus on the extent to which they are building on home-base NIS strengths, and how; or alternatively attempt to escape NIS limitations, and the challenges inherent in this strategy.

A majority of the case companies are old, and thus have long histories as key domestic actors within their respective sectors. The oldest company covered is the Norwegian shipbuilder Aker Yards, with a history dating back to 1841. They cover industries ranging from construction and shipbuilding through advanced electronics, advanced

[30] By Sverre J. Herstad, NIFU STEP, based on country contributions in Herstad (red) 2006).

mechanical and electro-mechanical engineering to petro-chemicals, paint and pharmaceuticals.

They are predominantly not radical innovators, but 'diversified quality producers' (Streeck 1992) following well-defined technological development paths through continuous incremental innovations. This applies a high likelihood of these having accumulated very strong in-house competencies, expected to exceed a strong influence on their internationalisation strategies. They are predominantly targeting professional users; necessitating a fairly high degree of customization and implying that direct interaction with these are a key source of both ideas for innovation and knowledge needed to put ideas into practice.

Table 13: Case companies

Country	Company	Business	International presence
Denmark	Danisco	Food ingredients/additives	R&D, sales or production facilities in more than 40 countries, on all continents.
	Hempel	Paint manufacturer	Sales offices in 49 countries; production in 18. R&D in Denmark, China, Singapore, Spain and the US.
	Lundbeck	Pharmaceuticals	Research organisations in Denmark, the US and China. Development organisations in Denmark, Japan and Singapore, and in most other European countries. Large center in Paris.
	Novozymes	Enzymes and micro-organism producer	26 sales offices outside Denmark, on all continents. Production in Denmark, Sweden, the US, Brazil and China. R&D in Denmark, China, Japan and the US.
Finland	KONE	Elevator and escalator producer	Global R&D centres in Finland, the US, Italy and China. Escalator R&D in Germany and the US. Software development centre in India. Some 800 service centres in over 40 countries.
	Lamor	Oil spill recovery	Product development in Finland. Foreign subsidiaries in China, the United States and the United Kingdom. Sales offices in Malaysia, India and Russia,
	Nestè Oil	Oil refining and marketing	R&D in Finland. Production facilities in Finland, Belgium and Portugal, and through

Country	Company	Business	International presence
			joint-ventures in Canada and Sweden. Retail networks in Finland and in Baltic Rim (St Petersburg region in Russia, Estonia, Latvia, Lithuania and Poland.
Iceland	Actavis	Generic pharmaceutical	R&D mainly in Iceland and USA, also in Denmark, India, Malta, Turkey and UK. Manufacturing sites in Europe, USA and Asia. Sales and marketing offices in Europe, USA and Asia.
	Ossur	Orthopaedics	R&D and manufacturing in Iceland and USA. Sales offices in Iceland, Nordic countries, Netherlands and UK.
Norway	Aker Yards	Shipbuilding	Hull assembly yards in Romania. Final assembly yards in Norway, Finland, Germany, France and Brazil. R&D tightly linked to yards.
	Jotun	Pain manufacturer	61 subsidiary companies in 37 countries, of which 36 are factories located in 22 countries. In addition ownership stakes in license producers. Regional R&D labs in Dubai, South Korea and China; one division headquarter in Dubai.
	Kverneland	Agricultural implements (harvesters, soil treatment equipment, sprayers etc)	11 European production plants, one Australian plant. 21 sales and marketing branches, covering all continents.
	Tandberg Data	Data storage and back-up equipment	European, US and Japanese marketing and sales branches. R&D in Norway, Poland, UK and the US.
	Wilh. Wilhelmsen	Maritime logistics and services	Global presence.
Sweden	Axis	Digital surveillance equipment	14 sales subsidiaries in Europe, Australia, Asia, the US and UK.
	Skanska	Construction	Project-based, but 53 000 employed world-wide. Units involved in R&D in Sweden, UK, Finland, Norway and the US. All projects however involve R&D, without being reported as such.

Country	Company	Business	International presence
			Currently withdrawing from engagements in China, India, Africa and Russia, mainly due to corruption.
	NCC	Construction	Dependent on projects, oriented towards Europe.

Origin in national innovation systems

The Danish case company Lundbeck is the second largest actor in the Danish pharmaceuticals industry, following second case company NovoNordisk. Demerged in 2000 from the latter, the third case company Novozymes develops and produces different enzymes and micro-organisms, for industrial purposes such as the production of detergents or foodstuffs. This indicates a linkage between two known Danish system strengths, namely pharmaceuticals and foodstuffs, and thus Danish case company Danisco. Established as a sugar trading company in 1872, it now develops and produces food texturing additives, certain specialty products (flavours, cultures and enzymes) and sweeteners.

Thus, all the Danish case companies are representatives of the Danish sectoral systems of innovation in pharmaceuticals and foodstuffs, and the interrelations between these to in constituting a national system of innovation. The last Danish case company is paint manufacturer Hempel. Taken together, these companies represent 30 % of Danish business sector R&D; NovoNordisk alone accounting for 16 %.

Aker Yards, Wilh Wilhelmsen and Jotun of Norway have all historically emerged out of the maritime cluster of Norway, whereas Kverneland is one of the largest companies originating in a very distinct mechanical engineering cluster and agriculture region of South Western Norway. Paint manufacturer Jotun still is still heavily involved in maritime paints and corrosion inhibitors, including products both for maritime vessels and offshore installations.

The Norwegian arm of present-day Aker Yards has a strong gravitation point at the North Western coast of Norway, traditionally a region with a strong shipbuilding industry, and state remaining linkages to both maritime cluster actors (customers, equipment suppliers and maritime consultancy firms) and to specialized research institutes (e.g. Marintek in Trondheim). They also emphasize the role of strong, specialized ship owning and operating companies in Norway, e.g. related to the offshore petroleum sector (supply and standby vessels).

The last case company, Tandberg Data, is one of the three remaining activities of former Tandberg Radio Factory. Thus, all Norwegian case companies with the exception of the latter have a distinct national and/or regional system origin, on which ownership advantages have been developed.

The Finnish case company Nestè Oil was initially established and grew as a result of political regulations and priorities. Elevator and escalator producer KONE was established as early as 1910. After the Second World War KONE supplied elevators, electric hoists and cranes as war indemnity deliveries to the Soviet Union. These forced KONE to expand its capacity, rationalize production processes and learn to meet demanding manufacturing schedules, and paved the way for subsequent visionary internationalization strategy. (Marchan-Piekkari, 2003).

Similarly; while initially spinning out of the Finnish shipbuilding and repair industry, oil-spill recovery equipment company Lamor gained experience of oil spill recovery acting as a subcontractor for the Finnish Ministry of Environment, buying oil spill recovery equipment worldwide. However, unsatisfactory quality and inefficiency led Lamor to develop more innovative own products. It remains strongly linked to a large network of Finnish partner/supplier companies, and has amongst its portfolio of product specialized equipment for oil recovery in arctic conditions. The latter must be understood in the context of climatic conditions in Finland, and the resulting competencies on ice conditions in the Finnish maritime industry (Aker Yards has recently opened a new ice laboratory at its Finnyards units).

ICT company Axis of Sweden was founded in 1984 by two students within the fields of technology and economics. It remains strongly embedded in the regional innovation system surrounding Lund Institute of Technology, and has in addition to linkages with the latter at present systematic co-operative relations with 5 other local firms.

Swedish construction company Skanska was founded in 1887 as a concrete manufacturing company, but expanded into construction. Its Swedish operations have mainly targeted the public procurement market, and the market for specialized industrial buildings (i.e. manufacturing plants, steel works). It is now the second largest construction company in the world, and remains linked to a broad network of Swedish university researchers. As third case company NCC, it has historically nurtured on linkages to publicly funded construction sector research at Swedish universities and research institutes.

As argued above, the Icelandic economy has traditionally been built on fishing and energy production. Neither Actavis nor Ossur grew out of traditional industrial clusters. Ossur however initially benefited from the specific national market for health care aids nurtured by public authorities in Iceland, and generic pharmaceuticals company Actavis based on Iceland initially not condoning international patent regulations. This enabled specific Icelandic first-mover advantages to be harnessed in generic drug development and production. Both are examples of entrepreneurial companies that were able internationalize due to the modernization of the Icelandic economy in the 1990's. The main factors in the economic changes were transformations in the fisheries, fully realized in 1990 and allowing capital to flow out of the fishing industry; the entrance into the European Economic Area in 1992; and the privatization of the Icelandic banks that started in 1999. Furthermore, the considerable Icelandic pension funds provided an important backstop for the expansion of Icelandic businesses.

Corporate governance system origins and linkages

Domestic financial support from the newly privatised Icelandic banks is stated as of very high importance for both Actavis and Ossur in their early phases of internationalisation. The banks' knowledge of the Icelandic economy and the fact that they shared the vision of the companies and placed trust in them is stated an important prerequisite for their internationalization processes. As the companies grew larger on foreign markets, their ties to the Icelandic banks decreased in importance and so did their embeddedness to the Icelandic economy. Actavis however remains tightly linked to the dense Icelandic network of cross-shareholdings between companies, key individuals and banks (Dagens Næringsliv March 11th 2006)[31], thus limiting its exposure to short-term capital market pressures, while Ossur now ultimately is linked to the Danish foundation which also control hearing aid manufacturer Oticon.

In general, all case companies but one, Tandberg Data of Norway, are backed by large, committed and – to different degrees – sector-specialised domestic owners. Companies such as Jotun and Wilh Wilhelmsen (Norway), KONE and Lamor (Finland) and Axis Communications (Sweden) are controlled by – or under strong influence of – their founding families. In Axis employees hold the 50% of company shares not held by the founding family or board members.

Skanska AB is controlled by one of the two key bank group investment companies in Sweden, Industrivärlden AB. The main owners of NCC include the so-called Lundberg sphere which in turn is a main shareholder in Industrivärlden, making both Skanska and NCC part of a cross-shareholding network that extend into NCC and Skanska partner companies such as Sandvik (construction steel) and Atlas Copco (construction equipment). These cases are therefore prime representatives of the very distinct Swedish industrial complex (Ruigrok and van Tulder 1995).

Kverneland (Norway) has as of the year 2000 been controlled by Norwegian industrial conglomerate Umoe Group, following two decades without backing by significant owners; whereas Tandberg Data (Norway) remain without such owners and thus under the direct control of equity markets. Representing a very distinct characteristic of the Danish system of corporate governance (Thomsen and Rose 2002, Rose and Mejer 2003), paint manufacturer Hempel, pharmaceutical company Lundbeck and industrial enzyme company Novozymes are all controlled by foundations operating with the defined strategic objectives of securing the long-term survival of controlled companies[32].

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[31] The largest Actavis owner is investment company Amber International with 35.1 %, in turn owned and controlled by the Bjorgolsson family. This family also control investment company Samson Holding, which is the main shareholder of Landsbanki, one of the three main Icelandic banks. Landsbanki in addition has a 16 % direct shareholding in Actavis. An additional position of 9% is held by Straumur Burdaras, which is owned 21, 4 % by Landsbanki (Dagens Næringsliv March 11th 2006).

32 The aim of the Hempel foundation is e.g. '...to preserve and continue all the Hempel businesses at home and abroad' (www. Hempel.com)

Respondents in the Norwegian DOMs Jotun and Wilh. Wilhelmsen directly point out that a) the buffer against short-term capital market requirements supplied by their main owners has enabled them to commit to a certain strategy when chosen, and to cross-subsidise between different units to finance e.g. entry into markets difficult to penetrate, or setting up greenfield R&D facilities abroad with related investments in human capital. They also b) point out that the same lack of exposure to the capital market has enabled resources to be channelled to cross-border organisational development. Not least c) they argue that the *trial and error processes involved in* reconciling different and often contradictory requirements on the international organisation, such as e.g. decentralisation combined with co-ordination of research and network formation, require a willingness and financial ability to commit to long-term organisational development projects.

The case of Tandberg Data is clearly illustrative of how this can translate into several implications for structure and strategy. Knowledge synergies between Norwegian and foreign R&D are not explored because of budget constraints imposed on organizational development through trial-and-error and investments in inter-unit interfaces. This extends into marketing and customer fronting functions of all subsidiaries not being sufficiently utilized, and produces the internally contradictory situation of a small, high-end developer and producer, very dependent on both aggressive international marketing and its ability to be at the technological forefront, not being able to invest sufficiently in neither marketing nor product development *'beyond finalizing the projects we are working on at present'*.

The respondents explicitly state that the main, underlying problem is budget constraints imposed by '*…the short money'* that constitute its present ownership structure: *'It is too much focus on indicators, on what will happen in a few week, our owners just don't understand what we are trying to do and we cant make them understand it. We are suffering from a very stressing day-to-day existence, and cannot think ahead'*. There is a lack of necessary commitment, and necessary competencies.

At Aker Yards, the respondent similarly point to how former ownership by institutional investors paralyzed corporate management, in spite of huge cash reserves; and earlier interviews with Kverneland management (Asheim and Herstad 2003) revealed huge internal tensions between the necessity of investing in post-expansion corporate integration, and the need to protect the group against the threat of a hostile take-over that emerged out of lack of committed owners. Protecting short-term earnings, and thus market capitalization, and investing in corporate restructuring and integration are inherently contradictory objectives. The collapsing stock-market capitalization of the company however did not trigger a foreign take-over, but the engagement of Norwegian Umoe Group as controlling owner.

This dynamic becomes increasingly plausible when viewed against the background of evidence from cases such as in particular Jotun, Wilh Wilhelmsen, Skanska and NCC: Jotun stresses how committed and *sector competent* ownership has enabled, and continues to enable, *'commitment to chosen strategies over long periods of time, commitment of resources for long periods of time'*, and explain their successful internationalization with direct reference to abundant, patient and competent financial

resources. This applies for R&D projects, but importantly it is also stated as applicable for internationalization strategies and subsidiary establishments abroad: *"We are dong things without any consideration as to effect on the bottom line. There are no specific requirements as to pay-back time on investments. Units are allowed to cross-subsidize each other according to need, and our ability to commit has proven very valuable when entering new markets and developing new activities abroad"*. A similar picture is portrayed by management respondents in Wilh. Wilhelmsen Group*: 'The only thing that matters is the long-term survival of the company. I doubt very much that we could have put so much effort on organizational development, and build the company group we have built, if we did not have a committed owner'*.

In the case of Skanska, respondents state that Swedish Industrivärlden exerts significant influence through an active ownership aiming at long term results, and contribute to linking the company tighter to domestic business partners belonging to the same control sphere. Similarly, NCC is primarily controlled by Nordstjernan, which is a fourth generation family owned industrial investment company targeting Nordic companies and aiming at long term growth. Nordstjernan is as of 2004, the main investor in the second largest rental machinery company in Sweden. As mentioned above, the second largest owner is the Lundberg sphere. Hence, the networks of cross-shareholdings both link Skanska and NCC to each other, through the relationship between the Lundberg sphere and Industrivärlden, and to a broad range of partner companies domestically.

The strategic commitment to the region is stated as strong (see Friberg (2006) in Herstad (red) 2006). In this it is important to note that part and parcel of active, hands-on ownership is the necessity of *strategic integration* (Lazonick 2005); of owners being tightly linked to controlled companies to enable monitoring, evaluation and dialogue-based control over management. This is likely to reinforce inertia in HQ and other strategic functions.

The purpose of these firm-level data is of course not to highlight the role of specific DOM owners, but to make a more general argument about national corporate governance systems and thus the implications of the financial resources and strategic competencies these represent (see e.g. Norwegian Ministry of Finance (2005) for an analysis of this in Norway). The limitations of this empirical analysis in itself is obvious, but our findings and respondent statements line up perfectly with a larger bulk of research findings (Porter (red) 1992, Fukao 1995, Ruigrok and van Tulder 1995, Pauly and Reich 1997, Doremus et al 1998, Bartlett and Ghoshal 1998, Morgan 2001, Morgan et al 2001, Geppert et al 2003). Independently of empirical limitations, resolving the general question of corporate control, strategy and innovation is far beyond the reach of DOMUS.

National corporate governance systems and DOMs are however internally related, as the former defines the prospects for the existence of the latter as such. This, our empirical findings and the larger bulk of research on corporate governance systems clearly justify treating such systems of ownership and control as key in shaping the extent, strategy and structure of domestic corporate internationalisation – and thus its implications.

General internationalisation patterns

All Scandinavian case companies are early internationalisers, and if a single motive for expansion abroad as such should be identified this would be proximity to markets. The predominant mode of entry has been acquisitions, but exceptions to this are found in the cases of Axis Communications, Hempel and Jotun.

There are several reasons stated why acquisitions are preferred; access to in-house competencies of acquired firms being among the most important ones (e.g. Norwegian Aker Yards or Danish Novozymes). Other reasons include access to networks of acquired companies (Norwegian Kverneland) and more rapid entry into new geographical markets or more rapid diversification of product portfolios than would have been possible through greenfield establishments or organic growth. Greenfield establishments have occurred, and have been used significantly by case companies such as Norwegian paint manufacturer Jotun. In these cases the underlying reason is the combined effect of presence being necessary for market access, lack of available acquisition candidates and negative experiences with integrating and controlling acquired firms.

Only in the cases of Axis Communications and NovoNordisk have greenfield R&D facilities been established with the sole purpose of gaining access to technologies and knowledge. The Silicon Valley unit of Axis was eventually closed down. Both Skanska and NCC hare grown through acquisitions, but interestingly the latter has now abandoned this strategy as a result of negative experiences with consequent unit integration into the corporate network (Friberg 2006 in Herstad (red) 2006).

Contrasting corporate knowledge bases

The cases of Tandberg Data, Aker Yards, Lamor and Ossur appear to share a common characteristic in that their activities are relying on very specialised knowledge bases, formed and reproducing in the intersection between different disciplines (externally) and departments (internally). Hence, they are synthetic (Asheim and Gertler 2005), collective (Lam 2000) in the sense of being embedded in the interaction between people and departments, rather than held by individual specialists, and they are *firm specific* (Blair 1997) in the sense of being products of the specific histories of problem-solving the individual firms represent.

For instance, Tandberg Data highlight how *'our main strength is our ability to think across disciplines...what we do contain elements of fine mechanics, electronics and software development. What we do is very, very specialised'* and has clear historical roots in the high-end audio tape activities of former Tandberg Radio. As a result, research cannot easily be ouysourced, and researchers have to spend years becoming insiders in the community collectively holding the knowledge base on which research must build.

A similar picture is portrayed by Jotun, who stresses that *'you don't learn this at University, you have to spend a long time getting your hands wet with paint, to learn this very specific trade'* in order to function in the R&D department. This, of course,

implies among other things that building research departments abroad is much more costly and time-consuming process than would have been the case given more analytical knowledge bases. Researchers are not merely employed, and knowledge difficult if not impossible to source from e.g. universities or research institutes. This is one of the prime reasons why proximity to *other* groups than customers are of little or no importance as centripetal forces; there simply does not exist external actors beyond those customers who has ideas and preferences relevant to this idiosyncratic knowledge specialisation.

Similarly, Icelandic DOM Ossur point out that innovation does not happen in one part of the company, but is rather a question of a dynamic culture in the company as a whole: *It's not just some technical department or R&D department that is really creative. It's not at all cut into different departments. So the company culture – everywhere in the company – must be creative, not just because with a creative culture more people participate [in innovation] but also because it attracts customers and good employees, who think like that too. Nobody in our company believes that innovation only happens in the R&D department"*.

The technical team work in close collaboration with the product managers. Product managers are specialized in the marketing of different groups of products. Several years ago, they were placed within the R&D department, so they work side by side with the technical lead.

Furthermore, the product managers are paying regular visits to the sales offices abroad. The competencies of product managers are highly cross-disciplinary, they must have knowledge of individual markets as well as technical knowledge, especially because the customers are often specialists who: *"don't want a manipulating salesperson. They want to get further"*. In an interview, one manager stated that it was important to have very qualified people in the product management: *"you need knowledge and experience, or else the decision making-process becomes too slow and there is greater risk of mistakes"*. Similarly, Finnish case KONE argues that their core competencies *'…are comprised of company specific knowledge concerning elevator systems on the one hand, and development of strategic area specific components on the other. In the latter case new technologies from outside are absorbed to in-house component development'* (Oksanen and Rilla 2006), for refinement and adaptation based on these in-house competencies.

The cases further clearly show that R&D facilities, in industries operating based on synthetic, specialised knowledge bases, is not something which is easily 'set up' or 'relocated' according to the prices of ubiquitous inputs – e.g. research staff. It is rather something that *may* be built bottom up given sufficient long-term rationale of and financial backing for doing so, as the case of Jotun clearly illustrate, or be built on in-house competencies of acquired firms – localisation decisions in the latter case becoming contingent on available acquisition candidates and in the former most likely on market conditions and thus a linkages between R&D and production. This knowledge base argument of 'inertia' is of course reinforced when accounting for the possible existence of domestic networks with complementary, synthetic specialisations;

as in the cases of again Aker Yards and Lamor with their specialised supplier networks domestically and surrounding the Finnyard activities of the former.

As a contrast to these cases; the Danish pharmaceutical companies operate based on knowledge bases to a much larger degree dominated by analytical knowledge, and hence with a much stronger emphasis on formal research. Consequently; these companies state that gaining access to *scientific knowledge* is the dominating motive for establishing R&D facilities abroad. Proximity to customers or production facilities is a localisation factor of much less importance than for the companies above; and the main motivation is stated as *'access to R&D personnel not available or not available in sufficient quantity in Denmark'* (Hansen and Lindegaard Pedersen 2006)**.** NovoNordisk have for instance established R&D facilities in China with the explicit purpose of expanding its knowledge in a certain area of biochemistry where Chinese competencies are strong, and in the US to tap into research institutes in the surrounding environment.

Contrasting strategic functions

As pointed out in the introduction, actors in the Norwegian maritime industry stresses that research and development is not something that can be done in isolation from in particular marketing and production, but rather must occur as integrated with these. It must build on competencies and ideas from production and marketing; develop for production, and remain in close contact with the latter throughout the production process. Such contacts in turn feed knowledge back into R&D.

Mutual R&D-production independencies exist in cases such as Tandberg Data, Ossur, Kverneland and, – perhaps surprisingly – Neste Oil, who stresses that proximity to production environments are important for product development processes; whereas similar interdependencies between marketing and R&D are identified e.g. in the cases of Axis Communications, again Ossur and not least Jotun and Hempel. These examples therefore all highlight the need for organisational integration (Lazonick 2005), and hence both limitations on where R&D can be located and the challenges involved in attempting to achieve this integration across geographical and social space.

Particularly illustrative of the relationship between 'production' and key knowledge generation processes are the Swedish case companies Skanska and NCC. In particular the former stresses that 'development' is conducted in tight relation to actual production; that it necessarily has to be so and that this in turn implies that neither the scale of knowledge generating activities nor their localisation are captured by size and location of formal R&D.

As opposite to this, no production-development mutual dependencies appear in cases such as Jotun and Hempel, and the Danish pharmaceutical companies emerge as the ones having the weakest linkages between production, marketing and R&D. In general we observe that the stronger the centrifugal forces on either marketing or production, and the tighter linkages between these and R&D that are necessary, the more strain will be put on remain domestic operations and the stronger the challenges of building well-adapted international organisations will be.

Organizational principles

By analysing corporate organizational principles we attempt to address two inter-related issues; first the extent to which the corporation is set up to enhance knowledge flows between units, thus enabling technological synergies, and second the co-evolution of domestic HQ and R&D functions, and international activities.

Thus, with this we attempt to grasp the home-base dynamics of internationalisation; including learning and competence accumulation effects and spill-overs into the larger NIS: What is attempted established through internationalisation; what is the view on the roles of different units in different places and what challenges are met when attempting to establish different organisational systems across national and thus system boundaries?

The general picture is one of functional and knowledge complementarity between units; and one where there appear to be increasing emphasis on network formation. Most case companies have been selective internationalisers, emphasising step-by-step foreign acquisitions or establishments with consequent integration into the corporate network. A few cases, namely Kverneland (Norway) and KONE (Sweden) have to some extent existed as portfolios; following either from aggressive acquisition strategies (Kverneland) or from a very strong emphasis on subsidiary autonomy to enable market adaptation of R&D, production and marketing. Thus, initial cross-unit learning processes have in these cases been limited. They are now putting increasing emphasis on creating cross-networks, and on establishing defined knowledge gravitation and co-ordination nodes in the form of corporate 'centres of excellence' for defined technologies and/or markets. Thus, the dynamic appear to be *increasing* international integration of activities, consequently increasing the 'communicative skills' of the corporate network. Illustrating potential investment involved is Kverneland, with their estimate of integration and restructuring costs *exceeding* EUR 100 million after 2000.

Group integration span a range from the formal establishment of corporate 'research development and innovation networks' (Aker Yards and Kverneland of Norway, KONE of Sweden, Ossur of Iceland) linking multiple gravitation points, through networks more strongly oriented towards the single gravitation point of the domestic operations. The latter appear as the most common among the cases; and clearly visible in e.g. Jotun and Tandberg Data (Norway), Axis communication, Skanska and NCC in Sweden, Lamor of Finland and Ossur of Iceland. This finding is consistent with broader research findings indicating that home-base operations combine with a few, selected foreign centres of excellence are the predominant mode of co-ordinating research within MNEs (Gerybadze and Reger 1999).

Complementary tools commonly applied include the establishment of ICT-based fora for information sharing and idea exchanges, and emphasis is by numerous respondents but on the fact that efforts towards enabling *working* network formation requires that *'...a huge amount of resources are put into creating linkages..'* (Aker Yards).

Similarly, all Danish case companies are stating that they are putting a very strong emphasis on *'ploughing knowledge back to domestic operations'* (Hansen and Lindegaard Pedersen 2006). They are experimenting with different set-ups to increase mutual learning effects between subsidiaries. As stated case company Novozymes, there will inevitably be a large amount of information floating around in the corporate network and the *'...the question is how to deal with it'*. Exchanging personnel is expensive, and in this particular case the costs involved has resulted in such exchanges being reduced.

More generally, the learning effects generated by subsidiaries, and the role of domestic operations as gravitation nodes within this network, is thus not only a question of the availability and exchange of knowledge, information or ideas, but also of the ability of the corporate system to enable 'novel combinations' to be established – efficiently – given the large number of possible combinations to be explored that stem from this variety (Nooteboom 2000). And to do so as a possible trade-off between one the one hand day-to-day operational efficiency in e.g. production and sales and on the other the prospects or harnessing synergies.

It is therefore not surprising that companies such as Neste Oil, Lamor, Jotun, Actavis and not least Kverneland have gone through extensive processes of trial-and-error in attempting to reach the right balance between domestic and foreign R&D, and the right organisational set-up linking both R&D to production and marketing; and different locations to each other. Nor is there reason to expect that future processes of trial and error in attempting to establish new and more efficient structures will not occur - according to case companies rather the contrary.

Very important to note in general is a) the need for co-ordination and gravitation points within the corporate network, b) how these predominantly are defined based on strength of initial in-house competencies of candidates, and c) how this then will redefine the direction and strength of competencies. Since domestic activities initially control the ownership advantages of the corporate group; these are very likely formally defined and de facto functioning as such co-ordination and gravitation nodes.

Co-ordination, control, communication

Following from the theoretical discussion above, knowledge is predominantly something which is held by people, and both put to productive uses and developed further through interaction between people. *Organizations*, in the sense of firms rather than corporation, form and evolve as focusing devices for this social interaction. *Corporations*, on the other hand, *formally* link different organisations without this implying that cross-unit learning processes are triggered (Attewell 1996). This poses key questions concerning how firms as such interact across their respective boundaries, independently of whether or not these firms belong to a common larger organisational setting – the corporation. Thus, there is no way around a more micro-oriented analysis of the interaction between people and units within the DOM if questions concerning knowledge flows, synergies and externalities are to be answered (ibid, Gerybadze and Reger 1999, Persaud 2005) The DOM must within its corporate umbrella develop

platforms '*..which enables joint problem-solving, learning and knowledge creation. Knowledge flows through pipelines are not automatic, and participation is not free'* (Bathelt et al 2004). It requires, first, compatible organizational principles as analyzed above, then conscious effort in order to establish the social condition necessary for information flows to translate into absorption and mutual learning.

The case companies are for two inter-related reasons emphasising 'creating a common institutional context' (Bathelt et al 2004) by embedding certain key organisational values and principles for interaction throughout the organisation. For instance, the management of Ossur recognizes that knowledge flows within the corporate umbrella are important enablers of innovation and are thus putting strategic emphasis on nurturing these (see Jonsdottir 2006). They want employees to be open and willing to share knowledge and people from the subsidiaries come to work temporarily at the headquarters and vice versa.

They also stress that employees must also be flexible within the headquarters, and be willing to move from one desk to another, sometimes according to which project they are working on, but also to distribute knowledge in general (ibid). This secures interactive learning within the individual organization, but more importantly it also increases the absorptive capacity of the organization with respect to knowledge brought 'back home' from abroad by individuals (Lam 1998a). Similarly, Aker Yards stresses their attempts at embedding the key corporate value of 'group first, then units' in order to eliminate incentives towards excessive focus on individual unit profit maximization and thus to increase individual unit openness towards inter-unit knowledge transfer processes.

The Danish case companies, while operating with analytical, science-based knowledge bases which in themselves ease codified communication, also stresses the role of individual mobility between units as the main channel for knowledge transfers. This extends into the ability of companies to diffuse knowledge sourced externally, abroad. They highlight the management challenges involved in the internationalisation of R&D; in ensuring access of relevant data for all employees in the organisation. The latter is important. In general, the companies which to the strongest extent focus on developing inter-unit research, development and innovation networks are also the companies that to the largest degree emphasise exchange of personnel between units for *longer* periods of time, and on formalised interaction e.g. in the form of defined Centres of Excellence through which units interact.

Enabling communication

Thus, the first inter-related reason for emphasis on creating a common institutional setting is stated as the need to establish a sound basis for inter-unit communication and knowledge transfer – to enable social interaction, understanding and mutual expectations conducive to interaction. The challenges in doing this is clearly illustrated by Tandberg Data, by the trial-and-error processes of e.g. Jotun and Kverneland and by the information overload referred to by Novozymes: The larger the variety in unit core competencies sought linked, or the larger amount of information generated within the

corporate network, the larger the potential for knowledge synergies but the larger also the challenges involved in establishing the necessary mechanisms for efficient communication, absorption and utilisation of what knowledge is generated (Nooteboom 2001). Embedded, not merely defined, common principles of interaction and developed mutual understandings in areas ranging from basic administration to complex technological work contribute to providing the overall institutional basis for inter-unit synergies. Different units know what they can expect from other units, under those conditions of uncertainty that interaction around complex technological knowledge represent. Incentive structures are common, understood and conducive to sharing knowledge (Herstad, 2005).

Tandberg Data is particularly illustrating case in question. Having its core R&D functions in Norway, the company stresses that it has been unable to create interfaces towards its R&D subsidiaries in the US, the UK and Poland. Thus, these units primarily conduct R&D *'...which can easily be done in isolation from everything else'*, complementary to the core competencies of the Norwegian R&D but to a very limited degree serving a competence upgrading function. In general, foreign R&D labs are therefore described as *'...fairly isolated from R&D in Norway'* since *'people have to be present here for longer periods of time to learn the product, learn the technology, or we have to send people over there for quite some time. It's simply too costly'*. Whereas one high-level management respondent put trust in modern ICTs being able to resolve this, the extensive analysis of Persaud (2005) and the intensive analysis in Herstad (2005) both directly support vice president of technology who stresses that such technologies may be complementary but no substitute for direct, intensive interaction.

Enabling predictability and control

The second reason for attempting to create and embed a common institutional context has to do with reducing perceived uncertainty and enabling predictability and control. With increasing degrees of decentralisation, to reduce information overloads, barriers so information flows and operational inflexibility caused by centralisation (Bartlett and Ghoshal 1998), the importance of predictability under different external influences increases; the same applies with increasing requirements for co-ordination.

Thus, Wilh. Wilhelmsen state that a key rationale for developing what it refers to as a 'common organisational culture not tied to places' is that *'...we cannot apply the control-and command principles traditionally used shipping, this as it is blocking innovation, but we have to know how people will act and react under different conditions. And our customers should expect to the same attitudes all over the world'*. Here, a very strong emphasis is put on management training as vehicle of 'socialisation', then monitoring employee-superior relationships using frequent, extensive employee surveys. Similar statements concerning the need to 'socialise' managers and other employees into a certain corporate way-of-acting throughout the international organisation are made by most case companies.

Case companies predominately appear as archetypical multinationals in the sense that models applied internally (von Krogh and Grand 2000) are strong reflections of broader

societal models and traditions for organising work processes found in their home economies (Pauly and Reich 1997); i.e. those models for which the external institutional context of the Nordic economies provide support. According to Whitley (2001); internationalisation implies facing unknown business contexts, this imposes uncertainty which predominantly is handled by 'exporting' own model abroad. This, then, reduces *perceived* uncertainty but presupposes a certain degree of compatibility between corporate model and host institutional context.

Illustrating this very explicitly are both Aker Yards and Wilh. Wilhelmsen with their use of 'The Nordic Model' as label for decentralised, group-oriented work processes with a strong emphasis on local empowerment; so are the cases of Ossur and Actavis in referring to a specific 'flexible company model' heavily influenced by the Icelandic working culture (Jonsdottir 2006). A complementary example of attempts at 'exporting' the home-base model to a new institutional setting is Finnish case company Lamor, which planned to implant its network-oriented model of production and development to its US operations but wrote the plan off as the business environment did support it; and by Swedish ICT company Axis Communications which experienced how the US corporate culture was incompatible with their preferred ways of acting; causing the unit to be closed down.

It is important to note that these tensions also exist within the Nordic countries; apparently in particular between the expectations of the Icelandic case companies and the institutional contexts represented by the Scandinavian countries. This raises the question of the extent to which there exists a Nordic model, or a Scandinavian model. For instance, Icelandic respondents state that Danes and Swedes have a working culture where they *'just don't get it'* – 'it' being the attempt to embed a specific company culture in Danish operations. A part of this picture appear to be a less group-oriented working culture among Icelanders than other Scandinavians, and what is perceived as a higher degree of risk-aversion among the latter, by the former.

The main point illustrated by these and other case companies operating extensive international industrial systems are the *need* to establish such corporate cultures (control, co-ordination and communication); the influence of their home-base in *defining* what corporate culture to be established in the group as a whole (routines and own experiences, see e.g. Whitley 2001) and the *difficulties* inherent in transplanting a corporate culture into a larger context where it does not necessarily achieve institutional or cultural support. If the latter applies within the Nordic economies, it is not surprising that respondents emphasise how this poses a very real substantial challenge within organisations crossing larger institutional and cultural divides. These difficulties, *specific to multinational corporations* (Bartlett and Ghoshal 1998, Morgan et al (red) 2001), then add to the more general organisational challenges of building large, network-oriented corporate groups, in turn translating into limitations for the ability of DOMs to communicate knowledge across national boundaries and reinforcing the 'containing social structure' role of individual units.

Impact on corporate domestic innovation activities

The immediate impact of corporate internationalisation is broader market access for technologies developed domestically; i.e. the standard technology exploiting internationalisation emphasised by the OLI approach. This is important, and the consequent indirect, financial reinforcement of home-base activities this triggers should not be underestimated. It appear as particularly important for firms operating in product markets with few, professional customers, such as Lamor (Finland), Skanska and NCC (Sweden) or e.g. the maritime paint divisions of Jotun and Hempel.

In these cases, international presence is a prerequisite for what still emerge as strongly home-base oriented strategic functions, because this presence create linkages to customer knowledge and ideas, in turn filtering these back to domestic operations. It is however also important to stress that these predominantly are ideas or already existing products, and to a much lesser extent knowledge not embodied in such products (see e.g. Friberg (2006) for examples of how Skanska and NCC has come across solutions to different problems abroad, and brought these solutions home).

Companies such as KONE or Jotun and Kverneland operate with what is de-facto a distributed network of R&D units for the sole purpose of adapting products to local market conditions. These, in turn, are linked to directly to a limited number of R&D centres for given product markets; which in turn are linked to domestic R&D responsible for basic research and concept development, and international co-ordination of all R&D; thus creating several tiers of R&D units with downward increasing focus on the specificities of given markets, which in turn necessarily must feed back knowledge to domestic operations in order for this to serve its co-ordination function. The size of domestic 'basic' R&D and foreign operational or market adaptation R&D appear to vary significantly, contingent on the technology in question, and other operational considerations. For instance, Jotun established a Norwegian Corporate Technology Unit in order to decouple large-scale basic R&D from specific market requirements, only to close it down again because this R&D became too decoupled.

The necessity of this tiered structure is clear; local presence is necessary to serve local markets, and in this local R&D may, contingent on product market and technology characteristics, be a prerequisite. Serving markets, in turn, are of course a prerequisite for *domestic* R&D. Domestic strategic functions remain key in controlling the knowledge base of the corporation, and R&D thus cannot easily be decoupled from this. The different layers are complementary to each other, and the alternative to foreign R&D is not serving foreign markets at all, and thus not harnessing the latent scale effects of domestic non-market specific R&D.

Hence, the analysis support Raimo Loivo's conclusion that in many cases there '*is no viable domestic alternative to foreign research. The Evolution of foreign R&D operations is a natural and inevitable consequence of the internationalization of the companies' business and production'*.

But even extensive foreign research and development activities emerge as complementary to domestic strategic functions, given certain characteristics of the product markets. This follows from the mere strength of in-house competencies or

external networks domestically, at the point in time where international R&D or operations are established. Even in cases where no R&D is conducted abroad (e.g. Lamor), we find that organisational presences in specific markets serve critical roles as listening posts, communicating ideas and preferences back to home-base product development and production.

As indicated above, there appear to exist a process of co-evolution that *changes* the nature of domestic operations towards e.g. being more specialised, more research than development and design intensive, or more oriented towards knowledge-intensive administrative functions or R&D co-ordination. In this process, the nature of in-house competencies of HQ are vital; and the process itself contribute to redefining the nature of these in-house competencies more by changing or re-channelling the direction of competence accumulation, than hollowing these out. To the extent that these are not easily relocated, which they predominantly are not, the question of where R&D is *localised* by multinationals become less relevant from the perspective of home-base implications than what *mutual dependencies* that may form and reproduce in the interaction between home and host activities. As put by a Norwegian DOM high-level respondent: *'If we where to relocate HQ, it wouldn't be about moving it out but rather about building something completely different, somewhere else'*. This 'inertia' is a result of such mutual dependencies.

Another key dynamic is the interplay between strong and contradictory centrifugal and centripetal, thus e.g. leaving certain R&D functions caught in a tension between organisational integration with remain HQ R&D and its external, domestic networks (centripetal force); proximity to certain customer groups (centrifugal force) or proximity to mere 'operations' abroad, such as production; relocated to achieve lower production costs (again, centripetal).

In other words; labour cost considerations or market access considerations may result in e.g. production and marketing being relocated abroad; as Tandberg Data illustrates, but this may simultaneously contribute to organisationally segmenting R&D and the broader resource base it must feed on.

Similar examples we find in marine industries, where key Norwegian actors should as Aker Yards and Rolls Royce Marine clearly state that in complex vessel design and production it is impossible to separate R&D, marketing and final assembly. Thus, if the *efficiency* and *knowledge* of the Norwegian or Finnish labour force cannot longer compensate for higher wage levels and this necessitate relocating all vessel assembly to lower cost countries, domestic knowledge bases and consequently R&D will most likely be hollowed out.

We raise this issue; as it is of the outmost importance in defining long-term implications. We provide no clear answers, apart from rejecting the idea that R&D is something than can be conducted effectively and efficiently in isolation from everything else – when faced with strong knowledge bases and networks surrounding production, process development and product engineering being established elsewhere – in closer proximity to customers.

Two distinct and inter-related mechanisms are contributing to defining the role of home-base operations in this process. *First*, the degree of competence 'embeddedness' in the respective national economies; either in the form of external linkages to specialised suppliers or research institutes (Lamor, Lundbeck, Axis Communications) or in the form of specific, synthetic in-house competencies embedded internally in the domestic organisation (Jotun, Wilh Wilhelmsen, Ossur, Actavis, Nestè).

These may be mutual reinforcing, as the geography of external innovation systems linkages may be strongly tied to the geography of in-house competencies; in turn contributing to strengthening such in-house competencies and increasing the degree of both network and organisational embeddedness.

The argument of in-house competencies creating 'inertia' in R&D location particularly applies to firms operating with distinctively synthetic knowledge bases, such as e.g. Ossur of Iceland or Tandberg Data of Norway; the argument of mutual reinforcements in particular applies when sector-specific synthetic knowledge co-evolve with a larger block of actors representing complementary knowledge; as e.g. traditionally in the case of shipping (Wilh. Wilhelmsen), shipbuilding (Aker Yards activities in both Norway and Finland) or oil spill recovery equipment in Finland (Lamor, and the wider company network to which Lamor outsource manufacturing).

This block can consist of universities or research institutes specialising on sector-specific research, customers and suppliers. Industrial enzyme company Novozymes of Denmark refer to this as the importance of 'critical mass' domestically; Norwegian shipping company Wilh. Wilhelmsen refer to the same when pointing at the *decreasing* critical mass in Norwegian shipping as a centrifugal force, and the interplay between external linkages and in-house competencies: The in-house competencies of the group are increasingly built up *'...where the relevant environments are'*.

Note that this has a short-term dimension related to the existence of networking partners, but a much more important long-term dimension related to the future expected availability in the labour market of candidates holding relevant *synthetic* knowledge; a direct function of the existence of such a block of specialised actors. A very relevant example of this is the decreasing availability of experienced Norwegian sea-officers for employment in administrative functions on land; a HRM principle described as part of the foundation of the Wilh Wilhelmsen group corporate culture.

The *second* mechanism contributing redefining home-base operations is the process of unit specialisation analysed above. A part of unit specialisation and inter-unit network formation is necessarily relocation of certain operations, and certain development functions. It is *mutual* adjustments of functions between subsidiaries, according to their respective core competencies, market and innovation system linkages.

In the cases of e.g. KONE (Finland) and Lundbeck (Denmark), specialised R&D is located where either acquired firms or the larger contexts represent competencies that are complementary to the activities domestically; Lundbeck locate a specific form of R&D in the Shanghai region because of distinct localisation advantages related to chemicals are found there; whereas the KONE network of different R&D units have

been established as a combined result of acquired firm in-house competencies, their external sub-contractor and research partner networks, and specific market requirements.

This, of course, implies that the specific research conducted by the foreign units is not conducted at home. But the inter-unit co-ordination and dialogue that allow for this research to be utilised in a broader scale – i.e. according to intention - of course in turn necessitate gravitation points and what one could call 'assembly' points in the corporate network. These are likely to be established in units holding the strongest and broadest knowledge bases, i.e. domestically.

In the case of e.g. KONE, ideas harnessed by subsidiaries and the results of R&D conducted for the purpose of adaptation are fed back into the key technology platform development located in the main R&D centre of Hyvinkä, Finland, thus contributing to providing a much richer frame of reference for key technology development in this unit. The HQ administrative functions are also redefined, accumulating new competencies related to both administration and business strategy, in turn enabling new externalities through the labour markets for professional experts and managers. The positive effects of this process itself, creating 'spill-overs' into both management labour markets and business services in the form of competencies in managing multinational organisations, should independently of the possible lack of specific technology content not be underestimated.

Technological invention networks in case companies: Patent analysis[33]

In this section we reconstruct the knowledge flows for three of the case study companies. To proxy the knowledge flows we utilize information captured in patent documents, i.e. data linked to *outcomes* of such knowledge flows in the form of patentable inventions[34]. It is important to stress that there are fundamental problems related to the use of this proxy, this as it measures only successful individual invention projects with output relevant for patenting. This implies that there are sectoral differences in the usefulness of such data; and that particular caution should be exercised when using patent data for analyzing knowledge interaction in sectors where patenting inherently does not occur frequently. The following analysis is therefore limited to companies identified as active in patenting, namely Novozymes, KONE and Kverneland

For the selection of firms analyzed below we identify all domestic and foreign subsidiaries the function of which is broader than just distribution and services. We assume that these subsidiaries can basically host some knowledge generating activity regardless whether the knowledge creation is institutionalized in a R&D department or not. To identify all patent applications of the case companies we use these subsidiaries as potential applicants in our search strategy. For each of the identified patents we record the applicants and the inventors with the appropriate information on their geographical location.

[33] This section builds directly on Ebersberger (2006).

[34] As distinguished from innovations as the latter require successful commercialisation.

When graphically illustrating the corporate applicant and inventor network, we identify the inventors by *solid-grey nodes*. The applicants are identified by *white nodes*, where different subsidiaries in a certain country are collapsed into one node. An edge linking two inventors or applicants indicates co-invention or co-application, respectively. An edge connecting an inventor and an applicant indicates that both appear on the same patent document.

Novozymes (Denmark)

For Novozymes we identified 259 patents which were applied for at the EPO between 1998 and 2002. 106 of these patents contained the contribution of an international inventor. 4% of which were from the other Nordic countries. The inventor network extends to a large degree into the US and also draws some ideas from Asia – or more precisely Japan and China, both places in which it has R&D labs. 17% of the patents with at least one international inventor contain an inventor from Japan or China (see Table).

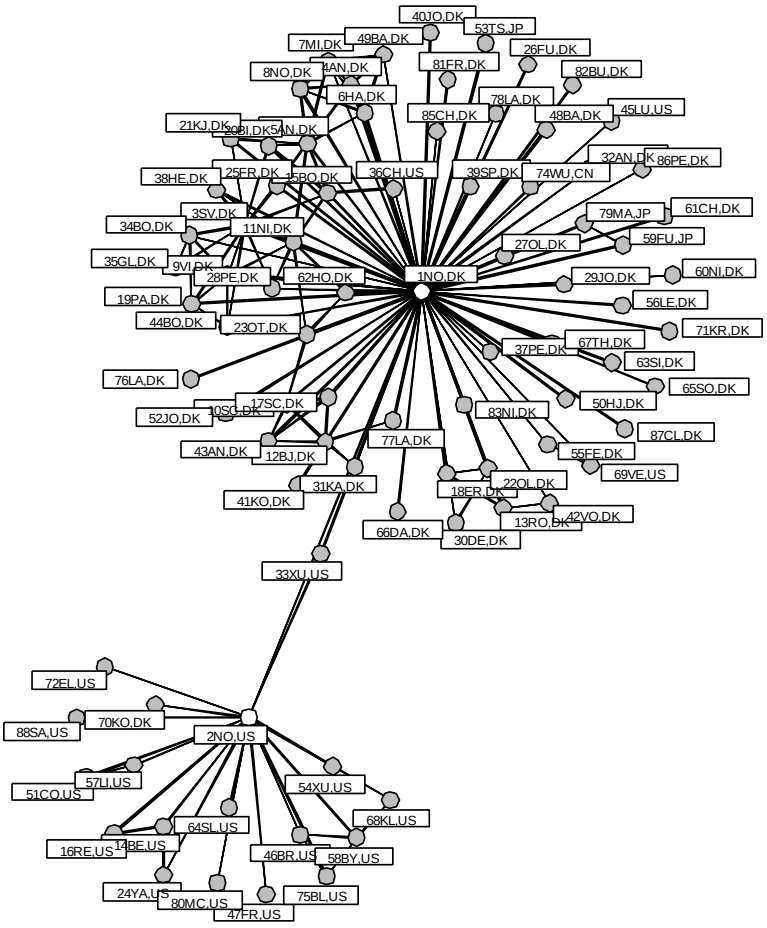
Table 14: Internationality of the Novozymes inventor network

	Number	%
Patents	259	
with international inventors	106	41%
of which with Nordic inventors	4	4%
of which with US inventors	79	75%
of which with Asian (JP, CN) inv.	18	17%

Note: Patents retrieved from ESPACE Bulletin, applications from 1998 to 2002.

Table 14 illustrates the applicant and inventors network of Novozymes, where only the highly interacting actors – both applicants and inventors - are identified. Only applicants and inventors with at least 3 instances of interaction documented by the patent applications are depicted. The illustration reveals the strong geographical focus of the network in Denmark and the US. Other countries such as Nordic inventors or Asian inventors are not identified in the illustration as they lack frequency of interaction to be included in the illustration here.

Figure 15: The Novozymes high intensity invention network



When focusing on high intensity interaction only we observe a strong division between US internal collaboration and Danish collaboration. Both groups of high intensity interaction are characterized by *hardly any international co-operation.* The network around the Novozymes US application node contains almost exclusively US inventors. The network around the Novozymes Denmark also consists almost completely of Danish inventors. If we however include all recorded interaction in the retrieved patent documents and do not restrict the view on high intensity interaction we obtain a graphical representation too disturbing to be presented here (see Ebersberger 2006), this as a result of apparent substantial international collaboration within the whole network. The illustration suggests a vivid information exchange as well as successful cross-border collaboration within the enterprise group.

KONE (Finland)

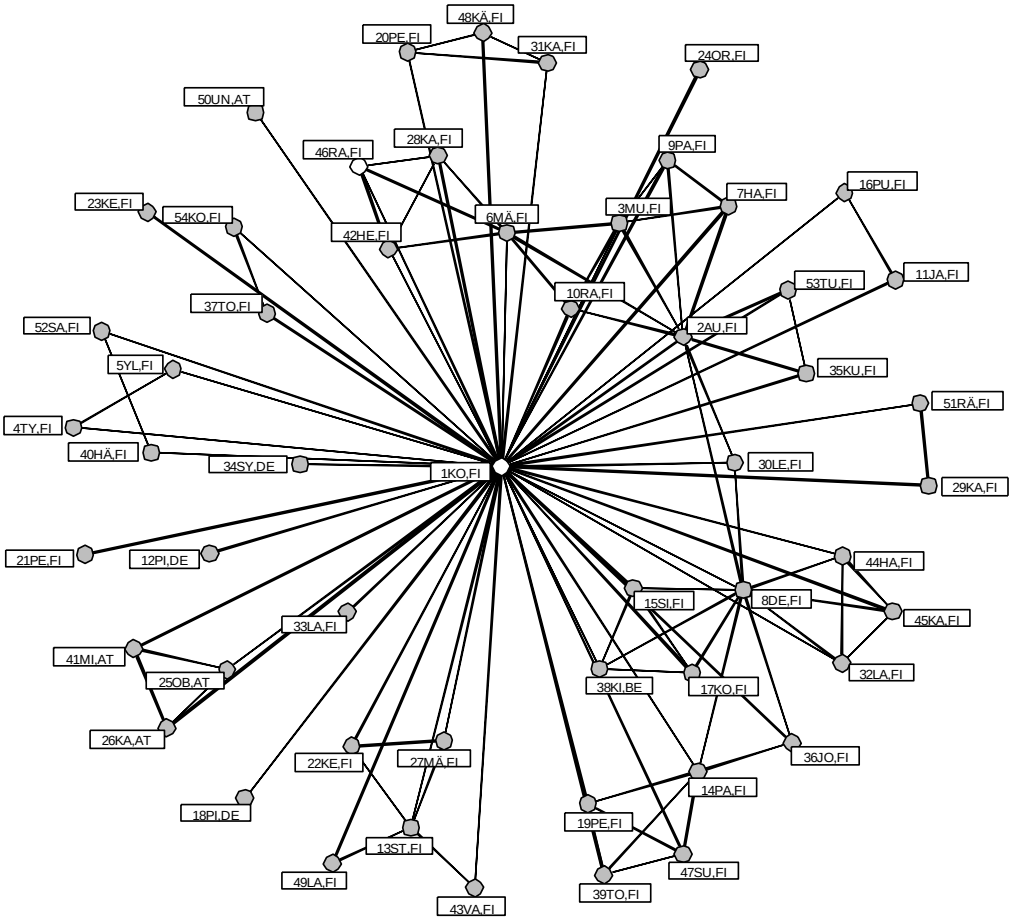
For KONE we identified 50 patents which were applied for at the EPO between 1998 and 2002. Only eight of these patents contained the contribution of an international inventor, and in five of these cases that inventor came from Germany. KONE thus appear as strongly embedded in Finland, with few and weak organizational linkages outward. This is consistent with the case study findings, where it is argued that KONE only recently has initiated processes of stronger cross-unit integration, and where HQ is identifies as having a key basic technology development and knowledge gravitation function in the network as a whole (Oksanen and Rilla 2006).

Table 15: Internationality of the KONE inventor network

	Number	%
Patents	50	
with international inventors	8	16%
of which with Nordic inventors	0	0%
of which with US	0	0%
of which with Asian	0	0%
of which with DE	5	63%
of which with AT	2	25%
of which with BE	1	13%

Note: Patents retrieved from ESPACE Bulletin, applications from 1998 to 2002.

Figure 16: Inventor and applicant network of KONE Corporation



Kverneland (Norway)

For Norwegian agricultural implement group Kverneland we identified 38 patents, of which as many as 21 had international inventors. These are predominantly European.

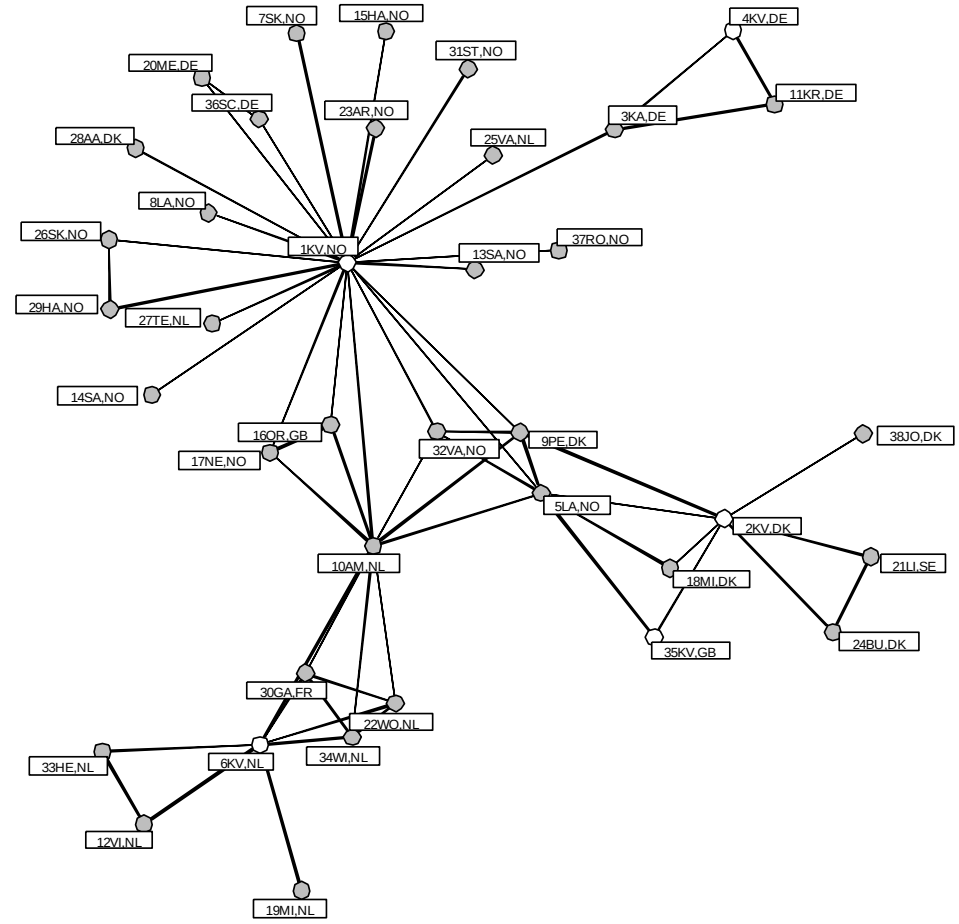
Table 16: Internationality of Kvernelands inventor network

	Number	%
Patents	38	
with international inventors	21	55%
of which with Nordic inventors	8	38%
of which with US inventors	0	0%
of which with Asian inventors	0	0%

Note: Patents retrieved from ESPACE Bulletin, applications from 1998 to 2002.

In Herstad (red) (2006), and earlier publications such as Asheim and Herstad (2005) or Herstad (2000) the challenges of and investments in corporate integration in the wake of the international expansion in the late 1990 are discussed. Kverneland Group now emphasizes that they have built a unique inter-unit research-development and innovation network where the different specialization of the different subsidiaries are set up to feed on and into each other. The patent analysis clearly support that this is the case.

Figure 17: Inventor and applicant network of Kverneland ASA



In the applicant and inventor network we observe four distinct centres of patenting activity. The strongest is located in Norway. Also particularly strong is the patenting activity of the Danish and the Dutch subsidiaries. Three inventors seem to represent the bridge between these foreign affiliates and the he Norwegian headquarter. To illustrate their role in the network: If we remove these three inventors from the network there is no direct interaction between the foreign affiliates and the Norwegian headquarter. Structurally we find the same setup in the case of the German subsidiary. One inventor represents the link between the inventor network around the German subsidiary and the rest of the network. These actors are responsible to maintain the knowledge pipeline from the subsidiary location to the headquarter location and vice versa. These bridging functions are particularly important if complementary knowledge is dispersed over the corporate network, which needs to be merged in order to yield novel ideas leading to new and improved products and processes.

Trade-off between interfaces?

All three interfaces of the global pipeline require significant investments and management attention, over a substantial period of time. This begs the question of the extent to which there are trade-offs between the different interfaces. For instance;

greenfield establishments imply that subsidiaries can be designed bottom-up for the purpose of functioning as a part of a larger corporate network, as the case of Jotun has illustrated, but arguably at the expense of the embeddedness in host context systems that e.g. Kverneland subsidiaries show and which is stated by e.g. Novozymes as an important reason for *acquiring* firms when attempting to tap into external networks. Hence, integration in the case of Jotun has been easy compared to the Kverneland process of integrating acquired subsidiaries – but these subsidiaries on the other hand came complete with *'brand names and product development networks'*.

The home-base operations of NIS may similarly show strong linkages to external resources; but to what extent do these exist at the expense of stronger organisational linkages to operations, and strategic functions, abroad? In general there are fundamental limits to how many different co-operative relations or inter-unit projects that can be established within a given R&D budget constraint, or within a given co-ordination capacity of HQ and the network as a whole. In addition to this, Aker Yards may touch on a complementary, important dynamic when pointing out how substituting external linkages in Norway with in-house competencies is part and parcel of the larger project of creating a strong corporate 'research, development and innovation' network, and the very strong organisational network eventually created by Kverneland, after years of trial-and-error, co-exist with very weak direct linkages domestically – in Norway. In this it is of crucial importance to remember that private companies are just that; their ends are profit maximization or survival in longer or shorter time horizons. They operate under budget constraints that vary according to existing profits and their – by owners defined - strategic objectives. Knowledge development, research and innovation are only means towards this end.

7. The role of domestic multinationals

The desktop study findings, qualitative and quantitative findings can now the synthesised to provide a coherent analysis of the three interfaces of the global pipeline. We start of by recapitulating to our point of departure, the FOTON (Ebersberger and Lööf 2005) findings. The analysis is based on 'Community Innovation Survey' data from the Nordic countries, for technical details see Ebersberger (2006) and Ebersberger and Lööf (2005).

Table 17: Innovation input and innovation output by company groups (source: Ebersberger 2006)

	Denmark		*Finland*		*Iceland*		*Norway*		*Sweden*	
	In	*Out*	*In*	*Out*	*In*	*Out*	*In*	*Out*	*In*	*Out*
DU	0.6	1.1	0.5	1.2	0.6	1.6	1.5	2.1	0.6	0.9
DM	1.8	3.0	1.8	3.3	0.6	1.0	4.6	5.4	2.3	3.0
NO	0.6	1.5	0.6	1.6	2.0	3.3	1.1	2.0	0.7	1.6

Note: The table reports the averages of innovation activities 'Input' means innovation input It is the log of innovation expenditure per employee in 1000 Euro. 'Output' denotes the innovation output measured by the log of sales from new or significantly modified products per employee also in 1000 Euro.

In table 17 above, firms belonging to either domestic non-internationalised corporate groups (DU), Nordic corporate groups (NO) with headquarter location in another Nordic country or domestic multinational corporate groups (DM) are compared on innovation input and innovation output. With the OLI framework as theoretical reference, it is not surprising to find that domestic multinational corporation show higher values on both innovation input and innovation output – except in Iceland where both companies owned by multinationals from other Nordic countries and uninational corporations outperform DOMs. It is reasonable to expect that this has to do with sectoral composition of the different ownership groups in general, and in particular the fact that Icelandic DOMs are found in industries which inherently report little or no formal R&D and where innovation outputs are not clear-cut or easily measurable (e.g. the financial sector).

The question then becomes *where* the R&D activities, and related strengthening of technological competencies and other strategic functions of domestic multinationals, predominantly occur. To answer this, we draw on both qualitative and quantitative evidence. Based on 'community innovation survey' data from the Nordic countries, the quantitative analysis compare different ownership groups with respect to different dependent variables, and control for a set of independent variables given in Ebersberger (2006), table 6. These include company size, sector, market orientation (local, regional,

national, international) and – importantly – innovation input. In other words, the companies compared below are comparable on these independent variables.

Innovation system linkages at home and abroad

Table 18 illustrates two key interfaces in the global knowledge pipeline. First, it portrays the degree of DOM embeddedness in their respective national innovation systems; measured as general system embeddedness, vertical embeddedness (within the value chain), horizontal embeddedness (co-operation with other firms in same sector) and utilisation of the domestic science system (e.g. research institutes, universities). The strong and uniform pattern of DOM general system embeddedness provides a particularly strong indication of the interplay between DOM development of core competencies and the respective national innovation systems, *in particular given how we already know that the sectoral distribution of DOMs vary substantially between the different Nordic countries.*

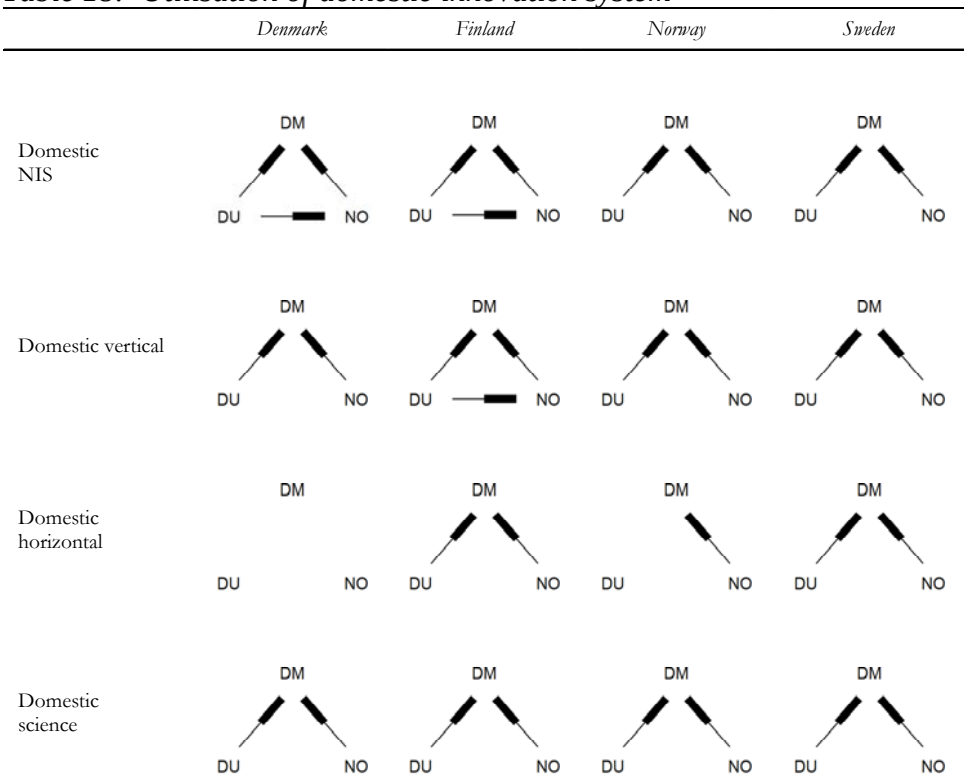
Second, and less obvious, the table also illustrate the host system interface of the global pipeline, i.e. the interface between DOM subsidiaries abroad and their respective innovation systems – although limited to subsidiaries in other Nordic countries. This is simply as the subsidiary companies NO in any given Nordic economy have parent companies originating in any other of the Nordic economies.

On the first interface the overall picture is that domestic multi-national companies are more embedded in the national innovation system than domestic uni-national enterprises and the Nordic-owned companies (table 18). On the latter interface we find no general clear-cut picture; the subsidiaries of companies from other Nordic countries appear as neither more nor less embedded in the host NIS than do the uninational of the same economy. The exceptions to this are found in Denmark and Finland, where DOMs from other Nordic countries appear to have managed to embed their subsidiaries strongly in the host innovation systems; or showed preferences towards acquiring firms with a strong degree of external system embeddedness. When broken down into different kinds of embeddedness, only the Finnish finding for vertical embeddedness remain.

Note that this analysis emphasises relative embeddedness, compared to uninationals. Thus, DOM subsidiaries are neither more nor less embedded in host innovation systems than the uninationals of the same systems, other company characteristics such as market orientation, size and innovation input being equal.

We know, however, that these subsidiaries use public funding from their host contexts equal to or – in Finland and Norway – or to a lesser extent than do subsidiaries of uninational corporate groups in the contexts (see table 12). This finding *may i*ndicate that the public funding element of national innovation systems are of less importance than other factors as motive for incoming FDI in these countries.

Table 18: Utilisation of domestic innovation system



Source: Estimations from Ebersberger and Lööf (2005a, 2005b, 2005c) and Ebersberger, Lööf and Oksanen (2005) and own computations.

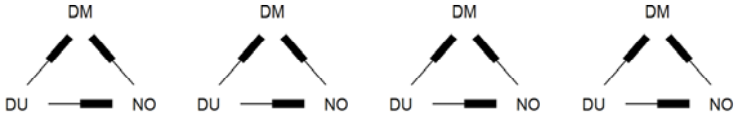
The organizational interface

The analysis reveals that multi-nationality has an advantageous effect on intra-corporate networking and knowledge sourcing, this as subsidiaries of both domestic and foreign multinationals to a large degree state using the corporate network (table 19). For all Nordic countries the analysis of the data sets show that Nordic-owned companies are more likely to utilize the corporate network to source knowledge for their innovation activities. Domestic multi-national companies rely on the corporate network for their innovation knowledge even more than Nordic-owned subsidiary companies do.

The latter observation reveals a key point. We have observed that subsidiaries of corporation from *other Nordic countries* use the corporate network to a significantly *lesser* extent than *domestic multinationals from the Nordic countries* – i.e. the parent companies uses the corporate network to a significantly *larger* extent as source of inputs for innovation than do their subsidiaries in other Nordic countries.

This is a clear indication of a *home-base gravitation effect* on the knowledge flows within these networks, the empirical finding although being limited to DOM activity within the Nordic countries and thus within economies which are fairly institutionally and culturally homogenous. This, in turn is clearly consistent with the qualitative findings, where a) the co-ordination and therefore knowledge gravitation role of HQs are emphasised, and b) where a process of co-evolution and the formation of mutual HQ-subsidiary are identified.

Table 19: Utilization of corporate network (source: Ebersberger 2006)

	Denmark	*Finland*	*Norway*	*Sweden*
Utilization of the corp. network				

Source: Estimations from Ebersberger and Lööf (2005a, 2005b, 2005c) and Ebersberger, Lööf and Oksanen (2005) and own computations.

Although there are limitations to the quantitative analysis in that no other foreign-owned firms than the NO group is included, we conclude that the preconditions for positive NIS spill-overs domestically appear as more positive for outward FDI than for inward FDI. This is consistent with recent findings from econometric studies. In a recent study of FDI flows between industrialised countries over twenty years, van Pottelsberghe de la Potterie and Lichtenberg (2001) found that *outward FDI makes a positive contribution to domestic total factor productivity.* Using a sample of 13 OECD countries covering 1983-1990, Xu and Wang (2000) similarly found evidence of reversed spill-overs from outward FDI to home countries, whereas no evidence was found of technological spill-overs from inward FDI.

This forces us to emphasise that rather than gearing policy towards harnessing expected positive spill-overs from inward FDI one *should focus on nurturing the technological (NIS) and institutional (corporate governance) preconditions from developing strong, domestic multinationals.*

In this perspective; policies attempting to secure a significant proportion of national industrial ownership (see e.g. Norwegian White paper no 61, 1966-1997) *by nurturing strong systems of industrial ownership* could find additional legitimization in the need to secure efficient international pipelines for the domestic NIS, given that these policies do not contain elements directly or indirectly inhibiting corporate internationalisation through FDI nor attempt securing national ownership merely by blocking foreign take-overs. Foreign ownership per se is not a problem; but lack of a strong domestic ownership system may very well come to be just that (Puttonen 2004). From the global

pipeline perspective here is a clear need to nurture strong, competent and internationally competitive systems of domestic corporate finance and control.

Pipelines are in existence. The questions then become how large gains that can be expected; to what extent gains are internalized between firms, or whether important spill-overs occur, and the possible resulting discrepancies between gains at firm level compared to country level.

Pipelines for national innovation systems?

DOMs only serve as global pipelines for their respective domestic systems to the extent that direct or indirect (through labour markets) interaction with these systems is strong enough for externalities to occur; and to the extent that the external systems themselves have sufficient absorptive capacity *within* the relevant synthetic or analytical knowledge fields in question. Quantitative data showing that DOMs utilise the domestic innovation system are not in themselves sufficient to make the statement that this translate into externalities into this system, traceable back to the foreign operations of DOMs.

First we have the issue of whether there is a trade-off between a) quantity and quality of domestic NIS linkages and thus channels for spill-overs, b) quality of network linkages within the MNE, feeding knowledge back to DOM domestic organisation, and c) quantity and quality of linkages to innovation system actors in host contexts. For instance, the ability of DOMs to create internal but inter-unit corporate labour markets dramatically increases knowledge flows within the group; but at the expense of DOM domestic spill-overs through the labour market. This as a well-functioning internal labour market broadly defined to include the temporary mobility of personnel, necessarily exist at the expense of external turnover of personnel. Similarly, if a given R&D budget predominantly is used for in-house R&D and acquisitions of technology domestically; this increases the likelihood of domestic spill-overs but decreases the likelihood of the DOM serving a pipeline role for NIS – of there being anything to spill over being channelled back home. If it for some time predominantly is used on organisational development and multi-unit projects within the group, or on R&D in subsidiaries, it dramatically increases the foreign linkage and thus internal network of the DOM; but most likely at the expense of its pipeline role domestically.

Holding amount of knowledge fed back to home-base operations constant, the question of externalities from the DOM to national innovation system actors still cannot be resolved without in-depth investigation the direction of knowledge flows and thus possible asymmetries (Lam 2002) in knowledge transfer processes within these domestic networks. We need to know more about the character of the linkages, of how co-operations are set up and technology sourcing occur – and we must remember that the CIS data above only cover targets for knowledge sourcing on the part of the MNE. Assuming that these are interactive relationships where knowledge is transferred both ways is not sufficient for strong conclusions to be drawn. We do not know the extent to which the utilisation of the domestic science system occur as outsourcing of things that

can easily be specified and conducted in isolation from everything else, or deeper relationships or a more reflexive (Storper 1997) and co-evolutionary character. Ali-Yrkkö and Hermans (2004, 116-117) for instance point out how Nokia co-operation with domestic universities and research institutes has provided a platform for diffusion of know-how to various parties. According to the researchers *"the exchange of information has been mutual, that is, in many projects the know-how has diffused from universities to Nokia and vice versa. The same concerns the partner companies of Nokia"***.** In-depth interaction necessarily facilitating externalities are identified in cases such as Lamor, Nestè Oil, Aker Yards and not least Axis, but identified as non-existing in the cases of Kverneland and Tandberg Data and very limited in the cases of e.g. Jotun, NCC and Skanska. The empirical evidence on this is sufficient only for raising the question, not providing answers.

In broader perspective externalities will of course inevitably occur through labour market mobility; but the extents to which they actually do are contingent on the external mobility of personnel between different DOMs, and research institutes. In a few of the Norwegian cases, namely Jotun, Kverneland and Tandberg Data, this mobility is very limited. The same applies e.g. for Icelandic case Ossur. Limiting this mobility is of course the degree of firm specificity in involved knowledge bases, if high in itself limiting alternative employment opportunities (Blair 1997). And the more specialised involved knowledge bases are, the higher the challenges of triggering such mobility are. In the words of Jotun; *'...we have nowhere to go to employ researchers, and they have nowhere to go if they want to leave us'*. This, in turn leads us to conclude that important in securing that NIS externalities occur is the existence of a broader cluster of technologically complementary activities domestically; supplier firms, competitors, sector specialised financial actors or highly specialised research institutes supplying relevant employment opportunities for researchers and other strategic personnel initially employed in DOMs and thus able to diffuse knowledge generated through its global pipeline into a NIS with absorptive capacity for the knowledge in question. If these prerequisites are not met; the knowledge generated by the pipeline will predominantly be contained within the domestic operations of DOMs. A particular illustrative general example is the Wilh. Wilhelmsen Group Norwegian group and division HQs; representing global gravitation points for advanced and specialised (e.g. car carriers) maritime logistics who's remaining linkages to a weakening Norwegian maritime cluster provide fewer and fewer channels for spill-overs into a surrounding environment with weakening absorptive capacity.

To this can be added that direct and indirect channels for spill-overs appear to co-exist with each other, and with the existence of NIS absorptive capacity within given technological fields. To the extent that relevant innovation system actors exist domestically, so will also more vibrant labour markets exist. Direct linkages between firms in the form of partnerships or purchases of technology will thus co-exist with indirect linkages working through labour markets. Similarly, when no relevant partners firms exist domestically the lack of direct linkages will necessarily co-exist with few or no indirect linkages thorough the labour market – and very low absorptive capacity in NIS as a whole. In the Danish pharmaceuticals, enzyme and food ingredient companies the necessary preconditions for externalities appear to exist; but they do not necessarily

do so e.g. in the Icelandic cases Ossur and Actavis, nor in the Danish Hempel or Norwegian Jotun or Kverneland cases. This, in turn, becomes a particularly pressing issue if the domestic-foreign operations co-evolution contributes to redefining the core competencies of domestic operations in a novel direction, thus decreasing the likelihood of domestic linkages remaining strong. This is clearly evident in the case of Kverneland.

We therefore conclude that domestic multinationals primarily serve as pipelines for their domestic NIS to the extent that the latter represent a certain critical mass within relevant technological fields; a critical mass consisting of competing firms, tight user-producer relationships and specialised research institutes linked by well-functioning external labour markets for specialists. Following from this, we also argue that the functioning of DOMs as global pipelines for NIS are *more likely to contribute to reinforcing the sectoral or technology specialisation of NIS; the areas within which the existing specialisation of NIS is securing both the emergence and consequent growth of DOMs, a strong home-base orientation in both intramural R&D and external purchases; and thus deepen an existing NIS technological development paths, rather than contribute to providing the diversity needed to break existing paths.* This argument is of course strengthened when taking into consideration the *support* for such firms given by NIS, their own internal financial resources and the possibility that corporate governance systems provide additional support in the form of sector-specialised competent owners and managers; and on the other hand the lack of support on all these faced by DOMs attempting to escape national limitations through internationalisation. The companies that have the strongest need to escape NIS limitations are the ones facing the highest risks of internationalisation; and the ones perhaps having the weakest financial muscles and weakest competent capital backing. These are, on the other hand, the companies with the largest potential for introducing *novelty* into the domestic system, in technological fields where NIS linkages to DOMS and NIS absorptive capacities are the weakest.

Hence we are back where we started, in the interplay between NIS specialisation and corporate internationalisation.

8. Policy implications

The immediate effects of investment incentives on the R&D efforts of DOMs domestically appear as very limited. DOMs remain embedded, and do so either because they over time have established trustful linkages to NIS actors, and/or because of in-house competence accumulation over time. Neither can easily be influenced by isolated policy decisions, at least in the short run.

On the other hand, it should be emphasised that many of the conditions that crucially impact on the costs and benefits experienced by firms are influenced by policies. Indeed, a range of policies matter in this context. The impacts vary from macro-economic conditions such as exchange rates and trade policies to education and labour-market policies, financial polices, taxes, corporate governance rules, competition, science and technology policy, and so forth.

It is very likely that many of these conditions, including the public research and research support system *over time* can exert a very strong influence on the process of co-evolution between domestic and foreign operations.

Weaknesses in the present business and innovation system, perceived stability in or uncertainty, and corporate expectations concerning *future* framework conditions may to a large extent influence on relevant decisions. Expectations are important. Such corporate decisions may over time lead companies to remove home based operations from the home country. The development of functions abroad may eventually evolve to the point where they can substitute for domestic operations.

Companies may not immediately chose the location of strategic functions; but decisions concerning what emphasis to put on R&D or key knowledge-intensive activities, and where to locate them, are *strategic* decisions that are taken, or should be taken, in a fairly long planning horizon. Expectations- concerning factors such as the future production of qualified employees through the education system, the development in research support measures and taxation rules, and priorities in public research, may thus exert a strong influence on where companies perceive that future competencies should be developed or what linkages to prioritize.

The phenomenon is dynamic; and whereas public policy cannot influence the immediate outcome of this dynamic it may – over time -- influence the dynamic itself. Cases such as Wilh Wilhelmsen, Aker Yards and Skanska are clear examples of this.

To a certain extent it is the properties of the home base that define whether or not corporate internationalisation is forming global pipelines into the NIS (which is a good thing), or contributing to a hollowing out the NIS. The extension of this would be the argument that global pipelines are no substitute for a sound domestic research system, and that both their formation and their function as such pipelines rather presuppose certain characteristics of public research and support; and the broader NIS. Again, this is a question of co-evolution and therefore the receptiveness and adaptiveness of NIS and public research.

This implies that major challenges follow from the fact that the Nordic countries are small, and the national R&D base therefore necessarily specialised within certain technological fields. Strategic choices must therefore be made concerning what direction public efforts should be directed; and one accept that the situation may occur where national R&D efforts are directed towards supporting companies that are establishing R&D facilities abroad on a large scale. Put simply; national research policy should to a lesser extent attempt to limit the internationalisation of corporate R&D, and to a larger extent focus on creating the national technological preconditions for DOM formation and for their consequent internationalisation to serve a healthy pipeline role.

General policy implications

Hence: In general one may say that innovation policies benefiting domestic multinationals are not different from policies of benefit to companies in general. The management of DOMs look for the same as CEOs managing uninational or foreign owned companies:

- A local market, which from a policy perspective is a call for a favourable industrial policy that encourages entrepreneurship and company growth.
- Favourable framework conditions, including
    - a sensible tax level combined with a efficient welfare system
    - a good infrastructure, both physical and ICT-wise
    - political stability and lack of corruption
    - a cultural climate favourable to entrepreneurship and business development
- A sound knowledge base, which requires an efficient education policy, support for relevant high quality R&D in both private and public sectors.
- Sufficient access to venture capital, including pre-seed capital (DOMs may go elsewhere to find such capital and let the investments go to the same country).

According to our research the access to human capital is of extreme importance, and given that most – if not all – domestic multinationals have grown out of existing industries, technologies or clusters, this points to a need for a public policy that takes the need of existing competence bases into consideration.

This may, for instance, be used as an argument for extensive R&D programmes for the development of such industries, the support for university and college courses of relevance to such clusters (even if they are not "fashionable" among young people right now), public procurement and development contracts that may help develop the relevant knowledge base and basic funding for technology institutes and research units owned by industry branch organisations. Such policies are not in violation with free trade agreements in Europe or elsewhere. All industrialised countries support the knowledge base of selected industries in one way or the other.

We should add one word of warning though. Although it is true that all successful DOMs have roots in existing or traditional industries, a policy based on the needs of existing companies only may lead to stagnation and a lack of relevant innovation. Existing companies or existing industrial branch organisations may become to focused on their immediate knowledge needs, and fail to foresee or make use of important technological break-throughs. Hence policy makers should make sure to encourage the development of front line competences and more radical innovations, for instance by encouraging researcher initiated research at universities, colleges and research institutes. This especially applies to generic technologies that may also be adapted to existing industries. The connection between biotechnology on the one hand and the pharmaceutical industry or the food industry comes to mind.

Last but not least, and leaving the innovation system as narrowly defined aside, of outmost importance for the emergence and growth of successful domestic multinationals is securing a healthy national financial system basis for such companies. If domestic multinationals are to exist as such – i.e. as international actors not belonging to a foreign corporate group - a strong national system of corporate ownership must also exist. If these are to be successful within their respective sectors, these owners must represent both commitment to the process of internationalisation and subsequent organisational development (as we have seen, internationalisation expansion is resource demanding), the necessary financial backbone and not least the competencies necessary to contribute to choosing, initiating and guiding companies through those internationalisation processes which are sound given the technological and market characteristics of their individual sectors. A birds-eye view of the histories of the largest Nordic DOMs, and the company evidence gathered through this project, leaves us with serious doubts as to the extent to which this key function can be supplied by capital market portfolio investors alone. This market undoubtedly serve the important function of offloading the risks, as well as financing mergers and acquisitions, but we are still left with the question of the extent to which it is necessary to consider policies aimed at establishing or nurturing private capitalist spheres willing and able to hold larger stakes in individual companies for longer periods of time – and thus contribute to controlling these based on long-term industrially oriented strategic objectives.

It is well documented that hands-on active owners prefer geographical proximity to the strategic functions of the companies in which they invest; i.e. R&D and headquarter functions. Active, national ownership thus arguably reduces the risk that strategic functions will be relocated at early stages of company development. This, in turn, contributes to 'embedding' companies domestically, through the accumulation of in-house competencies and through the development of external relationships – domestically.

Focused implications

Less general and more immediate policy implications can also be drawn. We have noted the importance of DOMs as knowledge institutions and competence relay stations in their own right. The Nordic countries depend on such companies for their competence development, and the big companies may in some areas be just as important as public R&D institutions in this respect. Because of this it becomes very important to integrate these companies in the national innovation system. In other words: It is essential to secure a good flow of people and competences between these companies and other companies and institutions in the NIS.

Thus, policy implications in this respect are possible at two levels:

a) One may influence the *organisational* setting to allow for mobility of personnel
b) One may influence the *personal* setting to create individual incentives for/remove individual incentives against, mobility

As regards the organisational setting the Nordic countries may develop instruments for DOM/company cooperation or DOM/Research institution cooperation. Some relevant measures already exist , as in R&D or innovation programmes that encourage industry/university collaboration or where large companies are encouraged to include SMEs in their applications. When developing R&D and innovation programmes meant to strengthen the development of core industries with large DOMs at its center, company/SME collaboration or company/research institute collaboration should be encouraged.

The DOM employees have both formal and tacit competences that may be of great interest to universities and research institutions. Especially high tech DOMs may be at the very front of technological development within their own area, and far ahead of university and college units that do not have the resources or contacts needed to stay up to date. The DOMs may also have access to scientific instruments that may be of interest to university, college and institute researchers. Hence it may be useful to encourage research institutes employees or students to work in these companies. Industry PhD and post. doc. industry/university collaboration may be used for this. In this respect it is important that the people involved are encouraged to bring back these competences to their own institutions as faculty members or teaching staff. If they stay in the company after the thesis is delivered, the collaborative effect may be weakened.

On the other hand there is a need for a flow of personnel the other way round, from the company to the knowledge institutions. Universities and colleges should invite company researchers, engineers and managers to lecture and lead courses, for instance within the framework of a guest professorship. This is often more difficult to carry out than Industry PhDs, as the company may feel that it looses one of its most important assets, and the company employee may not be willing to accept a salary reduction or a weakened position in the company, career wise. The authorities may consider supporting the university, college or institute in this respect, helping them fund the gap in salary. Giving the company employee a good position or title may strengthen their standing in the company and thus strengthen, and not weaken, their career. Moreover, if the company is convinced that the competences developed during the stay at the research institution, they may even be willing to fund the "guest worker" themselves.

The Domus team will, however, take this line of reasoning one step further, and propose a more radical approach in addition to this. We would like to see scholarships for company/company internship, where companies are rewarded for sending their employees to other companies for a limited period. As knowledge predominantly move with people; and our research clearly show how multinationals struggle with organising knowledge flows across national and organisational boundaries, supplying such scholarships could be one modest way of increasing the degree of organisational integration between domestic and foreign activities, thus increasing the pipeline function DOMs.

This is particularly important as many companies are so specialized that company employees have to stay in the company out of lack of options. The company invests a lot in this employee to make him or her useful in their work environment, but by doing so the employee will also find it hard to make use of his or her experience in another line of work, so they stay. However, if they are encouraged to spend some time with colleagues in another company, they may generate unforeseen innovation through their interaction. The intern may find new uses of his or her special competences, while the host company might find new uses of the technology delivered by the intern's company.

Competitors are probably unlikely to embrace such a scheme, but partners and allies may find it very useful. Hence a supplier may lend a customer an expert for a six months time for the development of a particular product, process or service. One of the companies should be a domestic multinational, the other a domestic uninational. Moreover, employees from a locally anchored uninational should be encouraged to work in foreign branches of the multinational. In this way he or she may also gain some useful international experience.

The Nordic governments should make sure that there are incentives in place that help DOM employees in other countries to work in their own national innovation systems. Hence let's say Brazilian employees of a Norwegian oil company should not be hindered from working in Norway on project of relevance for that company. The EEA area already ensures a relatively free movement of experts within the European arena, and the Nordic countries also allow a number of non-European experts to take up residence in the Nordic area . However, removal of any remaining red tape should be considered. Packages for family reunions and financial support for spouses and children may be included.

One may also consider giving more active support to DOMs in their recruitment of experts from abroad. As long as these experts are located in the Nordic country and not in one of the foreign affiliates, a knowledge flow from this expert into the national innovation system may be achieved through agreements on guest professorships, lecturing, company/company collaboration and so on. Hence one might consider a scheme whereby domestic multinationals could ask the relevant public agency for financial support when hiring a foreign expert, on the condition that this new employee gives a contribution to national knowledge dissemination in return – for instance through lecturing at a university or taking up a part time position at a research institute. Again, such additional funding should only be considered when this person's expertise of national importance, and he or she has demands as regards salary, family support, access to science infrastructure etc. that cannot be met by the company alone.

9. Research implications

We propose a set of complementary projects should be conducted in order to utilise and further refine the theoretical perspectives developed by DOMUS, and to build on this to significantly increase our understanding of the dynamics and implications of corporate internationalisation

Intensive, qualitative fieldwork

There is an obvious need for in-depth analysis of research, development and innovation networks within multinationals. The real knowledge flows within such networks, as clearly delineated from their formal, defined purpose, should be analysed using state-of-the-art theoretical contributions within the fields of organisational and inter-organisational learning. Further, it would significantly increase our understanding of MNEs as organisations if this empirical analysis could be linked to more general perspectives on principles for co-ordination, capital allocation and monitoring within MNEs. This would require access to and actual participation in MNE strategy formulation, management processes and actual cross-unit projects, making this a challenging venture.

Large-scale survey of multinationals

Complementary to this, or as a more feasible alternative, a survey should be conducted with the purpose of mapping and explaining the organisational and social conditions for knowledge transfer within MNEs. Such a survey could be purpose-built cost-efficiently using the theoretical line of reasoning developed in DOMUS, through its use of company level qualitative data, and should both for the purpose of making cross-country comparisons and for the purpose of general applicability of findings be conducted on a large sample of US and European MNEs.

The role of Nordic DOMs in Nordic economic integration

Last but not least intra-Nordic FDI should be analysed as a one of the strongest possible channels of integration (Gertler 2002) between the Nordic economies. Relevant research questions would include the extent to which *intra-Nordic sectoral innovation systems* are forming through the activities of DOMs, and the extent to which corporate networks within the Nordic area are easier to establish and functions more effectively than corporate networks spanning larger geographical and cultural distances. A future project on this should – in line with the projects suggested above - take the form of a combined statistical mapping exercise, a survey and case-studies of selected companies in selected key sectors, e.g. the financial sector, the construction industry or the shipbuilding industry. These are all sectors where Nordic MNEs, including MNEs from Iceland, are active in each others economies. The findings of such a project could have a strong impact on policy formulation at the Nordic level.

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The Nordic Innovation Centre initiates and finances activities that enhance innovation collaboration and develop and maintain a smoothly functioning market in the Nordic region.

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