Nordic Innovation Centre

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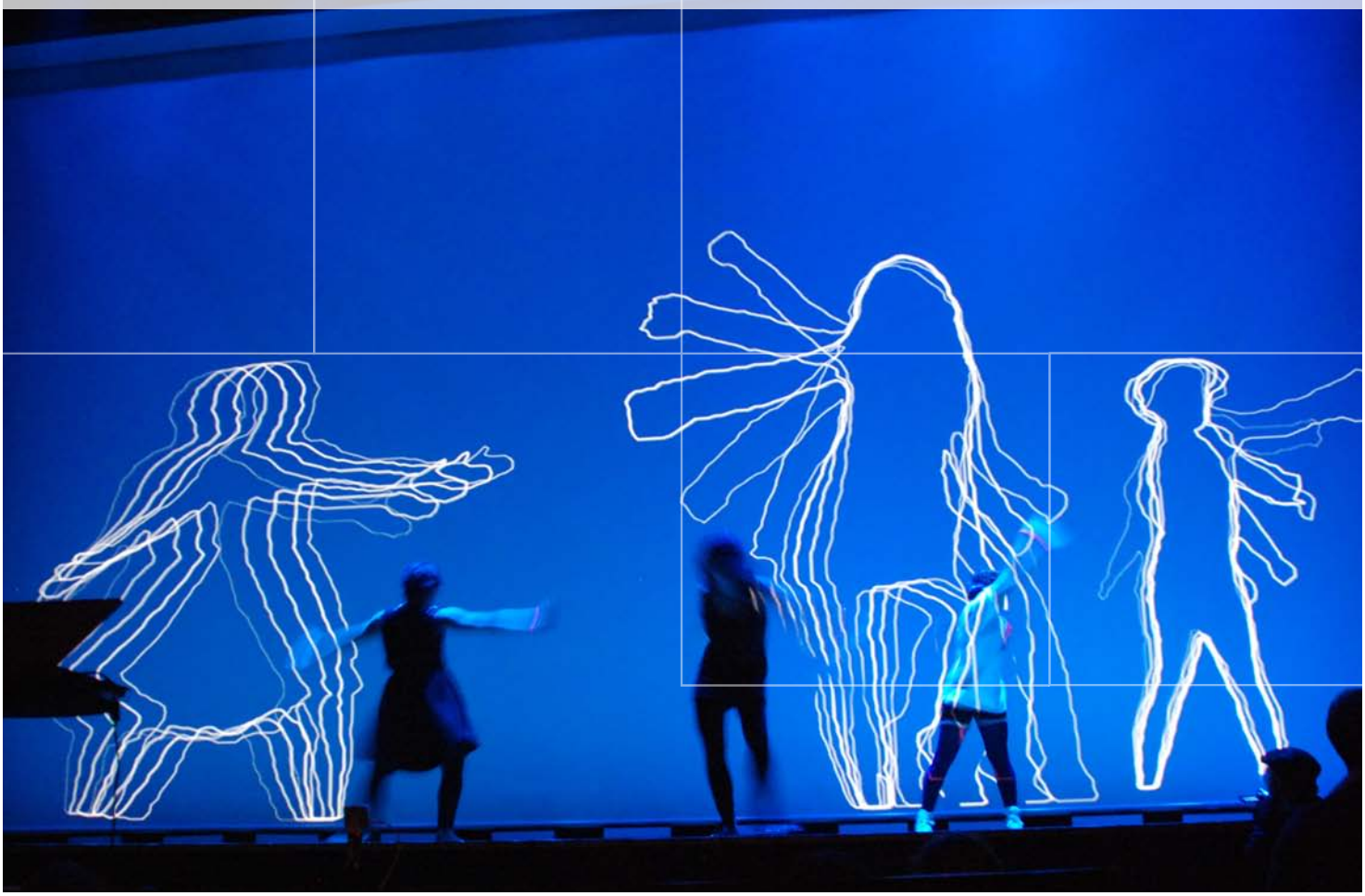
Regional trajectories to the knowledge economy: Nordic-European Comparisons

- Knowledge dynamics in the ICT, KIBS, New Media and Food & Drink sectors in seven Nordic regions
- Cross-sectoral, multi-actor and multiscalar knowledge interactions drive product development
- A better understanding of how policies may be developed and used to facilitate knowledge dynamics



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Title:
Regional trajectories to the knowledge economy - Nordic-European comparisons (REKENE)

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Abstract:
The main objective of the REKENE project as well as the 'mother project' EURODITE has been to investigate how knowledge is generated, developed and transferred within and among firms or organisations and their regional contexts in order to gain a better understanding of how policies may be developed and used to facilitate knowledge dynamics. Furthermore, a specific aim of the REKENE project has been to deliver a policy toolkit regarding knowledge dynamics and innovation. In the REKENE project, we have investigated knowledge dynamics in seven regions in Denmark, Finland, Iceland and Sweden. We have been able to compare our results with those from the 22 regions studied within the EURODITE project.

The main findings regarding knowledge dynamics can be summarised in three key points. Firstly, cross-sectoral knowledge interactions drawing on different disciplines and fields of expertise are innovative and drive product development. Secondly, knowledge interactions are multiscalar; they include highly relevant extra-regional knowledge interactions. Multiscalar interactions are supported by policy instruments, ranging from cluster organisations to support for organising and participation in various events. Finally, knowledge dynamics include many types of actors conducting a variety of knowledge interactions. The REKENE toolkit consists of two types of interrelated items, *tasks* and *tools*, which are necessary to master in order to harness knowledge dynamics.

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Executive summary

Main objectives

The main objective of the REKENE and EURODITE projects has been to investigate how knowledge is generated, developed and transferred within and among firms or organisations and their regional contexts in order to gain a better understanding of how policies may be developed and used to facilitate knowledge dynamics and innovation. Furthermore, a specific aim of the REKENE project has been to deliver a policy toolkit regarding knowledge dynamics. The reason for exploring the dynamics of knowledge is that a knowledge-based economy is considered vital for competitiveness in the global economy. For instance, the goal of the EU Lisbon Agenda was that Europe should become the most competitive and dynamic knowledge-based economy in the world. In addition, knowledge is intimately connected with innovation. Briefly, the knowledge economy is distinguished from earlier 'economies' by the speed with, and extent to, which knowledge is generated and used. Furthermore, generation and exploitation of knowledge plays a predominant role in wealth creation. The increased recognition of the role of knowledge for economic development has also become visible within policies for regional development, where entrepreneurship, innovation and knowledge have come to the fore.

In the REKENE and EURODITE projects, knowledge is seen as a process that uses given individual and firm competences for the appropriation of required new economically useful knowledge that, for instance, results in an innovation, seen as a change in products, services or processes. An important concept in the project has been knowledge dynamics. The core of knowledge dynamics is that changes in knowledge are the driving force behind innovation. Knowledge dynamics arise through changes in knowledge itself and in the various ways in which knowledge moves, is transformed, and created.

A region has been a point of departure for the empirical case studies. This is because the regional level is considered crucial in the development of a more competitive Europe and has been designated a site of innovation and competitiveness in the globalising knowledge-based economy. However, we assume that knowledge dynamics are not restricted to bounded territories such as administrative regions. Instead, knowledge interactions stretch across administrative borders. The importance a regional context may play is also seen in the concept of *regional trajectories*. Regional trajectories can be seen as paths to move towards a knowledge economy, which is constantly shifting and changing because of processes of knowledge development. The paths are developed and changed over time through a number of different processes, such as investments and decisions made by firms and public bodies and changes in the global economy. The multitude of interrelated knowledge interactions that exist in any region form parts of these trajectories.

Methods and implementation

In the REKENE project, we have investigated the knowledge dynamics in seven regions in Denmark, Finland, Iceland and Sweden. We have been able to compare our results with those from the 22 regions studied within the EURODITE project. The REKENE project has been designed as a project including cooperation between researchers and practitioners. From the start, each region participated with a team consisting of at least one researcher and one practitioner. This has been valuable both in terms of the research process and for working with policy tools.

Empirical research into knowledge dynamics has been conducted based on the building blocks of region, sector, territorial knowledge dynamics, and firm-level knowledge dynamics. *Territorial knowledge dynamics* involve knowledge exchange, networks and interactions among actors. Key actors may include firms, higher education institutions, chambers of commerce and local and regional authorities. The regional level is important, but interaction is not constrained to an administrative region. Knowledge dynamics are multiscalar and may include important interactions at great distances. The *firm-level knowledge dynamics* analysis aims to contribute with greater depth and more detail on knowledge dynamics and how knowledge is developed and transferred at a micro level, whether within a firm or an organisation, or between networks of firms or organisations.

To investigate knowledge interactions at the firm level, a knowledge biography approach has been applied, including the tracing of knowledge dynamics starting from a change in product, process or organisation. Key events of knowledge interaction have been identified in an attempt to understand the processes and the role of different actors. The links between firm-level and territorial knowledge dynamics are seen through the interaction among actors. From both a research and policy perspective, it has been important to understand which knowledge types (analytic, synthetic and symbolic), phases (exploration, examination and exploitation) and processes (cumulative and composite) are at play in knowledge interactions, and when policy instruments are designed and applied. We have also studied knowledge interactions from a gender perspective. This approach has been applied to obtain a wider perspective on knowledge development and innovation when selecting policies to support regional development in the knowledge economy.

Results and conclusions

The main findings regarding knowledge dynamics can be grouped in the following three key points.

- *Cross-sectoral knowledge interactions are innovative and drive product development.* Composite knowledge processes drawing on different disciplines and fields of expertise are at the heart of the processes.
- *Knowledge interactions are multiscalar.* All cases of territorial and firm-level knowledge dynamics include some kind of highly relevant extra-regional knowledge interaction. Actors who are firmly connected to other local and regional actors utilise extra-regional knowledge when needed. Multiscalar interactions are supported by policy instruments, ranging from cluster organisations to support for organising and participation in various events.

- *Knowledge dynamics include many actors.* Knowledge interactions include many types of actors conducting a variety of knowledge interactions. The activities performed by various kinds of actors support the conclusion of combinatorial and cross-sectoral knowledge interactions promoting innovation.

In addition, major results and conclusions are presented under each heading below.

Knowledge anchoring – inflow and recirculation of knowledge

In the analysis of territorial knowledge dynamics, we have looked at knowledge anchoring. Knowledge anchoring refers to how knowledge flows into the region and how it is recirculated. Knowledge anchoring has been analysed by looking at activities that could be connected to four different channels: 'firm-level interactions', 'work-place or job-related mobility', 'acquisition of codified knowledge', and 'events'. By looking at concrete activities and mechanisms connected to the above-mentioned channels, we can conclude that the inflow and recirculation of knowledge may occur at the same time and in complex mixes of processes and channels. For example, knowledge anchoring through firm-level interactions takes place through both organised networks and direct interactions between firms. These processes are often influenced by higher education institutions. The 'work-place or job-related mobility' channel provides examples of people with dual positions: at a university as a lecturer, and in a firm. Such mobility strengthens knowledge transfer between academia and the business community. We also see that different kinds of events are an important channel for inflow and recirculation of knowledge. Public policy has been influential in relation to this channel. Public support is available for organising events within regions attracting extra-regional knowledge and for individuals to participate in events outside the region.

Firm-level knowledge dynamics: a deeper understanding of knowledge types, phases and processes

Firm-level knowledge dynamics concern how knowledge is developed and transferred within a firm, an organisation or a network. Looking at knowledge interactions, we can conclude firstly that they have a *multiscalar* character. The firm-level knowledge dynamics include a combination of knowledge interactions among actors at close quarters and large distances, nationally as well as internationally. Furthermore, the knowledge interactions have a *multi-actor* character. A variety of actors, ranging from public agencies such as local authority departments and higher education institutions, to individual entrepreneurs, are included in the studied knowledge dynamics. Individuals belong to different networks that are interlinked and overlaid, facilitating knowledge interactions across contexts. The importance of symbolic knowledge in firm-level case studies can also be highlighted. In addition, the research shows that the knowledge phases—exploration, examination and exploitation—are interlinked and may take place at the same time. The complexity of innovation processes—for instance, in combining different kinds of knowledge and actors—is also evident. This research has shown that the development of an innovation is a non-linear process, although it is often considered a knowledge chain. In innovation discourse, such interaction echoes the concept of user-driven innovation. When it comes to knowledge processes, we have demonstrated that knowledge interactions take place across sectors and that cross-sectoral knowledge interactions are a good seed-bed for innovation.

Knowledge interactions and gender issues

Looking at knowledge dynamics from a gender perspective helps us to unravel a more nuanced picture of the knowledge economy. An important reason that a gender perspective is on the EU knowledge economy agenda is that women are considered an untapped resource in many economies. The project findings also indicate that women are not frequently seen in the knowledge interactions. The absence of women may be explained by the fact that most of the

sectors covered are dominated by men. Consequently, the study confirms that there is a horizontal (different kinds of jobs) and vertical (higher or lower in the hierarchy) gender segregation on the labour market when it comes to the representation of women and men. The result is relevant for knowledge interactions and innovations, because studies have displayed that the development of innovations may be enhanced by diversified workplaces and work groups. Looking at knowledge interactions from a gender perspective may also shed light on conditions that may be reconsidered when it comes to developing a knowledge economy from the policy field. The empirical case studies indicate that the perception of innovation and the knowledge economy still tend to be focused on technology development. A stronger emphasis on other sectors, both private and public, including services (for instance, in health and education), would probably contribute to new perspectives on the development towards a knowledge economy in general, and knowledge interactions including women in particular.

Policies influencing knowledge interactions at the regional level

The project has conducted a systematic discussion of public policies in relation to knowledge interactions. Many policies are in place for supporting knowledge dynamics. Across the board, many policy instruments within the framework of the knowledge economy have focused on research, scientific knowledge and engineering; i.e., on analytic and synthetic knowledge. In the REKENE case studies, we can see that symbolic knowledge is important, not only in sectors that are high in symbolic knowledge in the first place, such as new media, but also, for example, in cases related to ICT and Food and drink.

There is a new multifaceted paradigm of policies for regional development in the Nordic countries as well as within the rest of Europe. These policies involve strategies and initiatives for *all* regions and aim at building on regional strengths to support regional growth. In this context, the three main aspects of importance to knowledge dynamics are as follows.

- *'Multi-actor' policies.* Many different actors are involved in strategy and policymaking. These include policy bodies, higher education institutions, private firms and chambers of commerce that take part in developing policies for regional development. Partnerships and governance are key concepts here.
- *Multilevel policies.* In addition to the national policy level, policy bodies at the regional level are playing an increasingly important role in the development of policies for regional growth. In the Nordic countries, the municipalities at the local level are also significant actors. There is a Europeanisation of policies that also affect the areas outside the European Union itself. A key concept here is multilevel governance.
- *Policy focus on software.* There is increasing attention to policies dealing with software factors such as training, education and business advice. Knowledge generation and knowledge transfers are target areas for policies for regional development.

The REKENE Policy Toolkit

The purpose of the *REKENE Policy Toolkit* has been to collect the shared experiences of the REKENE practitioners in a format that encourages institutional learning and knowledge recirculation. The toolkit consists of two types of interrelated items: *tasks* and *tools*. The tools were generated by creating a list of the tasks that are necessary to harness knowledge dynamics, as perceived by the participating teams and as indicated in the emerging analysis from the study. Then, from the REKENE case studies as well as the total reference frames of all the participants, possible tools to achieve each of these tasks were listed. Both policy tools in use in their regions or by others, as well as "needed tools"—that is, a perceived lack of effective means to achieve a particular end—have been discussed and included. Some tools are applicable to several tasks, and each task may use or require several alternative tools. It must be mentioned that the work with the toolkit went much

further than what was originally planned for the REKENE project. Consequently, it is considered as work-in-progress to be further developed.

Nordic–European comparisons

In the REKENE project, we have looked at knowledge dynamics in seven Nordic regions from a wider European perspective. We recognise that there are similarities and differences between these two contexts. A similarity is that the *national level* has a strong presence in the regional trajectories. However, in the Nordic regions, the *local level* is also important for knowledge dynamics. A reason for this is that the municipal level of government may work with issues relating to economic development at the local level; for example, through involvement in science parks and in relation to attracting firms and a well-educated workforce. In addition, the *regional level* has gained importance regarding regional development and the knowledge economy both in the Nordic countries and in the rest of Europe. Finally, in comparison with the majority of regions, particularly in western and central Europe, most Nordic regions have considerably smaller populations, and apart from Denmark, struggle with large distances between major urban settlements and have large sparsely populated areas. However, we have seen that the small size and remoteness of some of the REKENE case studies provide no barrier for multiscalar territorial and firm-level knowledge dynamics.

Recommendations

How will policy actors assist the cross-sectoral, multiscalar nature of, and the multiplicity of actors involved in, knowledge dynamics and interactions? To be able to answer this question, various aspects of the issue need to be considered. There is a need to consider *the perception of knowledge and knowledge types*. For instance, symbolic knowledge may have been underestimated in the knowledge economy and innovation discourses. So far, many of the policy instruments have focused on research, scientific knowledge and engineering. A broader perception and application of knowledge concepts may also imply that sectors that are now dominated by women may become visible in discussions of a knowledge-based economy. A broader perception of knowledge may also imply a broader definition of innovation, meaning increased attention to supporting the development of innovations related to new ways of selling, marketing or industrial design. Secondly, we can conclude that the development, generation and transfer of knowledge are processes that are constantly changing in terms of interactions and combinations of knowledge fields; that is, there is a *dynamics of knowledge dynamics*. In a region, several knowledge dynamics prevail at the same time involving different sectors, businesses and other actors. The constant change of knowledge dynamics implies that it is important to keep networks open, both in terms of actors, geography and the issues at stake. This may also imply that the 'triple helix' approach, comprising the notion that it is important to unite actors from the public, higher education and the business sectors in order to develop an innovation system, needs to be further elaborated. We already see that the term 'quadruple helix' has emerged, referring to the inclusion of the civil society, such as non-governmental organisations, in the collaborations. For example, this can be seen in the REKENE case study investigating the development of the New Media Meeting in Östergötland. For policy-making, continuous efforts to provide opportunities for brokering, such as funding of platforms and networks where different actors can meet and interact, will also be important in the future. Finally, knowledge dynamics and interactions are very complex, constantly changing, and context-dependent. We wish to highlight that '*one size does not fit all*' when it comes to policy that supports knowledge dynamics. Instead, strategies and policy measures need to be adapted to the specific situation at hand. Working with knowledge dynamics at a regional level is a fairly recent and evolving policy field and provides a golden opportunity for new politicians and practitioners to be brave, as there is limited risk of being locked into traditional thinking. There is potential for a more open relation to build on the regional strengths by combining with new sectors, knowledge types and geographies.

Contents

Preface

The following report is the result of the *Regional Trajectories to the Knowledge Economy: Nordic–European Comparisons* (REKENE) project.[1] REKENE is a Nordic spin-off from the *Regional Trajectories to the Knowledge Economy: A Dynamic Model* (EURODITE) project.[2]

The intention of the EURODITE and REKENE projects is to probe beneath the popular notion of the 'Knowledge Economy' by describing the diversity of learning processes, knowledge dynamics and knowledge trajectories across Europe. The projects were also intended to examine the assumption that regions and other spatial arrangements, such as 'clusters' or 'milieus', represent coherent units of explanation and intervention in the knowledge field. In addition, the inclusion of practitioner partners was important for the projects because it provided safeguards for users, influenced the work and aided the development of applied research outcomes.

In the EURODITE project, empirical case studies were conducted in 22 regions in 13 European countries. In the REKENE project, seven additional regions of Denmark, Finland, Iceland and Sweden have been studied. The same methods and input from contextual research as in the EURODITE project were utilised to allow comparisons between Nordic and European regions.

This report mainly synthesises and analyses the empirical case study of knowledge dynamics in the seven regions in the REKENE project and compares the EURODITE cases to set the REKENE cases in a wider European perspective. The target readership of this report is practitioners, policymakers and academic scholars with an interest in the field.

In addition to this report, a number of papers have been published or are in the pipeline to be published as a result of the projects. The publications range from articles in scientific journals to pieces orientated towards policymakers and practitioners. Please visit the REKENE and EURODITE homepages for further information on publications.

We would like to stress that this report is a result of collaborative process. The REKENE project has been designed in close co-operation between researchers and practitioners. This has been valuable in terms of the research process, the purpose of working with policy tools and the development of this report. Further information about the working process in the project is included in the executive summary and in Section 1.3. In the report, we have listed the authors of each chapter except for the concluding Chapter 15, to which all project partners contributed. Lise Smed Olsen contributed with editorial work to Chapters 3-9. The illustrations in the report were produced by José Sterling, unless stated otherwise.

We would also like to thank people in the case study regions, who have enabled the research to take place, for instance by participating in interviews or by providing information.

Finally, we would like to express our gratitude to the project partners of EURODITE and REKENE for input and discussions during the projects.

Stockholm, June 2010

Margareta Dahlström and Sigrid Hedin on behalf of the REKENE project team

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[1] The REKENE project was financed by the Nordic Innovation Centre (NICe) under the focus of 'Innovation Policy' for project number 07058, and by participating partners. Read more about the project at (www.nordregio.se/Rekene/).

[2] EURODITE is funded by the European Commission and the Directorate for Research under Priority Seven (Citizens and Governance in a knowledge-based society) of the Sixth Framework Programme, contract 006187 (CIT3). Read more about the project at (www.eurodite.bham.ac.uk). The EURODITE project is led by the Centre for Urban and Regional Studies at the University of Birmingham.

Part I: A framework for understanding knowledge dynamics

This first part of the report consists of two chapters. In Chapter 1 we introduce the aim and design of the project and the building blocks of the research. In Chapter 2, the key concepts utilised in the research are discussed. Furthermore, the main research issues in the analysis are introduced.

1 Regional trajectories to the knowledge economy—the project

By Margareta Dahlström, Sigrid Hedin & Susan Brockett

The Nordic Innovation Centre (NICe) called for the *Regional innovation and Regional innovation actors of tomorrow* programme to develop recommendations for regional innovation policy development in the Nordic countries. NICe identified a need for new knowledge on innovation, to extend themes such as regional innovation systems and provide fresh insights for policymakers in regional innovation. This is in line with the paradigm shift concerning policies for regional development, where entrepreneurship, innovation and knowledge have come to the fore. These issues are discussed further in Chapter 13 of this report. As mentioned in the preface, the *Regional Trajectories to the Knowledge Economy* project (EURODITE)[3] was already underway in this field, and provided a unique opportunity to develop a spin-off project responding to the call by NICe. The current project, *Regional Trajectories to the Knowledge Economy—Nordic–European comparisons* (REKENE), shares the aim of EURODITE to investigate how knowledge is generated, developed and transferred within and among firms or organisations and their regional contexts.

The reason for exploring the dynamics of knowledge is that a knowledge-based economy is considered vital for competitiveness in the global economy. Knowledge is intimately connected with innovations. There is a large body of literature, both in the world of academia and policymaking, dealing with the *knowledge economy,* the *knowledge-based economy* or the *new economy* as it is sometimes called. Very briefly, the knowledge economy can be defined and distinguished from earlier 'economies' by the speed and extent to which knowledge is generated and used. The knowledge economy is characterised by the predominant role of generation and exploitation of knowledge in wealth creation.[4] Over the past decade, policies have consequently been developed to encourage knowledge production and innovation and contribute to economic development. This development is strongly related to the strategic goal of the Lisbon summit: 'that Europe should become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion'.[5] According to the Lisbon Agenda, this was to be achieved by preparing the transition to a knowledge-based economy and society through better policies for the information society and R&D, by stepping up the process of structural reform for competitiveness and innovation and by completing the internal market.[6] However, progress has generally been slow in Europe and in the Nordic countries. Despite good intentions, policies have not delivered innovation and ultimately economic growth at the rate that had been hoped. The fact that the goals had not been achieved resulted in the launch of the

[3] The project is known as EURODITE, see the preface.

[4] For a further discussion of the knowledge economy in academic and policymaking settings that has guided the EURODITE project, see Burfitt *et al.* (2007)

[5] The Lisbon European Council 23 and 24 March 2000.

[6] The Lisbon European Council 23 and 24 March 2000.

strategy document *EUROPE 2020: A European strategy for smart, sustainable and inclusive growth* in March 2010.[7]

If the knowledge economy concerns the increased speed and importance of the generation and use of knowledge, what then are the 'regional trajectories' to this knowledge economy? According to the Lisbon Agenda, and many agenda-setters, the knowledge (-based) economy is a goal. Regional trajectories can be seen as roads or paths to this goal. The knowledge economy is constantly shifting and changing because of processes of knowledge development. Hence, there is no end-state knowledge economy to be reached. Furthermore, the trajectories or paths are also shifting, and need to be flexible to allow for changing direction. The paths are developed and changed over time through a number of processes, such as investments by firms and public bodies, changes in the global economy and to some extent political decisions regarding priorities and programmes. The multitude of interrelated knowledge interactions that exist in any region form parts of these paths or trajectories.

1.1 Understanding knowledge dynamics

EURODITE and REKENE are multidisciplinary projects including researchers from economic geography, organisational theory, economics, management theory, business administration, sociology and other disciplines. This means that from a theoretical and conceptual point of view, the project draws from a multitude of academic disciplines and sources. The main bases of the empirical research in the projects are introduced in Chapter 1. Two of these are concepts developed within EURODITE. In Chapter 2, key concepts that formed the starting point for the empirical research are introduced. In addition, further academic concepts and debates that informed the analysis of the empirical work are briefly introduced. Here we draw attention to the concept of knowledge anchoring, which is a conceptual contribution of the EURODITE project that is also applied to the REKENE analysis.

In these projects, knowledge is seen as a useful economic resource. Knowledge is defined as a learning process in human brains, generated and used in personal and collective interactions in various contexts. It is seen as a process that uses given individual and firm competences to appropriate new and necessary economically useful knowledge. Knowledge is therefore seen as both a resource and a process, which may be confusing. However, an important motive for this view of knowledge is to stress that knowledge is not static but constantly changing and dependent on context and application. Although clearly linked to knowledge, innovation is seen as a change in products, services or processes.[8] There is also a difference between knowledge and information. The latter can be seen as raw material in the knowledge process. Information needs to be processed and contextualised to become knowledge.

A key concept in the project for investigating how knowledge is generated, developed and transferred is knowledge dynamics. In the concept of knowledge dynamics, knowledge as a resource and process are clearly linked to the interactions among actors. According to Strambach, the core of knowledge dynamics is that changes in knowledge are the driving force of innovation. Knowledge dynamics arise through changes in knowledge itself and in the various ways in which knowledge is moved, transformed and created. A result of knowledge dynamics may be an innovation in, for instance, a new or improved product[9] (good or service), organisation or process.[10] Specifically, knowledge dynamics are related to interactions of individuals or groups of actors who are directed to learn, seek and diffuse new knowledge, and

[7] European Commission (2010)

[8] Crevoisier *et al.* (2007)

[9] In this report, 'product' refers to both goods and services.

[10] Strambach (2008) p. 153–154

to apply old and new knowledge in the economy. This may include many activities such as employment of knowledge workers, education, training, consulting and in- and outsourcing.[11]

In the empirical case studies, research into knowledge dynamics was conducted. The empirical case studies are based on the following components: region, sector, territorial knowledge dynamics and firm-level knowledge dynamics, as outlined in Figure 1.3 and discussed below. Better understanding of how knowledge is developed within and among various sectors and types of businesses, how it is transferred, and the role of regional contexts, such as public actors, higher education institutions (HEIs), networks of firms and, for example, social capital can contribute to insights into how policies may be developed and used to stimulate and support knowledge dynamics. This in turn can contribute to increased regional competitiveness.

1.1.1 The region and knowledge dynamics

The point of departure for an empirical case study was the selection of a region in which to explore knowledge dynamics. In EURODITE, 22 regions in 13 countries were studied. In Figure 1.1, the regions where the 55 firm-level case studies of EURODITE were conducted are marked.[12] In the REKENE project, seven regions in four countries were studied (see Figure 1.2). The reason for starting from a region is that the regional level was considered crucial in the development of a more competitive Europe. Increasing attention has been paid to regions as designated sites of innovation and competitiveness in the globalising knowledge-based economy, and there is an extensive body of literature stating that regions are an important source of competitive advantage in growing global interregional competition.[13] The notion of regional competitiveness gained ground with Porter's *The Competitive Advantage of Nations* (1990).[14] The concept of clusters, first coined by Porter, and the development of related concepts, such as industrial districts, innovative milieus, learning regions and regional innovation systems, have all been described as important in relation to competitiveness that extends the boundaries of individual firms but operates within the boundaries of a (loosely defined) territory.[15] However, we assume that knowledge dynamics are not restricted to bounded territories such as administrative regions. Instead, we assume that knowledge interactions stretch across administrative borders, but because the regional context appears to play a role in knowledge interactions—for instance, in discussions of policies—regions are used for the empirical case study. Within the field of policy supporting regional growth and development, there has been a shift to greater focus at the regional level. Stimulating and supporting knowledge dynamics in all types of regions and building on the strengths of each region has come to the fore. This is further discussed in Chapter 13.

[11] Crevoisier *et al.* (2007) p. 2.

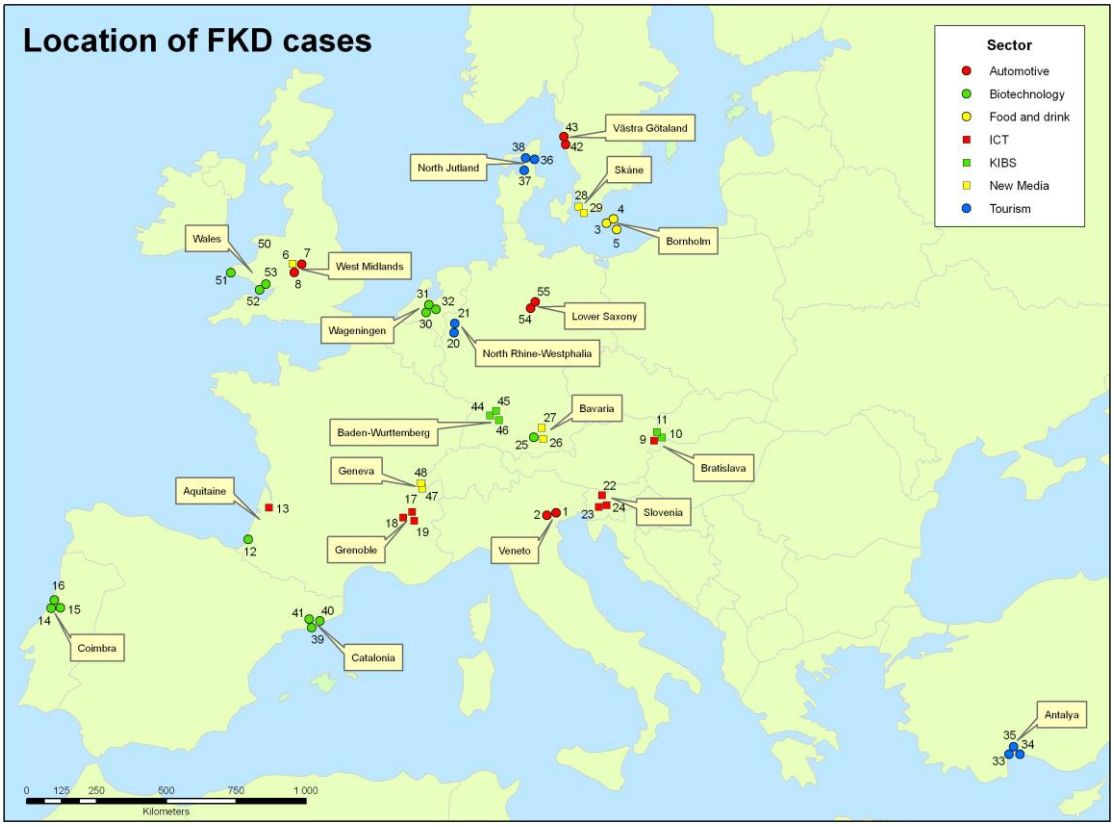
[12] In Figure 1.1, only 20 regions are marked because not all regions were included in the analysis. Appendix 2 includes a list of the EURODITE territorial knowledge dynamics case studies.

[13] See, for instance, Asheim & Coenen (2005), Boschma (2004) and Visser & Atzema (2008).

[14] Porter (1990)

[15] Boschma (2004)

Figure 1.1: The case study regions and firm-level case studies in the EURODITE project



Source: Anders Larsson, Göteborg University

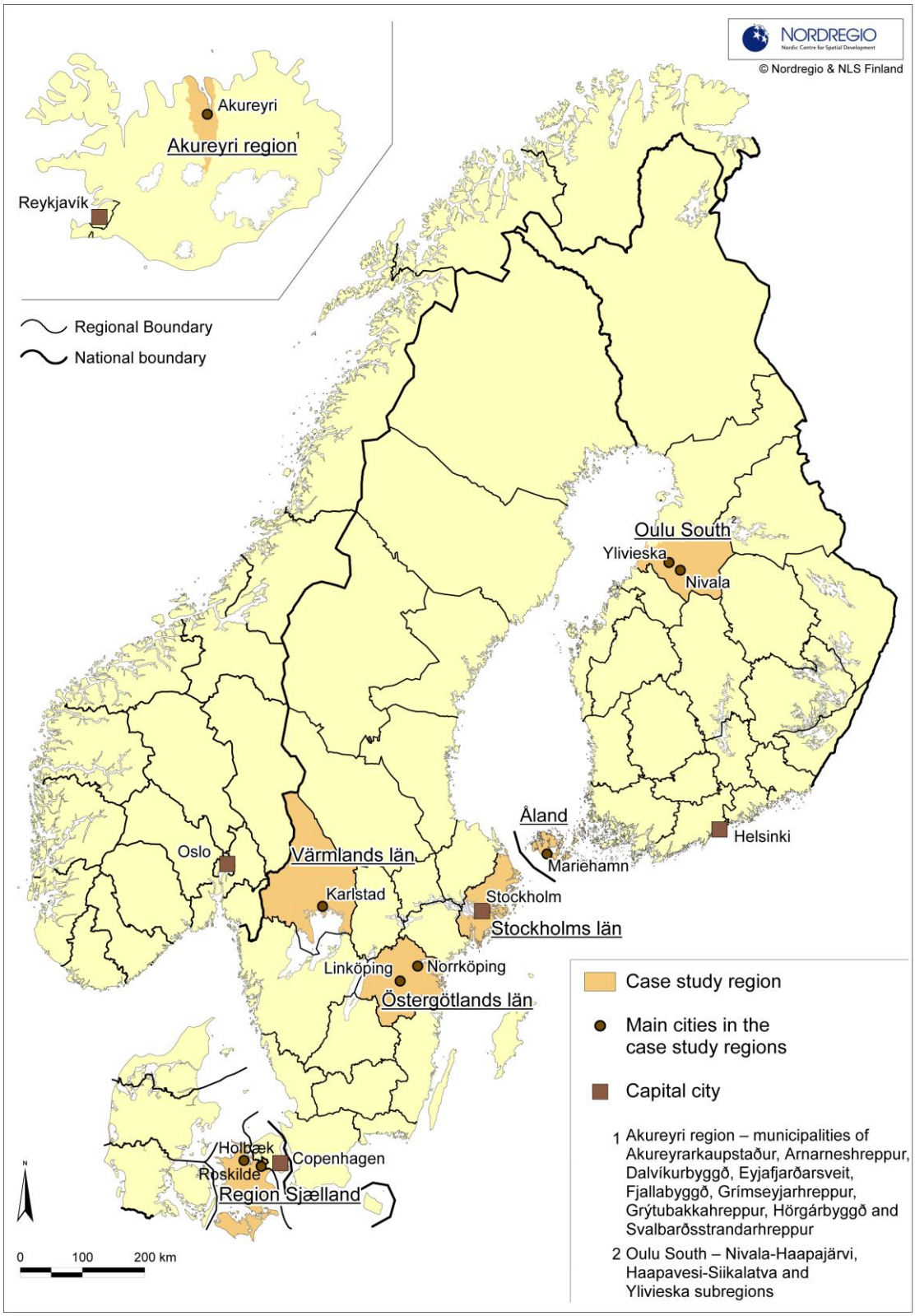
1.1.2 The sectors and knowledge dynamics

Sectors are another component of the EURODITE and REKENE empirical research. EURODITE chose seven sectors to investigate in the project, including sectors with large knowledge content, such as biotechnology and information and communication technologies (ICT), and sectors that have not yet achieved their potential in innovation despite high growth rates, such as tourism and food and drink. The sectors include high-, medium- and low-tech companies. It was assumed the sectors would represent a variety of knowledge dynamics in both good production and services. However, it is important to stress that the predefined sectors were only intended to be a starting point for the empirical case study. A challenge of the sector concept in general is that it is a rather static and analytical category that does not always fit the complex reality of knowledge dynamics. Furthermore, some sectors are themselves heterogeneous entities, such as the new media sector. Many innovations and knowledge interactions tend to occur across sectors. This is evident in many of the empirical case studies investigating knowledge dynamics.

The seven sectors investigated are as follows.

- Automotive
- Biotechnology
- New media
- Food and drink
- Information and communication technologies (ICT)
- Knowledge-intensive business services (KIBS)
- Tourism

Figure 1.2: The REKENE case study regions



1.1.3 Territorial and firm-level knowledge dynamics

In this section, the final two components of the studies developed within the EURODITE project are introduced. In the empirical case studies, the key approach was investigation of knowledge dynamics from territorial and firm-level perspectives.

Territorial knowledge dynamics concern knowledge exchange, networks and interactions among actors from a spatial perspective. Key actors may include firms, HEIs, chambers of commerce and local and regional authorities. The spatial focus stresses the importance of the regional level while emphasising that interaction is not restricted to the administrative regional level. In contrast, territorial knowledge dynamics are seen as multiscalar and may include important interactions at great distances. Understanding territorial knowledge dynamics requires the probing of issues such as the role of proximity and distance in terms of knowledge interactions and the importance of mobility of different actors and individuals. Special attention is paid to how various types of policies affect the knowledge dynamics. These policies may stem from the supranational, national, regional or local levels, but it is the way that the policies are realised at the regional level that is in focus.

While territorial knowledge dynamics provide the context, *firm-level knowledge dynamics* contribute depth and detail about knowledge interactions. Thus, firm-level knowledge dynamics concern how knowledge is developed and transferred at a micro level: within a firm or an organisation, or within a network of firms or organisations. The research framework uses a knowledge biography approach in investigating—or more precisely, tracing—knowledge dynamics starting from a change in product, process or organisation. Key events of knowledge interaction are identified in an attempt to understand the processes and the role of different actors aiming to 'tell the story' of the change from idea to implementation. The links between firm-level and territorial knowledge dynamics, for instance, are seen in the interaction among actors.

1.1.4 Territorial and firm-level knowledge dynamics studied in the REKENE project

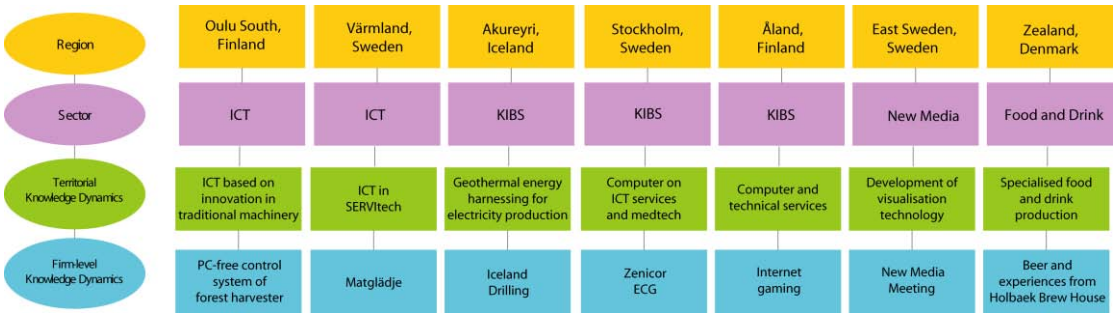
In this report, we describe and analyse the territorial knowledge dynamics with accompanying firm-level knowledge dynamics that have been studied within the REKENE project. Findings from the EURODITE project are used in the discussion and analyses of the REKENE empirical case studies to provide a wider European perspective.

In the REKENE project, the following sectors have been covered in the empirical case studies.

- Food and drink
- Information and communication technology (ICT)
- Knowledge-intensive business services (KIBS)
- New media

An illustration of how the empirical case studies conducted in the REKENE project fit the EURODITE framework, including the components of region, sector, territorial and firm-level knowledge dynamics, is shown in Figure 1.3.

Figure 1.3: Structure of empirical research in EURODITE and the territorial and firm-level knowledge dynamics in the REKENE case studies



1.2 How the study was conducted

The aim of studying knowledge dynamics is to unravel the processes of knowledge interactions and to identify types of actors involved in these processes. An essential part of the research is interviews with key informants, mainly conducted face-to-face during field work, but in some cases via telephone. Because the research deals with interactions and networks among actors and is particularly aimed at identifying knowledge exchange and development, it would not have been possible to discover so much about such processes in any other way. Furthermore, we were interested in the location of the various actors. An advantage of this method is that these issues may be broached and discussed with actors involved in knowledge interactions. At the same time, it means that we became very dependent on the information from the interviewees, and it could be difficult to verify information and maintain distance from the informants. Although we have attempted to speak with different actors and obtain several people's views, it is important to remember that we obtained 'stories' and had to handle our information as such. In addition to the interviews, information was gathered from policy documents, reports, academic literature and Internet homepages.

At the heart of the firm-level case studies are the so-called 'knowledge biographies' in firms and organisations. The 'knowledge biography' method is an innovative approach providing a deeper understanding of knowledge dynamics in firms and regions. We traced the development of a product and interviews were used to obtain basic information about the space and time dimensions of knowledge dynamics. What important knowledge interactions occurred in the development of the product? Who were the actors? Where were they located? What type of knowledge did they contribute? All information was gathered through semistructured interviews and from home pages or documents. The 'knowledge biography' method can capture the diversity of the social environment of a firm or organisation, identify knowledge flows and obtain information about partners inside and outside it.

We stress that both the territorial and firm-level knowledge dynamics were studied over a particular period. We examined past knowledge interactions that occurred over a limited time period. The empirical field work began in January 2008 and ended in June 2009. Furthermore, it is important to stress that most interviews were conducted before the global financial crisis began in September 2008. Conditions would most likely have been different if the interviews had been conducted later. For instance, most companies faced a lack of labour when the interviews were performed.

The aim of the case studies has not been to map all actors and knowledge interactions completely. This would not be possible. Moreover, it is important to remember that knowledge dynamics are ongoing processes and therefore, the processes we have captured should be seen as 'snapshots' covering the time periods of the empirical research.

1.2.1 Insuring policy relevance through research–practice co-operation

An important part of the REKENE project is that it was designed as a collaborative project between researchers and practitioners. This has been valuable both in terms of the research process, and for the purpose of working with policy tools. It was an exploratory research method and we therefore provide some further details of the processes below.

The methodological concept: Practitioners and researchers as teams

Making research results relevant to policy is always a goal, and is not always easy to achieve. Researchers may lack experience or insight concerning what will make the results of their work most useful, while practitioners lack understanding of research methodology and limitations. Research is often characterised by a 'downstream' knowledge flow, in which research is designed, conducted and analysed only by researchers, and results are transmitted to the user. There is often minimal 'upstream' knowledge flow from users to researchers. This mono-directional flow underestimates the value of practical or tacit knowledge relative to scientific knowledge. Practitioners can provide important input into defining research questions, assisting researchers by providing ideas for research implementation, and providing extra insight into analysis.

From the outset of the project, a team from each region consisting of at least one researcher and one practitioner participated. The practitioners served as 'door-openers', helping the researchers to gain contact with useful and relevant informants, and as 'sounding boards' to discuss the relevance and significance of research results as they began to emerge. The researchers could, in turn, 'hold a mirror' to the practitioners, giving them feedback on their attempts to reflect upon and understand their practices and their context.

Communicative process: the project as a series of working seminars

To practise research communication within and among the partner teams, the project included a series of nine working seminars. Some seminars were designed only for researchers and six were for both practitioners and researchers. The teams also worked together in discussions and preparation between seminars. The joint seminars included a combination of parallel sessions, in which the practitioners explored salient aspects of their work while researchers discussed their progress, and sessions involving practitioners and researchers working together. One of the aims of REKENE was to deliver policy tools for knowledge dynamics. Although this was a collaborative practitioner–researcher task, the practitioners bore the main responsibility for this undertaking. The seminars proved invaluable formats for this work. The work with the policy tools went far beyond what was originally planned for the project, which in itself is an indication of the fruitfulness of this way of working. The process of working with the policy tools is further discussed in Chapter 14 and in Appendix 4. The ninth seminar had not been held at the time of writing this report. It was planned as an open conference in which project results should be presented, workshops on the policy tools should be conducted, and where external experts would contribute reflections on the study. This conference will take place on 24–25 August 2010, and this report will be distributed to the participants at the event.

Showcases as research input and reflections on practice

Because each region was visited, it was possible to include a showcase in each. The hosting team prepared on-site visits to organisations, businesses and HEIs that displayed territorial knowledge dynamics and exemplified the use of policy tools. These were chosen for their relevance and many were not research subjects, but supplements to the case studies. The rich set of shared experiences provided a set of common references that promoted better discussions and new insights, as well as helping to contextualise the work for all involved. They also provided an opportunity for the researchers to engage interactively in 'testing', analysing and developing the emerging knowledge about knowledge dynamics. In addition, participating practitioners discovered new ideas that were immediately applicable to their own practice.

Thus, the project had policy relevance from the start, even before research results were available.

1.3 Structure of the report

Now that we have introduced the project, Chapter 2 will present the conceptual framework employed in the project. Some key debates that have been considered in the analysis of the empirical findings will also be presented. In Part II of the report, the seven case studies are presented in Chapters 3–9. These chapters include descriptions of the regional contexts of the regions and sectors studied, brief summaries of the territorial and firm-level knowledge dynamics that form the empirical case studies, and some concluding comments. In Part III of the report we turn to a more systematic analysis of the case studies, where we also draw on the EURODITE research to provide Nordic–European comparisons. In Chapter 10, a deeper analysis of the territorial knowledge dynamics is conducted. A special focus of this analysis is the question of how extraregional knowledge is accessed and recirculated within the regions, and how it is anchored. Chapter 11 concerns firm-level knowledge dynamics analysed in relation to the elements of knowledge types, phases and processes. In addition, emphasis is placed on the role of geographical distance and proximity within knowledge dynamics. Chapter 12 includes a discussion and analysis of how the knowledge interactions found in the empirical case studies can be interpreted and analysed from a gender perspective. Policy issues are discussed in each of these analytical chapters, and in addition, a more systematic deliberation of public policies in relation to knowledge dynamics is conducted in Chapter 13. In Chapter 14, we consider the work with policy tools in the project. Finally, in Part IV, Chapter 15, we conclude the report with some reflections on our in-depth studies of knowledge dynamics and a brief discussion of policy implications of the study.

For names of actors and institutions in their respective native languages, we have used English names if there is an official translation. If not, the native language name is used. The first time a name is mentioned, an English translation is provided. To aid readers, we have provided a list of abbreviations in Appendix 1.

2 Key concepts and issues in knowledge dynamics

By Margareta Dahlström, Sigrid Hedin & Lise Smed Olsen

The aim of the EURODITE and REKENE projects was to investigate how knowledge is generated, developed and transferred within and among firms or organisations and their regional contexts. Consequently, territorial aspects of innovations in general and knowledge interactions in particular are scrutinised. In this chapter, we first address some key concepts regarding *knowledge types, phases and processes* that have been used in the design of the empirical cases studied in the projects. Secondly, we refer to some central issues and concepts that have been incorporated in the analyses of the research. In this context we also introduce a concept that has been developed within the EURODITE project, addressing some of these issues. This concept is called *knowledge anchoring*, and is discussed in greater depth in Chapter 10.

2.1 Key concepts used in the REKENE and EURODITE projects

To study territorial and firm-level knowledge dynamics, we need to address further elements that are important for a deeper understanding of knowledge dynamics and interactions. These elements constituted the key framework for the empirical case studies of EURODITE.

2.1.1 Knowledge dynamics and knowledge types

As discussed in Section 1.1, knowledge is defined as a learning process in human brains, generated and used in personal and collective interactions in various contexts. Knowledge is understood both as a resource and a process. Because this is a rather broad definition of knowledge, it is necessary to distinguish among different types of knowledge that may be encountered in the empirical case studies. This was considered important because knowledge develops from various fields and sets of players, and integration of different kinds of knowledge is needed for innovation.

For knowledge types, the point of departure in EURODITE was the discussion of analytical, synthetic and symbolic knowledge.[16] These concepts were operationalised to guide the empirical work in the following manner. *Analytical knowledge* is understood as research-based knowledge, primarily developed through scientific exploration. *Synthetic knowledge* was considered a result of a secondary-stage combination of analytical and (perhaps) symbolic knowledge. For instance, engineering knowledge is said to be synthetic because it derives from application and from original (scientific) research. *Symbolic knowledge* relates to knowledge about representation. For example, the 'styling' of a product, organisation or process in a way that may convey an image that appeals to certain consumers. It may also include knowledge that contributes to the development of a brand symbolising certain characteristics of a product.

[16] There is a growing body of academic literature on this issue, and references can be made to many researchers. See, for example, the discussion in James *et al.* (2010a). A useful starting point is Asheim *et al.* (2007).

Furthermore, understanding the development, management and protection of this abstract quality can be described as symbolic knowledge.[17]

In knowledge research, a distinction is often made between tacit and codified knowledge. This distinction was important for investigating variation in the transfer of different types of knowledge, for instance in relation to geographical distance and proximity. The operationalisation of this distinction was as follows. *Codified knowledge* is understood as knowledge that can be represented in writing or other digital or analogue formats. Therefore, codified knowledge can be transmitted to others who are prepared to make sufficient investments—for instance, in time or money—and who can absorb and utilise it. Codified knowledge can be transferred without requiring geographic proximity among actors. However, for it to be absorbed and used, 'cognitive or relational proximity' may be necessary.[18]

In contrast to codified knowledge, *tacit knowledge* is understood as knowledge that largely comes from practice and is embedded in people.[19] Asheim *et al.* state that tacit knowledge is difficult to codify because it is articulated 'through practical skills and cannot be reduced to numbers, graphs, maps, diagrams, texts, formulas, etc.'[20] They argue that face-to-face contacts or 'buzz' are consequently important for transfer of tacit knowledge. This is elaborated further in Chapter 10.

However, it is not possible to separate tacit and codified knowledge entirely, because they usually coexist. In practice, tacit knowledge is, for instance, often necessary to understand codified knowledge. An example is that laboratory results can be codified, but in experimentation there are many subtleties of method that are known to the experimenters. This is unique to them and is the added value that they retain.[21]

2.1.2 Knowledge dynamics and knowledge phases

To understand the complexity of firm-level knowledge dynamics, it was necessary to distinguish among various knowledge phases of exploration, examination and exploitation. However, it is important to stress that knowledge dynamics seldom entail a linear process. This means that innovations are rarely developed in a research laboratory, tested and then applied in a market. Instead, the development may take place in various phases at the same time, and there may be loops between these phases. This may be related to the increased number of interactions between producers and end-users. However, by examining knowledge dynamics and considering these phases, more information about how the phases are connected and the loops between them was acquired, which is hoped to contribute to a deeper understanding of the mechanisms of knowledge dynamics. We also investigate whether different types of actors tend to be more active in some phases. From a policy perspective, it is relevant to the kinds of phases for which policy instruments are designed and applied.

The *exploration phase* is often described as the first step in a knowledge chain. This phase is characterised by the action of searching for new knowledge or maintaining and developing existing knowledge. The phase may include scientific knowledge but does not necessarily do so. An example that does not entail scientific knowledge is searching for upstream or downstream collaborators or competitors as an exploration process that may lead to new knowledge. The *examination phase* was understood as a testing phase in which the veracity and applicability of the knowledge is considered, for example subjecting a potential new therapeutic method to clinical trials. Another example is stress testing of a new material or component. Finally, the *exploitation phase* can be seen as the 'selling' or 'using' phase in which knowledge is put to use.

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[17] Collinge *et al.* (2008)

[18] Collinge *et al.* (2008). Such proximities can, for example, relate to factors such as the shared understanding among people working within the same discipline.

[19] Collinge *et al.* (2008)

[20] Asheim *et al.* (2007) p. 655.

[21] Collinge *et al.* (2008)

This may be for financial return but may also, as in academia, be for status, position or recognition.[22]

2.1.3 Knowledge dynamics and knowledge processes

As stated above, the point of departure for the EURODITE project is that knowledge is about processes. It has also been mentioned in the discussion about the sectors that innovations tend to take place across sectors and academic disciplines. To investigate this dimension further, a distinction was made between cumulative and composite knowledge processes when we studied knowledge dynamics empirically. A *cumulative process* is one in which new knowledge builds upon, and depends directly on, existing knowledge within the same field or discipline. An example is a scientific discovery that adds to previous discovery. Thus, the 'body of knowledge' is increased. A *composite process* consists of and depends upon several disciplines or functional areas of knowledge. These may include various sources of analytical or science-based knowledge.[23] It is therefore typical that in the process of generating composite knowledge, different and basically separated knowledge stocks are brought together. However, each knowledge stock may be anchored in a cumulative knowledge process.[24]

2.2 Key issues in analysing the empirical research

There is a vast body of literature available to aid the analysis of the empirical research, not least owing to the complexity of the material and the various academic disciplines that the project draws upon. Below, some key issues and concepts that we have used as a framework for analysing the findings of the empirical research are introduced. The first section elaborates on the development of the concepts of regional innovation systems, clusters and the triple helix approach now being applied in various policy instruments supporting knowledge development and transfer. The second section concerns the concept of path dependency and the roles of history and institutional setting in knowledge interactions and regional development. In the third section, we introduce the concept of knowledge anchoring. The fourth section considers a gender perspective on knowledge dynamics, and in the final section we turn to the shift in paradigms of policies for regional development.

2.2.1 Path dependency and knowledge dynamics[25]

The concept of path dependency is often associated with the statements 'history matters'[26] or 'the past influences the future'. However, the concept can be broadened further; for example, to include the concept of lock-in. Regional development paths arise not only from historical legacy in a deterministic manner but also as an interrelation, or co-evolution, with local structures and human action.[27] Thus, both time and space form a development path, but history influences the possible options and probable outcomes of policies and strategies for developing new growth paths.[28] Variations in endogenous factors form the basis of development. Interaction with actors inside and outside a region is necessary for cumulative

[22] Collinge *et al.* (2008)
[23] Collinge *et al.* (2008)
[24] Strambach & Stockhorst (2010)
[25] See also Dahlström *et al.* (2010)
[26] David (1985)
[27] Bassani & Dosi (2001)
[28] Boschma (2004)

knowledge dynamics and learning to take place. Path dependency is strengthened by these self-reinforcing elements and structures that 'lock-in' certain pathways of development. In addition, exogenous factors such as changes in the global economy continuously alter the development of regions.

A successful regional development process is characterised by learning processes that moderate the development path. The processes of emergence or regeneration of a path can be initiated at the micro level in the following ways. The push factor may be novelty, for instance in the form of new sectors or clusters, self-renewal, or diversification into new development areas.[29]

A process of negative path dependency, or lock-in, makes it difficult to introduce changes, perhaps because options to change have become limited. These lock-ins can be divided into functional, cognitive, and political forms. The *functional lock-in* refers to dominant working methods that do not permit new ways of doing things or allow upgrading and enhancement of existing industries. The networks are closed, and established coalitions prevent the widening of the existing knowledge and innovation base. *Cognitive lock-in* refers to an inflexible use of discourse and view of regional development actors who concentrate on sustaining the existing system. *Political lock-in* refers to political administrative coalitions that wish to remain in their positions and are unable to introduce changes in their working environment. *Negative lock-in* is a potential consequence of path dependency; however, it is not unavoidable.[30]

2.2.2 Regional innovation systems, clusters and triple helix

Regional innovation systems and *clusters* are concepts concerning territorial innovation that have gained particular attention from both academia and policymakers. The concepts are closely related, but as Asheim *et al.* stress, there are also distinct differences between the concepts.[31] Clusters can be defined as 'a concentration of "interdependent" firms within the same or adjacent industrial sectors in a small geographical area', whereas regional innovation systems can be described as 'interacting knowledge generation and exploitation subsystems linked to global, national and other regional subsystems'. Clusters and regional innovation systems can coexist in the same territory. However, from a policy perspective, the sector-specific nature of clusters and the more generic sector orientation of regional innovation systems are significant.

The regional innovation system can be described as the institutional infrastructure supporting innovation in regional production. Thus, a regional innovation system involves two subsectors of actors actively engaged in interactive learning:[32] (1) the regional production structure or knowledge exploitation subsystem consisting mainly of firms, often displaying clustering tendencies, and (2) the regional supportive infrastructure or knowledge generation subsystem, consisting of such institutions as public and private research laboratories, universities and colleges, technology transfer agencies, and vocational training organisations. Moreover, the institutional context—i.e. norms, trust and routines—is significant for interactive learning, which informs innovation systems. An innovation system involves a systems perspective, which is the recombination of the economic dynamics of the market, the dynamics of knowledge-based innovation, and governance. The systems perspective that informs innovation systems can be applied at different levels of governance, and can thereby be evident at national and regional levels, and in dynamic models such as the triple helix of university–industry–government relations.[33]

According to the triple helix approach, strong relationships among universities, firms and government agencies are crucial in encouraging innovation within regions. In earlier phases of triple helix thinking, there was a strong focus on natural sciences and technology transfer.

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[29] Martin & Sunley (2006)

[30] Martin & Sunley (2006)

[31] Asheim & Coenen (2005)

[32] Asheim & Coenen (2005), p. 1177.

[33] Cooke & Leydesdorff (2006)

Science parks and incubators are examples of the infrastructure that is often part of public policies supporting triple helix knowledge transfers.[34] Other examples include funding to link universities and firms in knowledge sharing and development.[35] Technical and natural sciences still dominate triple helix thinking. However, in line with a move within innovation policies from a focus on technological innovations to a broader innovation concept including services innovation, triple helix thinking has also expanded beyond its previous narrow focus on technology. More recently, the phrase has, in some cases, become shorthand for almost any strategy that focuses on knowledge interaction for development, innovation and growth where all three spheres of industry, universities and government are active. An example of this is the Swedish Governmental Agency for Innovation Systems (VINNOVA).[36]

2.2.3 Knowledge anchoring—a new concept[37]

In the analysis of territorial knowledge dynamics in EURODITE, the concept of *knowledge anchoring* was developed. It emerged from a focus on intraregional interactions among firms and other actors, and policies supporting such interactions, which were prevalent in economic geography until recently. The issues introduced above relating to regional innovation systems, clusters, triple helix and path dependency are important sources of literature here. In addition, the issues concerning the concepts of *local buzz* and *global pipelines* were addressed. The concept of knowledge anchoring relates to the inflow and recirculation of knowledge in regions. This is further elaborated in Chapter 10, in which we present an analysis of the territorial knowledge dynamics of the REKENE case studies. In addition, we briefly introduce the concepts of local buzz and global pipelines that occur in the final body of literature that were incorporated in the development of the concept of knowledge anchoring.

The concepts of local buzz and global pipelines have been developed to show how knowledge interactions among actors at the local or regional level are combined with interactions with those at a greater distance. The model is intended to explain the role of both intra- and extraregional interactions. According to Bathelt,[38] buzz can be understood as information, knowledge and inspiration that circulates among the actors of a cluster. The buzz may consist of specific information flows, knowledge transfers and continuous updates that take place in both organised and spontaneous meetings. Bathelt argues that buzz is based on the co-location within a region of many firms in one value chain that share face-to-face interactions. Thus, buzz can be defined as the non-deliberate acquisition of knowledge through interaction, in contrast to more deliberate actions such as monitoring of competitors, sharing of knowledge among suppliers and customers, and collaboration on specific projects.

To avoid negative 'lock-in' in a region, local buzz may be combined with extraregional linkages or 'pipelines'. These global pipelines may, for instance, offer access to new knowledge about markets or technologies. Global pipelines have been used to describe the channels of knowledge flow among regions located in different parts of the world. Compared with local buzz, the knowledge transfer through global pipelines may be seen as more structured and explicit.[39]

The concepts of local buzz and global pipelines have been criticised because precise understanding of the mechanisms by which actors in, for instance, a cluster gain access to knowledge at different spatial scales is missing.[40] There have been additional nuances of buzz.

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[34] Etzkowitz (2002)

[35] Benner & Sandström (2002)

[36] James *et al.* (2010b)

[37] A deeper discussion concerning the development of the concept of knowledge anchoring, and its policy implications, may be found in James *et al.* (2010a) and (2010b).

[38] Bathelt (2007)

[39] Bathelt (2007)

[40] Trippl *et al.* (2009)

According to Asheim *et al.*,[41] buzz cannot simply be translated as face-to-face communication. Instead, face-to-face communication is, above all, related to transfer of tacit knowledge, while buzz is important for symbolic knowledge. It has also been demonstrated that buzz can be seen as a planned process.[42] The characteristics of knowledge interactions are consequently not so distinct that they could be considered typical of local buzz or global pipelines. The same kind of interactions may occur regardless of where an actor is located. In this discussion, Boschma's distinction of five kinds of proximity (cognitive, organisational, social, institutional and geographical) may be used to understand the roles of different kinds of proximities. Physical proximity may facilitate learning or knowledge exchange but is not a necessity. Instead, the role of other kinds of proximities may be more important for knowledge interactions. The interactants may have disciplinary proximity because of their professional training, or social proximity because of trust.[43]

2.2.4 A gender perspective on knowledge dynamics

A gender perspective in analysing knowledge dynamics shows a more nuanced picture of the knowledge economy. A gender perspective in this respect means that knowledge interactions are analysed in terms of the roles of men and women. It includes discovering whether the actors involved in the knowledge dynamics are men or women, and if the way in which knowledge interactions occur tends to exclude men or women. It also examines the connotations of terms such as innovation and entrepreneurship. Because these are key aspects of the knowledge economy and the focus of policies to support the development of such an economy, it is important to unpack the view that policymakers have of entrepreneurs' and innovators' identities, and the sectors within which they operate. These issues are further discussed in Chapter 12, in which the empirical results of the project are analysed from a gender perspective.

2.2.5 Policies for regional development in the knowledge economy

A final issue in the analysis of the research of the EURODITE and REKENE projects is the shift in paradigms of policies for regional development. The 'old' regional development policies focusing on regions that lag behind have been replaced by strategies for regional growth in all types of regions. There has been a Europeanisation[44] of these types of policies whereby the overarching agenda has been the Lisbon Strategy, focusing on competitiveness, innovation and entrepreneurship. Another aspect of the Europeanisation of the policies is the way in which strategies are developed and implemented through partnerships of various actors and the linking of policies and funding on several geographical scales. In the analysis of the policies for regional development in the knowledge economy, the dimensions of hardware, software and orgware have been utilised. Briefly, these refer to initiatives or measures targeting physical infrastructure, human resources and network capacities respectively.

2.3 Concluding comments

To summarise, in this chapter we have presented and discussed some of the key concepts underlying the empirical case study. We have also introduced the key issues and concepts to which we refer when analysing the research and placing the empirical case studies in a broader theoretical framework. The following chapters include an introduction to the regional contexts

[41] Asheim *et al.* (2007)

[42] Moodysson (2008)

[43] Boschma (2005)

[44] Böhme & Waterhout (2008)

of the case study regions and brief summaries of the territorial and firm-level knowledge dynamics studied. In Chapters 10, 11, 12 and 13, we return to the key concepts and issues in the analysis of the empirical findings of the studies on territorial and firm-level knowledge dynamics.

Part II: Knowledge dynamics in seven Nordic regions

In this part of the report, the seven case studies are presented in Chapters 3–9. These chapters include descriptions of the regional contexts of the studied regions, the sectors that are studied and brief summaries of the territorial and firm-level knowledge dynamics that form the empirical case studies. The order of the chapters is based on the sectors that form the starting point for each case study. The first two chapters include the case studies that begin with the ICT sector; Chapter 3 deals with knowledge dynamics in the ICT and traditional machinery sectors in the Oulu South region, and Chapter 4 deals with knowledge dynamics in the ICT sector of Värmland. Following these are three chapters in which KIBS form the entry point of the studies. In Chapter 5, KIBS in the renewable energy sector in the Akureyri region are discussed. Chapter 6 deals with the KIBS and medical technology sectors in the Stockholm region. In Chapter 7, knowledge dynamics in KIBS and the subsector of computer technical services in Åland are discussed. Chapter 8 turns to a case study of the new media sector in Östergötland. Finally, Chapter 9 describes knowledge dynamics in the food and drink sector in Zealand.

Each chapter is based on two unpublished reports produced for each region. In these reports a full list of sources and interviewees can be found. Appendix 3 provides a list of these reports, and contact details of the authors.

We stress that the case studies and figures exploring territorial and firm-level knowledge dynamics, including actor maps and knowledge biographies, are only snapshots of the actors and interactions involved in knowledge dynamics. Consequently, they should be considered simplified versions of the interactions, because other actors may have been involved.

An analysis of the case studies is presented in Part III.

3 Knowledge dynamics in ICT and traditional machinery sectors in the Oulu South region

By Harri Jokela, Eija-Riitta Niinikoski & Ari Saine

This chapter provides a perspective on knowledge dynamics in a cross-sectoral focus on ICT and the traditional machinery industry in the Oulu South region. First, the regional context of Oulu South is described. Second, the sectors in focus are introduced. Third, an introduction to the territorial knowledge dynamics of the main actors in Oulu South region is provided. Finally, a firm-level perspective on knowledge dynamics in ICT and traditional machinery is provided, describing a specific case of the development of a control system for forest harvesters.

3.1 The Oulu South region

The region of Oulu South is situated in the southern part of northern Ostrobothnia, 50–150 km south of the city of Oulu. Oulu South is not a governmental unit or area. It was formed to increase intermunicipal co-operation and development and to gain the required critical mass for national and international competition.

Figure 3.1: The Oulu South Region

Oulu South consists of three subregions and 14 municipalities. It has an area of 10,895 km^2, which is almost as large as Skåne in Sweden. Its peripheral location is one of the greatest challenges to the region. It is 450 km from Helsinki, Finland's capital city, and 1,500–2,500 km from central Europe. Much of the area consists of forests and agricultural land. Urban areas are concentrated on the banks of three rivers: the Kalajoki, Pyhäjoki and Siikajoki rivers, and in small towns of the region. In the Finnish regional typology, Oulu South is one of the main rural areas. Oulu South could also be considered an industrialised countryside, which refers to its ability to offer sufficient employment for every inhabitant. Furthermore, the unemployment rate is the lowest in northern Finland.

The number of inhabitants in the Oulu South region was 87,475 in 2005. The population has been decreasing over the past 15 years. However, in recent years, this trend has ceased in the western Ylivieska subregion. Another trend is the concentration of the population westward towards the north–south railway and the coast. The demographic challenge is emigration from the area, while the strength of the region is that the birth rate is the highest in Finland. Therefore, the proportion of young people will remain high for the near future. The situation in other rural areas in Finland is very different.

The Oulu South region consists of 14 municipalities, of which seven are small towns. Furthermore, the region consists of three subregions, which are Nivala-Haapajärvi, Ylivieska and Haapavesi-Siikalatva with 31,000, 40,000 and 16,000 inhabitants respectively. The biggest of the cities is Ylivieska, with 14,000 inhabitants, while the other cities have approximately 10,000 inhabitants. Each rural municipality has 3,000–5,000 inhabitants.

In spite of its peripheral location, Oulu South is well connected to logistical networks. The nationally important north–south Bothnian railway line traverses the area with stations in Ylivieska and Oulainen. There is also a line from Ylivieska to Iisalmi (with stations in Nivala, Haapajärvi and Pyhäjärvi) connecting the Bothnian line to the eastern line. The railways are used mainly for interregional travelling. One of the most important roads in Finland, Highway 4, which is also a part of the European TEN network, goes through the region. Another important road connection is Highway 8 along the western coastline. The weakness of the region is its relative remoteness from airports (Oulu and Kokkola, 100 km). On the other hand, Oulu airport is Finland's second largest airport and is busy in terms of the number of flights per day. Finally, the region has dense broadband network connections.

In January 2005 there were 4,377 companies in the Oulu South region, which was 25 per cent of the total number of companies in northern Ostrobothnia[45]. The public and private sectors together provided 32,496 jobs. The biggest employers in the area were:

- The welfare sector (mainly public): approximately 5,500 jobs;
- Agriculture (farms and food companies): 5,000 jobs;
- The metal and machinery industry: 2,700 jobs;
- Retail: 2,500 jobs;
- The wood processing industry: 2,000 jobs;
- The ICT sector: approximately 1,000 jobs; and
- Tourism: 500 jobs.

In annual turnover, the largest economic sector was retail (€830M), the second was the metal industry (€385M) and the third was agriculture, at €360M. Almost as large was the wood processing industry, at €355M. The ICT sector had annual turnover of €126M, and mining brought in €115M (mines in Pyhäsalmi and Nivala).

[45] Statistics Finland (2007)

3.2 The ICT and metal and machinery sectors in Oulu South

Co-operation between the ICT and metal and machinery industries is significant for the economy of the Oulu South area. The ICT sector has developed in two phases. The sector experienced steady growth in the first phase between 1995 and 2002. In 2002, the ICT bubble 'burst', which resulted in several ICT businesses being acquired by global companies and leaving the region, and this began to have a negative effect on the turnover of the ICT sector. In 2007, the sector had reached approximately the same level as in 2000. Meanwhile, following the collapse of the ICT sector, attempts were made to find new business opportunities in the region. Accelerating globalisation has posed additional challenges. The adaptation of ICT to the traditional business sectors is seen as one response to the challenges of the region. The ability to implement new, technological, wireless IT solutions and automation is considered critical in the mechanical engineering industry. The machinery manufacturers are mainly small companies with limited opportunities to invest in R&D.

In December 2005, 108 ICT companies were located in the Oulu South region. The number of companies increased by approximately 30 per cent from 1995 to 2005[46]. The ICT sector in the region can be divided into four main categories: production, services, media and 'mixed' ICT.

The largest actors in the production of ICT products are also among the largest industrial companies of the Oulu South region (Scanfil Ltd., Ojala Yhtymä Ltd. and Darekon Ltd.). These companies are mainly active in international markets. The service ICT sector companies are small and their focus is mainly on the national and regional levels; there is only one large actor, Pohjanmaan Puhelin Ltd. In the media sector, the companies are small, employing from one to 10 people; their focus is on the regional and national level. In the mixed ICT category, the companies are also relatively small local actors.

The ICT sector influences other business sectors in the Oulu South region. Thus, the efficiency and productivity of wood processing and metal industries has been increased through R&D activities to implement ICT in production and products. The implementation of ICT has had an impact on agriculture and retail, which are supported through regional strategies both on the Oulu South and provincial levels.

In December 2005, a total of 182 metal sector companies were located in the Oulu South region. The number of companies remained approximately the same from 1995 to 2005[47]. The metal sector in Oulu South can be divided into three branches: production of metal products (excluding machinery), machinery and the mixed metal industry.

With regard to manufacturing of metal products, the largest actors are also the major industrial companies of the region, YIT Industria Ltd., Mecanova Ltd. and Rautaruukki Ltd. Examples of their products are parts for large structures such as bridges or nuclear power plants. These companies focus mainly on international markets. In the machinery industry, the companies are mainly small or medium sized. Their focus is mainly on national markets with a small international share. Companies in this industry produce agricultural machinery and similar products.

The turnover in Oulu South's metal industry doubled during the period 1995–2005. The positive development of the turnover has not been directly reflected in the number of employees in the sector. During the period 1995–2001, the number of employees in the sector increased; however, after 2002, the increase in efficiency and the continuously growing productivity of the industry caused a decline in the number of employees.

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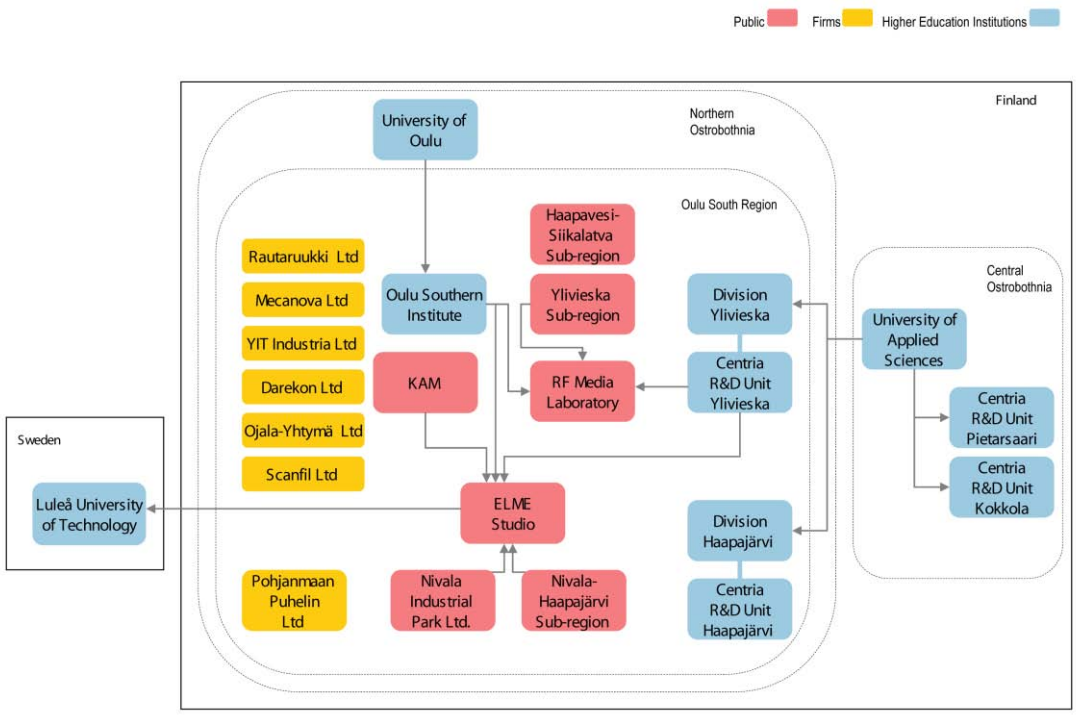
[46] Statistics Finland (2007)

[47] Statistics Finland (2007)

3.3 Territorial knowledge dynamics in ICT and metal and traditional machinery[48]

The main actors in ICT and the traditional metal and machinery sectors in Oulu are introduced in this section and illustrated in Figure 3.2. The figure also provides examples of extraregional knowledge interactions.

Figure 3.2: Examples of key actors in ICT and metal and traditional machinery in the Oulu South region



As mentioned above, the Oulu South region is divided into three subregions, which co-ordinate development projects, provide funding and ensure implementation of a number of these projects. The subregions are Nivala-Haapajärvi, Ylivieska and Haapavesi-Siikalatva.

Overall, compared with the national average, the level of education is low in the Oulu South region. However, an HEI, the University of Oulu, is present in the region. Oulu Southern Institute was established as a regional unit of the University of Oulu in the year 2000. In the same year, the Kerttu Saalasti Foundation was set up to support the management and development of projects at the institute, and support research and education by providing grants and scholarships. The University of Oulu offers education programmes related to both the metal and ICT sectors through three different departments focusing on mechanical engineering, information processing science and electrical and information engineering. It is common for students in these programmes to have internship placements and to write their theses in co-operation with firms in the region. The Oulu Southern Institute does not offer education programmes, but helps students living in the Oulu South region with distance learning, and finding local subjects for their theses and places for their practical training periods. During the period 2002–2007, the Oulu Southern Institute had three projects financed

[48] Please note that the figures, including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively, are only snapshots of the actors and interactions involved.

by the European Social Fund, which dealt with the local arrangements of three master's degree programmes (focusing on information processing science) that were conducted at the University of Oulu. The programmes were organised using distance learning methods in the Oulu South region.

Central Ostrobothnia University of Applied Sciences is located in a neighbouring region. The university has two departments, in Ylivieska and Haapajärvi in Oulu South. Like the University of Oulu, this university provides education programmes involving the metal and ICT sectors, and students are engaged in the local business community for internship placements and thesis writing. As part of Central Ostrobothnia University of Applied Sciences, the Centria R&D unit was established in the towns of Ylivieska, Kokkola, Pietarsaari and Haapajärvi. Centria implements R&D projects and assists in the co-ordination of education programmes.

The Educational Municipal Federation of the Kalajokilaakso Region (KAM) was established to co-ordinate a number of vocational colleges in the region to ensure a wide coverage of vocational education opportunities. Vocational education programmes involve an interdisciplinary focus including the metal and ICT sectors.

Education institutions at the second and third levels have formed the Oulu South Educational Network, which, among other institutions, includes the Oulu Southern Institute, Central Ostrobothnia University of Applied Sciences and KAM. The network has a common strategy that involves seven focus areas including metal and ICT. The network also has a common website, which provides information on all education programmes in the region.

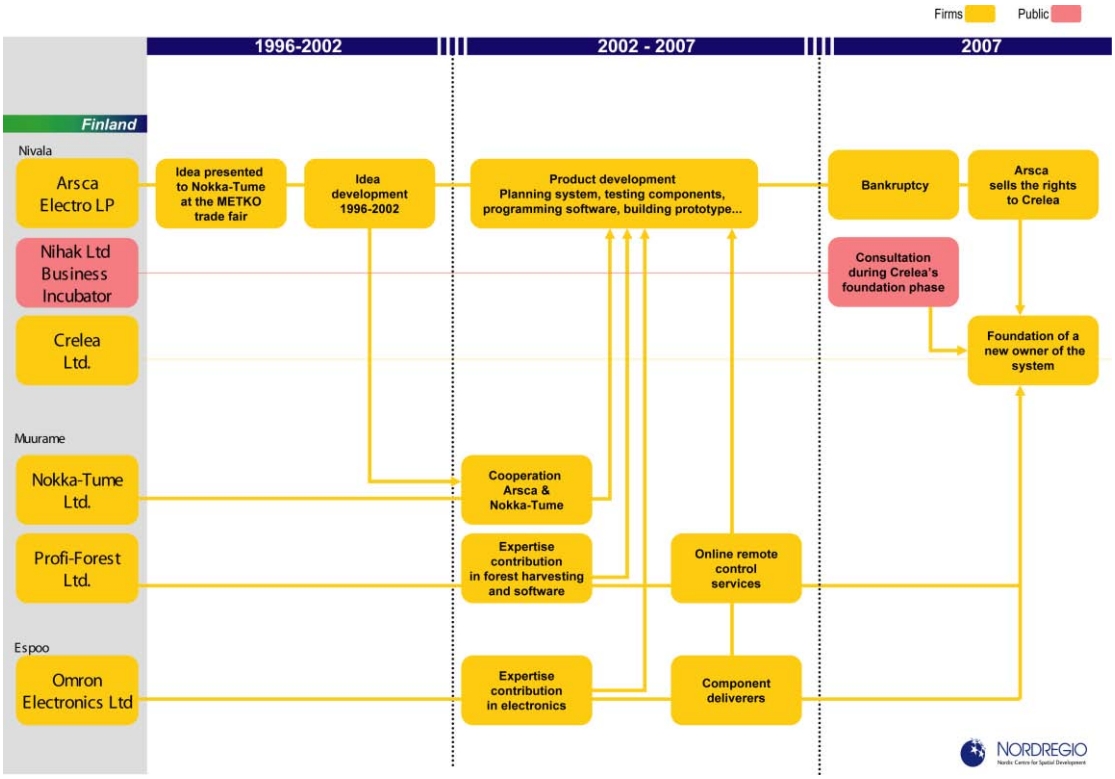
RF Media laboratory, which focuses on wireless communications technology, is located in Ylivieska. The laboratory has been established in collaboration with the Oulu Southern Institute, Centria R&D Unit and the Ylivieska subregion.

The ELME Studio (a production laboratory of electronics' mechanics and metal) is located in Nivala and has laser-assisted metallurgy (sheet metal technology) and future production technology as its focus area. The ELME Studio has been established in collaboration with Oulu Southern Institute, KAM, Nivala Technology and Industrial Park Ltd. and the Nivala-Haapajärvi subregion. The ELME Studio is located in the premises of the Nivala Technology and Industrial Park Ltd. A recent development of the ELME Studio is that it is now used for distance learning. Thus, the Luleå University of Technology in Sweden has used the laboratory's laser equipment through a satellite connection in a number of lectures.

3.4 Firm-level knowledge dynamics: PC-free control system for forest harvesters

This section explores a case of firm-level knowledge dynamics involving the ICT and machinery industries. The development of a control system for forest harvesters by three firms, Arsca Electro LP in Nivala, Omron Electronics in Espoo and Profi-Forest in Muurame, was the focus of the study. The study describes the development of the product from when the idea was first discussed in 1996 until it was commercialised and the firm Crelea Ltd. was established and bought the rights of the control system in 2007. Figure 3.3 illustrates the development of the control system for forest harvesters and the key knowledge interactions among the actors involved.

Figure 3.3: Knowledge biography of PC-free control system of forest harvesters



3.4.1 Developing the product idea

The idea to develop a PC-free control system for forest harvesters with remote control possibilities was first developed by the entrepreneur Arsca, who owned the small firm Arsca Electro LP. The firm had conducted electric installations of forest machines since 1986, and through this experience, Arsca had the idea of making forest harvesters more efficient by replacing numerous hand adjusted functions with a centralised adjustment and control system.

In 1996, Arsca shared his idea with the forest machine manufacturer Nokka-Tume at the METKO trade fair. Arsca was interested in a product development collaboration with Nokka-Tume; however, at the time company management declined, as it considered the idea too risky. During the period 1996–2002, Arsca developed the idea further in his leisure time and at his own risk. Meanwhile, in 2002, Nokka-Tume decided to join the development process, and its employee Jyrki Ikonen, an engineer in the field of information technology, was assigned to the process. At this stage, Jarmo Paavola from the firm Omron Electronics also became involved to deliver electronic components and provide expertise in electricity and automation technology.

3.4.2 Product development and commercialisation

In 2003, Nokka-Tume sold its forest machine manufacturing to Profi-Forest Ltd. Ikonen also moved to this company and product development continued without interruption. The first prototype of a forest harvester with the new control system was finished in 2005 and presented at the ELMIA trade fair in Jönköping in Sweden in the same year. During the period 2005–2007, Arsca Electro LP produced the control systems for Profi-Forest's forest harvesters.

In 2007, Arsca Electro LP went bankrupt. The bankruptcy happened as a consequence of the firm's previous involvement in unsuccessful product development projects. Meanwhile, to continue product development, Arsca sold the rights of the control system to the newly founded firm Crelea. Arsca's two sons were the main stakeholders of Crelea, in which Arsca served as an expert and advisor. Moreover, Ikonen and Paavola became stakeholders in Crelea.

The business development company Nihak Ltd. assisted Crelea in its start-up phase, especially in terms of applying for R&D grants.

3.5 Concluding comments

The focus on investigating knowledge dynamics at the territorial and firm level has provided new perspectives on the regional innovation environment and development in the Oulu South region. Scrutinising knowledge dynamics has been an interesting way to gain more information for policymakers, development agencies and education and research institutions about the state-of-the-art and the needs of entrepreneurs in the region. The application of the concept of knowledge dynamics has also enabled a deeper understanding of the elements and importance of networks, both regional and international, which are essential for knowledge development in a rural area such as the Oulu South region.

An interesting finding in the firm-level knowledge dynamics studied was the significant role that personal contacts and self-study play in the studied innovation process. The crucial knowledge for innovation was anchored to Oulu South mainly as tacit knowledge possessed by the entrepreneur. It is also interesting to note that the development of the innovation from an idea to a product took quite a long time. An explanation for the slow development is that the entrepreneur only collaborated with a small number of partners that he trusted during the innovation process. Furthermore, when his idea was rather advanced, it took some time to convince partners to co-operate with him. Another interesting finding from the firm-level case study is that there were few connections to public actors or to the regional innovation network at all. A question that may be posed here is whether the time span could have been shortened by broader participation of the public sector and the innovation network in the development process. The approach used to describe the knowledge dynamics made the existing regional features visible to regional actors. The results of the case study have, for instance, been used by public actors in the creation of new initiatives concerning the R&D support of microcompanies. Even the microcompanies found the results useful; for example, the knowledge biography enabled a forest machine manufacturer to develop its co-operation with a foreign partner.

After this introduction to the region of Oulu South and the territorial and firm-level knowledge dynamics, the analysis of the case of Oulu South and knowledge dynamics in the ICT and traditional metal and machinery industries are presented in Part III.

4 Knowledge dynamics in ICT in Värmland

By Samuel Petros Sebhatu

This section introduces the region of Värmland, the ICT sector and the traditional industries in the region, the actors engaged in territorial knowledge dynamics, and the firm-level case study that explores the establishment of the *Matglädje* ('Good Food') firm, which has developed an online food delivery service.

4.1 The region of Värmland

Värmland is located in central Sweden, north of Lake Vänern and east of Norway. Värmland is a small region in terms of population; it has approximately 274,000 inhabitants. The largest city, Karlstad, is located about 300 km from Stockholm, 250 km from Gothenburg and 250 km from Oslo.

Figure 4.1: The Region of Värmland

The county is relatively remote, which makes it strongly dependent on well-developed networks. Värmland is well known for its traditional industries of large mills (forestry, steel, pulp and paper). For generations, the presence of these highly competitive industries has provided Värmland with a stable development and labour market. However, the number of people with higher education is low compared with the national average. Instead, the economy of the area is dominated by the production from the mills. These industries originally had local ownership, in either Värmland or Gothenburg, whereas today they are owned by global firms. There is still a tendency for small and middle-sized companies to grow in number and many of these companies are related to the traditional industries in various ways.

Länsstyrelsen (the County Administrative Board of Värmland) in its 2005 strategy made it clear that there was a regional and national interest in a process to increase the economic activity in Värmland. The first focus of the strategy was to enhance knowledge assets by maintaining high quality education at all levels, research at Karlstad University and pursuing interaction with regional trade and industry. Second, it was developed to facilitate the transformation of knowledge into new products and services. Third, the strategy aimed to develop or maintain various knowledge centres. The knowledge centres are intended to strengthen capacity for innovation and business start-ups. During the past decade, the region has intensified its transformation from a manufacturing region towards a knowledge region. This transformation has contributed greatly to the growth of the ICT sector, which is one of the main focus areas of the region's strategy.

4.2 The ICT sector and traditional industries

The ICT companies are mainly concentrated in Karlstad city and its environs, with some diversification into other areas of the region. In the past decade, the ICT sector has increasingly moved into the fields of service development and the traditional sectors in Värmland.

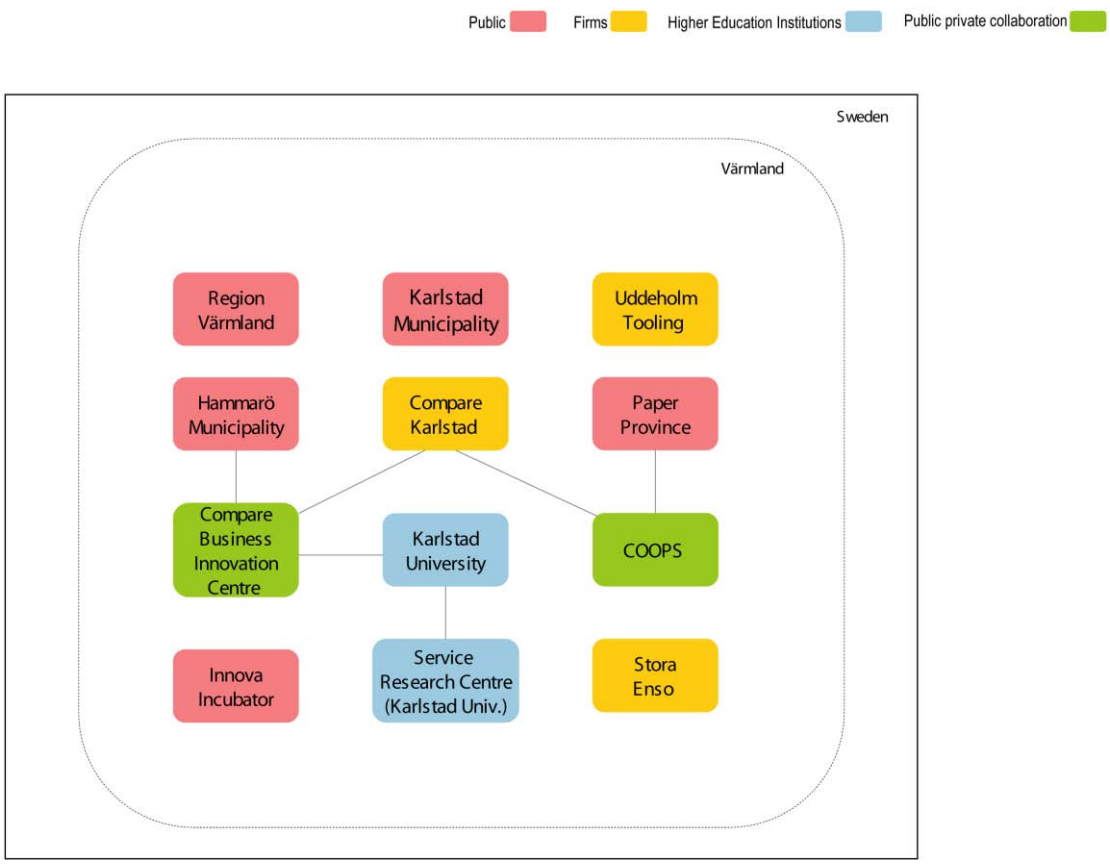
The region of Värmland has developed so-called knowledge centres. In the past decade, cluster initiatives have been developed to broaden the knowledge base of their respective industries. The different knowledge centres in this region are founded in networks, which gradually developed to become fully fledged clusters and knowledge centres. One of these centres is Compare Karlstad, a cluster for ICT. Compare was established in 2000 as a foundation for its member companies. In 2008, Compare Karlstad had about 100 member ICT firms, with approximately 2,500 employees and a total turnover of approximately SEK.4,600 million

Besides the ICT cluster, Värmland also has a knowledge centre for paper and packaging. The paper and packaging sector has a long tradition and focus on excellence in packaging materials and development. There are approximately 600 companies related to the paper, pulp and packaging industry. The region has a world-leading company that produces fibre-based packaging material based on competencies in the pulp and paper technology, coating technology and finishing. Some of these companies network with The Paper Province (TPP) cluster. The region also has companies in pre-production, graphic technology, packaging designers, advertising agencies and specialists in brand communications. On the basis of the knowledge and skills of these companies, educational institutions, local authorities and a variety of actors undertook more extensive co-operation, becoming the knowledge centre of The Packaging Arena (TPA).

4.3 Territorial knowledge dynamics in the ICT and traditional industries[49]

Territorial knowledge dynamics in the ICT sector in Karlstad are centred on the interest organisation, Compare Karlstad, and linked to the traditional regional industries of paper, pulp and packaging. The main actors engaged in knowledge interaction are introduced in this section and shown in Figure 4.2.

Figure 4.2: Examples of key actors in the ICT and traditional industries in Värmland



Compare Karlstad stimulates economic growth through increasing entrepreneurship and employment in the ICT sector in Värmland. The purpose of Compare is to create growth in the ICT field, generating businesses and companies in Karlstad. The scope of work is in four areas: business development, entrepreneurship, research and education, and membership services. Compare organises various activities to enhance interaction among its stakeholder firms. It was established as an interest organisation run by ICT firms in the region.

The Compare Business Innovation Centre (C-BIC) has been established as a learning centre based in the municipality of Hammarö, south of Karlstad. It was established by Compare in collaboration with Hammarö Municipality and Karlstad University. C-BIC is a test laboratory, where the firms in collaboration with researchers have the opportunity to test their products and services.

[49] Please note that the figures, including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively, are only snapshots of the actors and interactions involved.

Compare co-operates closely with the Faculty of Economic Sciences, Communication and IT at Karlstad University, which is a major player in ICT research. Collaborative R&D projects are carried out between CTF researchers and ICT firms in the region. CTF also offers so-called continuing professional development courses that are developed through ongoing communication with Compare. Furthermore, in relation to the higher education programmes at the university, students often have internship placements with the ICT firms in the region as part of their studies.

The Inova Incubator has been established to support the commercialisation of business ideas and co-operates with the ICT sector and Compare. It is owned by the Inova Foundation, which is sponsored by organisations including Karlstad Municipality, Region Värmland, Karlstad University and national and international organisations. The Inova Incubator and Compare together organise workshops and seminars for ICT actors both inside and outside the region.

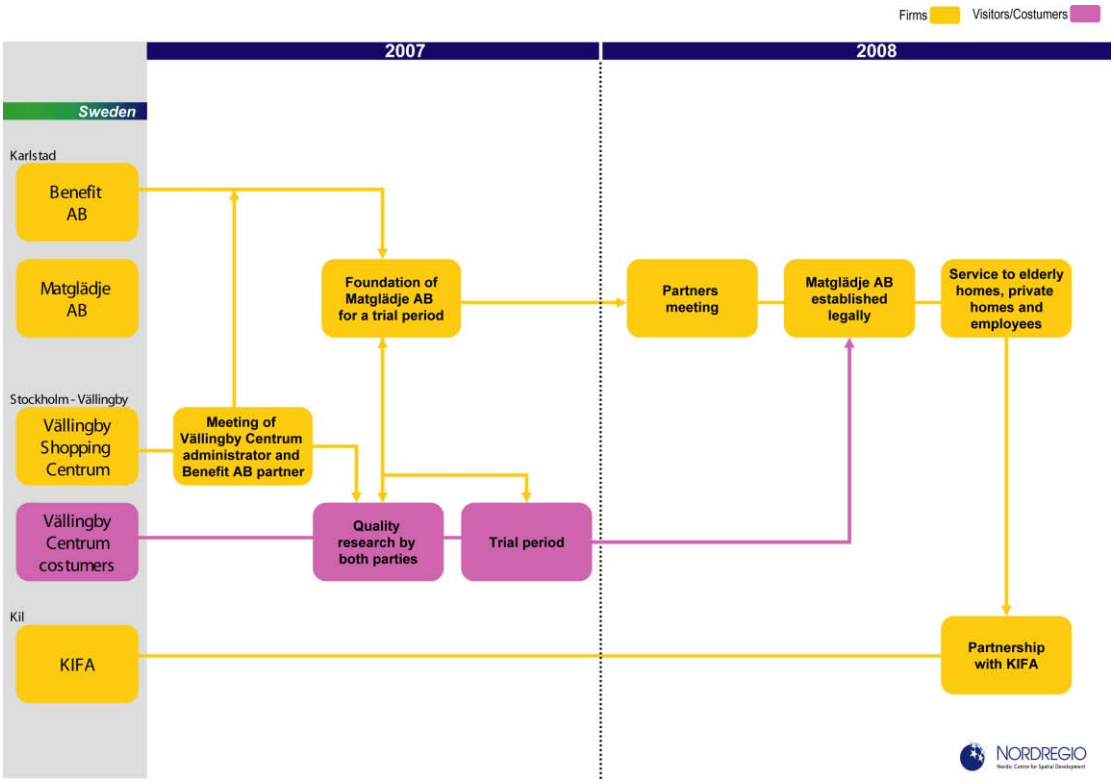
Compare also collaborates with the traditional industries in the region. For example, it collaborates with the cluster organisation TPP, set up by Region Värmland and a number of municipalities, to identify potential areas where the two sectors can collaborate to develop new business ideas. The collaboration is conducted through the COPPS (Compare och Paper Province i Samarbete) project. The main purpose is to develop common strategies by which ICT can improve the manufacturing process of pulp and paper, for example through operations monitoring technology, research and education.

The rise of the ICT sector in the past two decades has been influenced by the forestry, steel, pulp and paper industries. Two large related firms that played an important role in the ICT context were Uddeholm Tooling and Billerud (today Stora Enso), which decided to outsource their computer engineering departments over a decade ago. These outsourced departments were eventually formed as independent units. Today, the ICT sector in Värmland is primarily focused on IT manufacturing and process technology.

4.4 Firm-level knowledge dynamics: Creating an online food delivery service

The firm-level case study explores the establishment of the Matglädje ('Good Food') firm, which is an online food delivery service. The idea to develop the firm was generated in 2007 and one year later Matglädje was established. Figure 4.3 illustrates the development of the firm and knowledge interaction among the actors involved.

Figure 4.3: Knowledge biography of Matglädje, an online food delivery service



4.4.1 Developing the idea

The idea to establish Matglädje came to the two founders, who were then employed by Benefit AB[50], in 2007 on a project for Vällingby Centrum, a shopping centre based in the Stockholm region. The more than 50-year-old shopping centre was to be renewed by launching an e-centre providing a variety of services via the Internet. The Karlstad-based firm Benefit AB was contracted by the administration of Vällingby Centrum to develop and implement an ICT system for the e-centre.

Benefit AB and the shopping centre administration co-operated to initiate a qualitative study with the customers of the shopping centre, to understand the demands of the users. Generally, customers complained about the food, its poor quality and the limited opening hours of the restaurants in the centre. The restaurants had a limited number of visitors and only served food at lunch time. Interviews and focus group studies were also conducted specifically with the elderly from the surrounding private and retirement homes. The elderly expressed dissatisfaction with the public food delivery system managed by the municipality, the service in general and the poor quality of the food that was delivered. Through these studies, the idea of connecting the restaurants and the surrounding retirement homes through e-commerce was generated.

4.4.2 Developing the service

The founders of Matglädje created a first trial version of the firm in 2007, run by Benefit AB. The trial period took place at Vällingby Centrum, where the administration, restaurant owners and elderly in the area agreed to participate. The founders were experienced in the IT side of the project. The logistics of the project were the main challenge; making arrangements with the restaurants, uploading the menus on the Internet, contacting the elderly, receiving orders and delivering the food.

[50] AB means *aktiebolag* and equals Ltd in English.

The local post office was contracted to manage the delivery of food. At the post office, most of the work is performed in the morning, and during the afternoon the staff is not fully utilised. With this contract, the post office achieved a better utilisation of its workforce.

Matglädje initiated its first experiment in the autumn of 2007. At this stage, the founders had provided training to the elderly and their service providers in the use of the website. First they organised workshops, then provided brief introductions in brochures and in the final stage sent information via SMS. The experiment was successful, and the firm Matglädje i Sverige AB was established in Karlstad in 2008.

4.4.3 Business development

Matglädje was established to deliver food on a daily basis to elderly and other customers, who order the food via a selection of online menus from a variety of restaurants. In addition, the founders aim to disseminate knowledge about nutritious food and encourage local consumption.

The firm originally had an arrangement with a supplier from Gothenburg to manage the packaging of its products. However, owing to the limited possibilities this supplier could offer, they instead hired a local firm, TPA, to manage the packaging. In 2008, the founders developed plans to extend the booking system to include mobile phones and TV monitors. Moreover, the firm organised training sessions to educate customers in the use of this technology.

Matglädje depends on developing networks, and in 2008 there were already examples of such networks. Matglädje is engaged in creating better solutions for the elderly and disabled, and thus, the firm has become involved in the 'freedom of choice' movement in Sweden. This involves collaboration with Kil Innovation Food Arena (KIFA) in Värmland. KIFA is a cluster initiative financed by EU Structural Funds and is concerned with the food industry. KIFA intended to combine, initiate and lead new and interesting developments in food production in Värmland. KIFA is now engaged in the development of the firm to supply healthy nutritious food. Collaboration with Uppsala University is also underway, to conduct research in the area of 'freedom of choice' and nutrition. Moreover, the firm has established contacts through participation in 'matchmaking' events organised by the Inova Incubator.

At the conclusion of this study, the firm planned to provide the service to retirement homes, offices and private individuals by the end of 2009, and planned to expand its franchises in 25 cities in Sweden in the coming years.

4.5 Concluding comments

In the Värmland region, knowledge dynamics focus on the ICT sector. However, Värmland is well known for its traditional industries such as large forestry, steel, pulp and paper mills. For generations, the presence of these competitive industries has provided Värmland with stable economic development and a labour market. The presence of these industries is one of the main reasons behind the recognised worldwide paper and packaging clusters, such as TPP and TPA.

The dependence on natural resources, the small population size and the relatively remote location of the region make the region heavily dependent on well-developed knowledge dynamics networks. The short geographical and social distance separating actors in the region is also beneficial. All important actors, such as Karlstad University, public institutions and municipalities, the cluster organisations, innovation and incubation agencies, are located in the Karlstad area.

General characteristics of the ICT sector are the need for continuous innovation and the combination of strong competition and co-operation. The firms representing this sector in Värmland work continuously in R&D. The case study shows that there is a foundation for

interactions and co-operation between the companies, cluster organisations and the main regional education and research institution, Karlstad University. A specific example of the co-operation in the region is the Compare ICT cluster, which is a significant actor in stimulating increased entrepreneurship and employment in and around the ICT sector in Värmland. In addition, Region Värmland's strategies and policies to support business with various initiatives contribute to the knowledge dynamics in the region.

In the firm-level case study of Matglädje, the knowledge dynamics and networks in the region are clearly illustrated. The development of the service began with the idea of providing elderly people's homes with tasty and nutritious lunches and dinners, by adapting to each person's needs. The provision of the service is based on an ICT solution, an e-centre, which integrates retirement homes, restaurants, logistics and transport. The goal is that the food will delight everyone. The company collaborates with certified restaurants and producers as part of the new service development based on customers' needs and satisfaction. In developing the product, Matglädje has used a variety of actors and networks such as universities and governmental and non-governmental organisations (NGOs), both inside and outside the region. Further discussions concerning the knowledge dynamics in the ICT sector in Karlstad and in Värmland are covered in the analysis of the empirical material in Part III.

5 Knowledge dynamics in KIBS and the renewable energy sector in Akureyri

By Hjalti Jóhannesson

This section provides a view of knowledge dynamics with a focus on KIBS and renewable energy, meaning the harnessing of geothermal energy for electricity production in the Akureyri region. The regional context of Akureyri is first introduced, then the sectors of interest, followed by the territorial knowledge dynamics of the main actors in Akureyri and its surroundings. Finally, a firm-level perspective on knowledge dynamics in KIBS and geothermal energy harnessing is provided, describing a specific case of the development of a drilling technology in collaboration between firms.

5.1 The region of Akureyri

The Akureyri region in central north Iceland is the most populous outside the capital region. It is an exception in the Icelandic urban structure because it has 17,500 inhabitants, unlike most other towns outside the capital region, which have fewer than 5,000 inhabitants. Thus, the 'urban' settlements around Akureyri are small. In 2008, the nine municipalities of the Akureyri region had just over 24,000 inhabitants. The regional centre is Akureyri.

Figure 5.1: Akureyri region

5.2 KIBS in the renewable energy sector

Natural energy sources are very important in Iceland because some 95 per cent of homes are heated with geothermal energy and nearly all electricity is produced by either hydro or geothermal power. Thus, the proportion of domestic renewable energy in the total energy budget is around 70 per cent.[51] However, further energy resources, which could provide further possibilities for production of export goods based on energy, are still unharnessed. In 2010, Iceland ranks highest among 163 countries on the Environmental Performance Index with a rating of 93.5, followed by Switzerland with a rating of 89.1.[52]

For environmental and economic reasons, Iceland's climate change strategy claims that 'it is a matter of high priority to reduce the use of fossil fuels in transport and fisheries to the maximum extent possible and to use electricity or climate-friendly fuels such as hydrogen, methane, or biodiesel instead'.[53] Iceland has adopted EU regulations concerning use of renewable energy sources through its participation the European Economic Area.

The focus of energy harnessing in Iceland has increasingly shifted towards geothermal energy and much progress has been made during the past quarter century in this field. For example, progress has been made in geological research and drilling techniques. A significant geothermal area is located east of the Akureyri region close to Lake Mývatn, where the Krafla power station has been established as the first geothermal power station in Iceland entirely designed to produce electricity.

The KIBS sector is the focus of the study of the Akureyri region in Iceland. In this sector the focus is on the following branches according to NACE[54] definitions because they provide important services for the energy sector.

- Research and experimental development on natural sciences and engineering, (NACE 73.1).
- Technical services, architectural and engineering activities (NACE 74.2).

Comprehensive NACE data on differences in the structure of the economy are not available for individual municipalities in Iceland. However there are indications that these sectors have become increasingly important for the economic development of the region in recent years. This relates to the tendency of (larger) companies and municipalities to outsource these types of services. This has led to distribution of knowledge to these service companies from various (larger) companies with other core activities and in other municipalities, and has stimulated the growth of the sector. Because of the economic crisis in Iceland that began in 2008, it remains to be seen if this development will continue. However, it was led by large companies on the Icelandic scale (headquartered in the capital region) that appeared to have more access to capital than did smaller companies in rural areas.

The Icelandic study concerns the development of a method for harnessing geothermal energy for the purposes of electricity production. This is *geothermal drilling technology*, which is a process of delivering the actual product via a functioning borehole that provides energy to run steam turbines and produce electricity, and sometimes provides geothermal water for local heating.

Examples of such energy sourcing can be found in the Akureyri region (harnessed for district heating) but to a larger degree east of the region (100–150 km). The area is a part of the volcanic zones of Iceland, which run diagonally SW–NE through Iceland, and are in fact a part of the Mid-Atlantic ridge. However, the Akureyri region is important because of its roles

[51] The Ministry for the Environment (2003).

[52] See the Environmental Performance Index homepage at Yale University: http://epi.yale.edu/.

[53] Ministry for the Environment (2007) p. 9.

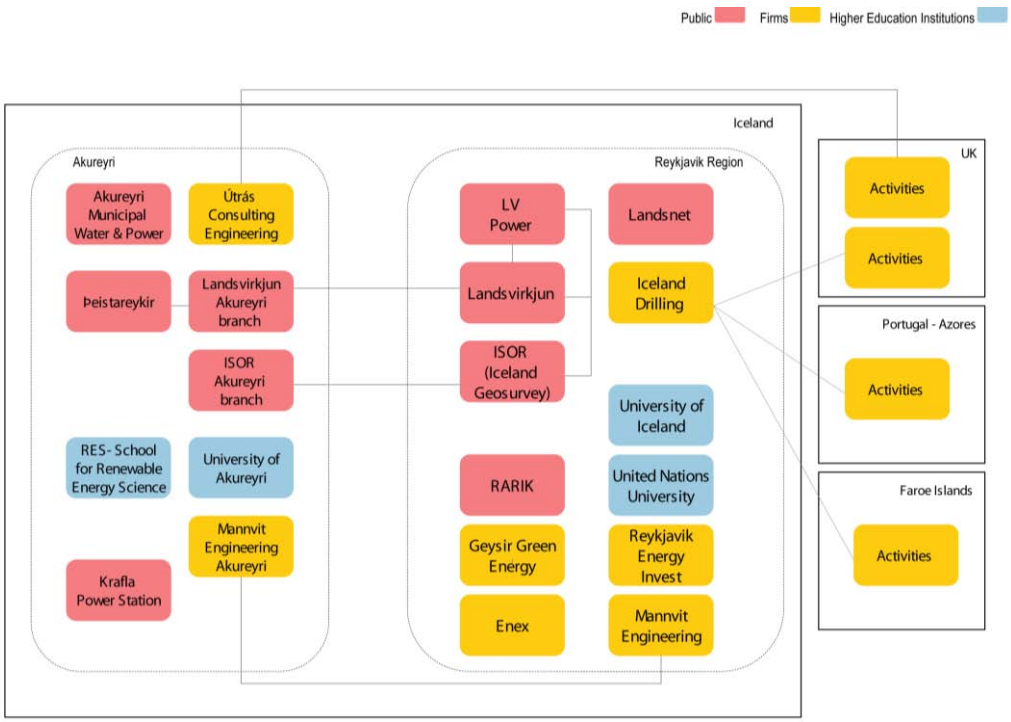
[54] NACE Code is a pan-European classification system which groups organisations according to their business activities.

as 1) a regional centre for north Iceland, and 2) the home of many companies that provide services for energy companies.

5.3 Territorial knowledge dynamics in geothermal energy harnessing[55]

This section explores territorial knowledge dynamics in the Akureyri region and focuses on KIBS in the renewable energy sector—more specifically, geothermal energy. The actors involved in knowledge interaction in this field in the region of Akureyri include three main groups: power companies that purchase services in the field of energy harnessing; and KIBS firms providing services to the energy sector and education institutions. The main actors and examples of extraregional knowledge interaction are introduced below and shown in Figure 5.2.

Figure 5.2: Examples of key actors in geothermal energy harnessing in Iceland



The largest company in the field of energy harnessing is Landsvirkjun, which owns and operates the majority of power plants in Iceland. It has a branch in Akureyri that is responsible for the maintenance of power plants. Landsvirkjun outsources most of its services in research, construction and maintenance. Regarding research, Iceland Geosurvey is a major KIBS providing services to Landsvirkjun in the field of geothermal energy. Moreover, engineering firms are significant in terms of designing power plants, and specialise in different types of plants, i.e. hydropower and geothermal, or in electrical installations.

[55] Please note that figures, including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively, are only snapshots of the actors and interactions involved.

In 2007, Landsvirkjun established the LV Power subsidiary, which deals with the preparatory work, general research, design and construction of geothermal and hydropower plants of Landsvirkjun. Landsnet operates most electricity transmission systems in Iceland.

Another important buyer of services in the region is Norðurorka (Akureyri municipal water and power company), established in 2000 through a merger of two older companies. In the energy sector, the company operates a municipal geothermal system for heating, a small hydro plant and owns a share in other companies in the field such as Þeistareykir.[56] Þeistareykir is a company that researches and plans major geothermal harnessing east of the Akureyri region, providing energy for energy-intensive industry in the town of Húsavík, 90 km east of Akureyri.

RARIK is a government-owned power company that owns and operates several smaller hydropower stations and geothermal grids and delivers energy to customers. It is not yet active in the field of geothermal energy for electricity production.

Geysir Green Energy was established to seek leading market opportunities in harnessing geothermal energy. There has been much interest among investors in the field but the financial crisis in 2008, in combination with political opposition, had a negative impact on this development. Enex is a company with a similar purpose, because it specialises in the search for opportunities for harnessing power, and the design, sale of solutions and operation of geothermal power plants. Geysir Green Energy was the main owner of Enex in 2009.

The Reykjavík Energy Invest investment company, which is primarily owned by Reykjavík Energy (Orkuveita Reykjavíkur), represents the international interest of investors in the geothermal energy industry; however, the development of this activity was slowed by both the financial crisis and political opposition during 2008.

Most of the research was undertaken in 2008 and early 2009. Since the onset of the economic crisis in 2008, there has been much change in ownership of these and other companies. In 2010 while this final report is being compiled, this situation is still somewhat uncertain.

One of the KIBS firms providing services to the geothermal energy sector in Akureyri is a branch of ÍSOR (Icelandic Geosurvey), which is a government-owned research organisation for the energy industry. The Akureyri office primarily focuses on services in the field of geothermal energy. The company has specialised research equipment, laboratories and computer software developed for the processing and interpretation of various data.

Jarðboranir (Iceland Drilling) is a firm specialising in drilling for the geothermal energy industry and other projects. The company was established in 1986 based on an originally government-owned company established in 1945. Iceland Drilling was privatised during the period 1992–1996. Iceland Drilling has operated drilling projects in the Azores over the past 13–14 years, and in Germany, the Faroe Islands and the UK.

The main engineering firms in Iceland have merged into fewer companies to increase capacity in both scope and scale. The three largest such firms are present in Akureyri. Mannvit Engineering is the largest firm and has grown rapidly, partly because of mergers. Mannvit has a large group of specialists working for the energy sector who are all located in the main office in Reykjavík. It has been difficult to recruit qualified staff such as specialised civil engineers for the Akureyri office. However, there have been sufficient tasks available, for example, energy harnessing in the Krafla and Þeistareykir geothermal areas east of Akureyri. These tasks are primarily performed by experts in Reykjavík, while only a small number are conducted by the office in Akureyri. Útrás Consulting Engineers is a notable company in Akureyri, specialising in harnessing waste thermal energy from sources such as power plants and industrial processes. One of the company's major projects in 2009 focused on better energy efficiency in power stations in London.

Two HEIs in the field of energy science are based in the Akureyri region. However, the largest and oldest in this field are located in Reykjavík. These are the School of Engineering

[56] Norðurorka sold this share at the beginning of 2010.

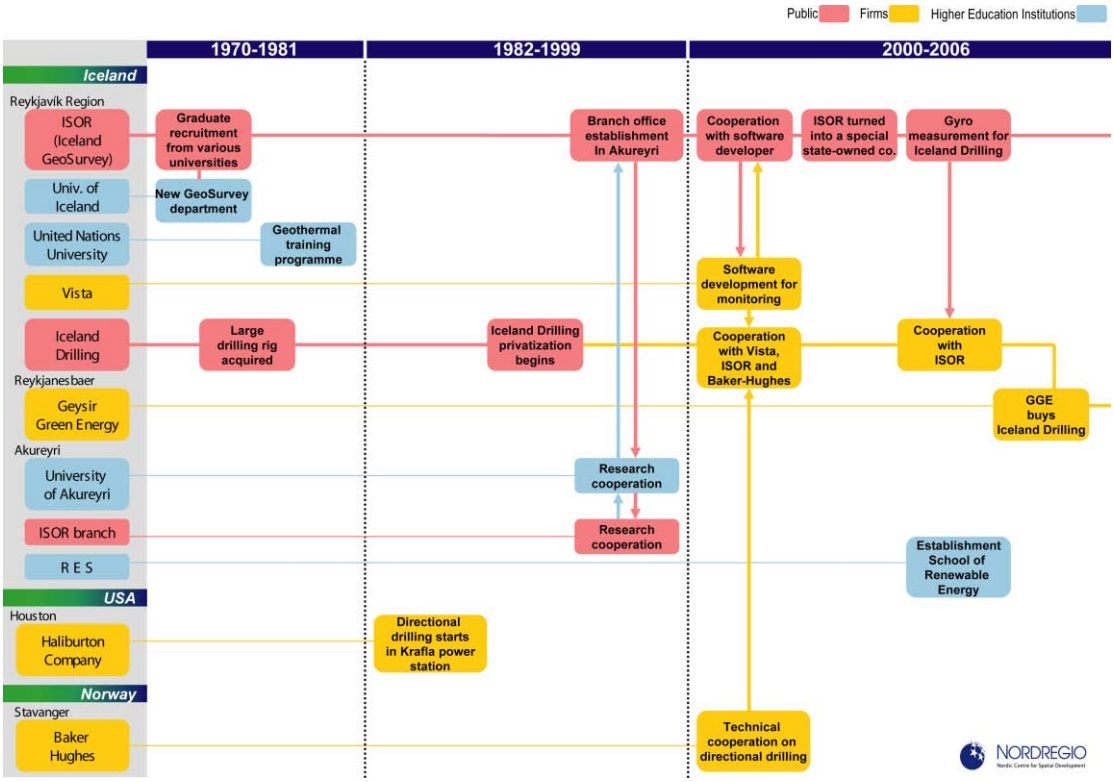
and Natural Sciences at the University of Iceland, and the United Nations University's Geothermal Training Programme, which attracts students from around the world.

The University of Akureyri was established in 1987. The School of Business and Science offers higher education in natural resource sciences. A graduate school for master's students of renewable energy science, RES—School for Renewable Energy Science—was established in Akureyri in 2007. It was initially located on the campus of the University of Akureyri, and the university is one of several owners. RES primarily aims to admit foreign students with master's degrees in engineering. The study for a master's degree at RES is an intensive one-year programme. The first group, which was enrolled at the beginning of 2008, consisted of just over 30 students from Europe and the United States. RES has co-operation agreements with several domestic and foreign institutes and companies in the field of renewable energy.

5.4 Firm-level knowledge dynamics: development of drilling technology

The development of drilling technology in Iceland is centred on the company Iceland Drilling and the research firm ÍSOR, which are both introduced above. This case study explores the process of delivering a functional borehole for the power industry. The study concerns the period from 1970 to 2008. Figure 5.3 illustrates the development of the drilling technology and the knowledge interaction among actors involved in the process.

Figure 5.3: Knowledge biography of geothermal drilling technology



5.4.1 Initial steps in high-temperature energy harnessing

The oil crisis at the beginning of the 1970s served as a driver for the rapid development of high-temperature energy harnessing. Construction of the Krafla geothermal power station began in 1974 but research in the area commenced around 1970. The following year, Iceland Drilling purchased a large drill that could bore deeper and was easier to transport than previous equipment.

5.4.2 Developing the product

During the period 1982–1999, the field of geothermal harnessing gradually developed. Lessons were learnt from the American-based oil company Haliburton, which made drilling methods more efficient during this period. Moreover, geological research and volcanic eruptions in the Krafla area in 1975–1984 influenced the development of drilling methods. The development of geothermal drilling centred on Krafla, which underwent expansion and finally overcame the challenging geological obstacles in 1999. In 1999, ÍSOR's predecessor ROS established a branch office in Akureyri in co-operation with the University of Akureyri, to conduct research and provide services for the energy industry in northern Iceland more easily.

5.4.3 Meeting demands for renewable energy

Since the year 2000, increasing focus has been placed on electricity production from geothermal energy. The number of drilling projects in Iceland has increased. Drilling projects in Iceland that involve the provision of finished boreholes, or 'turn-key projects', undergo a public tendering process. Iceland Drilling, as the largest firm of its kind in Iceland, was the main actor in terms of winning tenders. Some tenders were submitted in co-operation with ÍSOR, and technological product development was ongoing over the period. Geological research and advancements in ICT influenced the process.

During 2000–2002, equipment and software that could illustrate drilling projects on the Internet were developed in co-operation among the engineering firm Vista in Reykjavik, ÍSOR and Iceland Drilling. After the conclusion of this project, it became possible to monitor the progress of a drilling project in real time at a remote computer terminal, which is especially useful for project managers and drill controllers.

The use of directional drilling technology accelerated while power was harnessed for the Hellisheiðarvirkjun power plant. Hellisheiðarvikjun, which is owned by Orkuveita Reykjavíkur, began delivering energy in 2006. Iceland Drilling employed a subcontractor, Baker-Hughes (Norway), to conduct the directional drilling process. This involved supplying the necessary tools and expert personnel. The procedure calls for drilling tools such as 'motors,' used to steer the drill bit while drilling, and 'measure while drilling' tools to obtain an approximation of the progress. In addition, high-precision gyro tools are needed to accurately map the progress of a well. These tools are operated by expert personnel and drilling must be stopped periodically to deploy the tools. Initially, ÍSOR supplied only logging trucks and personnel to operate the truck and the truck's winch. ÍSOR has subsequently, in co-operation with Iceland Drilling, taken charge of all high-precision gyro logging.

5.4.4 Export of knowledge in the geothermal energy sector

In 2007, different developments in the sector strengthened export of knowledge in this sector. RES was set up in Akureyri, mainly attracting students from other countries. Moreover, financial institutes became engaged in the sector. Iceland Drilling was acquired by the Geysir Green Energy investment company in 2007. The involvement of financial institutions was slowed by the onset of the financial crisis in 2008. The Krafla area is still very important in the research and learning process in the field of geothermal energy harnessing, because experiments for the Iceland Deep Drilling Project are being conducted there and will provide much knowledge about the potential energy of deep underground resources. The project is

international and entails sharing of knowledge among many Icelandic and foreign institutes. It entails drilling into high-temperature fields 4–5 km underground, where heat and pressure—and therefore potential energy—are much greater than is normally accessed.

5.5 Concluding comments

The territorial and firm-level knowledge dynamics studied in the Akureyri region differ from other cases in that the story spans a relatively long period. In addition, the 'product', a borehole delivering steam capable of powering turbines, may be considered less tangible than those in other REKENE cases. However, the product is of considerable economic importance. Furthermore, the case study depicts how knowledge has played a considerable role in harnessing geothermal energy and converting it to an economic asset. In addition, product development appears to be continuous. Geological conditions in Iceland provide opportunities for international research projects and continuing learning processes, such as the Iceland Deep Drilling Project, which explores possibilities for harnessing geothermal energy from deeper wells than was previously possible.

In the case study, the importance of existing conditions becomes obvious. The specific natural conditions in Iceland stimulate diverse activities related to the generation, application and distribution of knowledge connected to these and natural conditions that can be used for economic activities. This development is observed in the tertiary sector in the development of KIBS firms and education institutes, such as the RES, the United Nations University Geothermal Training Programme (UNGTP) and the University of Iceland.

It is also interesting to see jobs serving both the domestic and foreign markets being created in these fields. Although economic conditions in Iceland changed drastically while the case study was undertaken, the export of knowledge seems set to continue. Examples of this are geothermal projects undertaken by Icelandic engineering firms in other countries and educational programmes in Iceland, which serve an international market in the field of geothermal energy and other renewable energy sources. Import of knowledge is also interesting, especially concerning the expensive technology used in the oil industry.

Regarding knowledge dynamics, there are indications that private ownership and market competition adversely affect creation and diffusion of codified knowledge. Regarding knowledge jobs, the population of the Akureyri region is small compared with that of Reykjavík; therefore, attracting specialised staff, to engineering offices for example, may prove difficult. The reasons mentioned are that small workplaces limit opportunities for team-work by specialists and the small number of similar workplaces limits inter-firm mobility.

This introduction to the territorial and firm-level knowledge dynamics in renewable energy and KIBS is further discussed in the analysis of the empirical material gathered in Part III.

6 Knowledge dynamics in the KIBS and medtech sectors in Stockholm

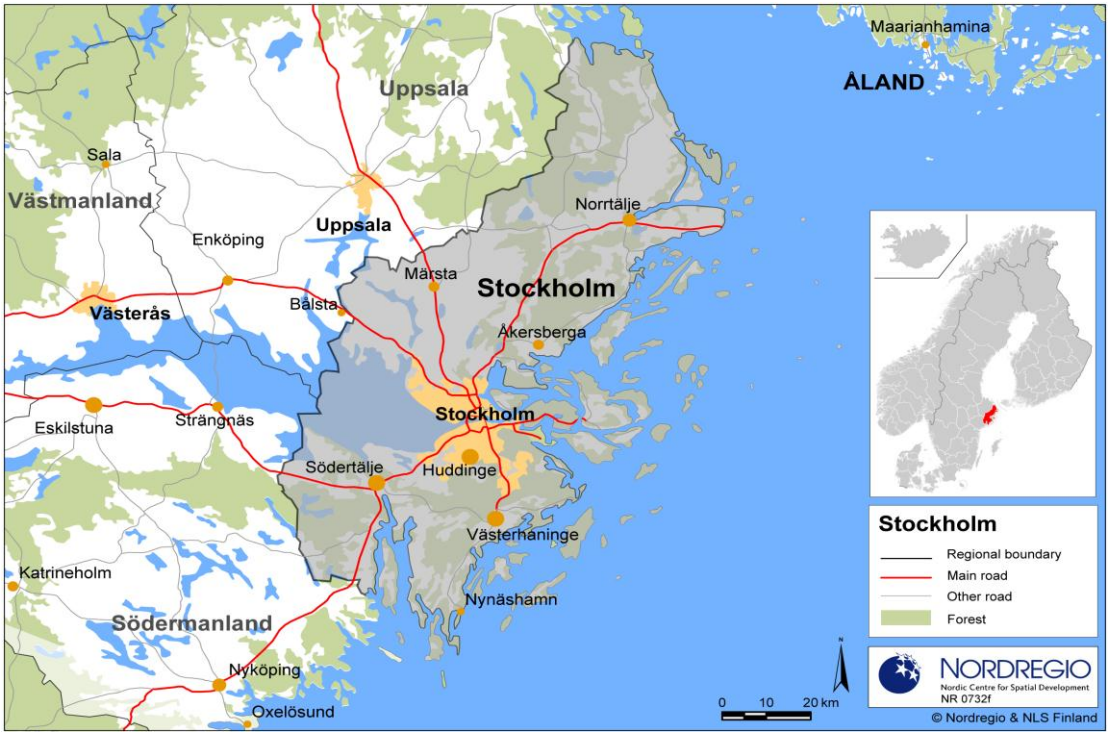
By Brita Hermelin & Lukas Smas

The case study in Stockholm began with KIBS and looked into computer services, a major subsector of KIBS. This study has also involved wider discussion of ICT including both services and manufacturing. Particular attention was paid to the development of ICT for products and solutions in the health sector in the context of the medical technology industry (medtech). The firm-level case study concerns the development of a medtech system for remote monitoring and analysing of heart arrhythmia, the Zenicor ECG.

6.1 The Stockholm region

Stockholm is the capital of Sweden, and the region (i.e. Stockholm County) has almost two million inhabitants. The economic structure of the region is increasingly based on knowledge-intensive and innovative businesses. Stockholm emphasises ICT and biotechnology as two increasingly important and significant sectors in the economy.[57]

Figure 6.1. The region of Stockholm



[57] Stockholm Business Region (2009)

6.2 The role of KIBS in the ICT and medtech sectors

A characteristic of the KIBS sector is that it transcends traditional industry boundaries and incorporates different activities usually categorised into different sectors.[58] The KIBS sector includes a range of different knowledge-intensive services and subsectors such as R&D, economic services, computer and technical services and marketing and advertising.[59] Statistically, the KIBS and ICT sectors overlap in the categories of: hardware consultancy, other software consultancy and supply, publishing of software, data processing, database activities, maintenance and repair of office, accounting and computing machinery, and other computer-related activities.

In the exploration of knowledge dynamics in the Stockholm region, we have identified the development of KIBS and ICT expertise in medtech as an interesting field with strong development in Stockholm, and focus on this in our territorial and firm-level case studies. Medtech is a resource for health care and a broad sector that incorporates competences and resource from a range of fields.[60] The medtech industry includes nearly all medical equipment except pharmaceuticals, and there are significant differences between the medtech sector and the pharmaceutical industry in terms of structure, products and regulations.[61] Medtech is an expanding sector in Sweden with approximately 10,000 workers and an annual turnover of SEK 60 billion in 2007.[62] The health care and medical sector is an information-intensive sector in which new ICT plays an increasingly important role.[63]

The type of medtech activities that are explored regarding territorial knowledge dynamics are those in which ICT plays a prime role, and which involve ICT and medical expertise. There are many actors involved in the medtech/ICT industry in the Stockholm area. The fact that Stockholm is the capital area means that many national and international actors and organisations are present in this milieu.

6.3 Territorial knowledge dynamics in the computer and ICT services related to medtech[64]

The exploration of territorial knowledge dynamics in KIBS that focused on computer services began with a cluster that developed in the Kista area, located in the northern part of the Stockholm region. Particular growth areas in Kista include broadband systems, mobile services, multimedia and wireless systems. In recent years, developing focus areas have also been cleantech, medtech and nanotechnology. Figure 6.2 provides an illustration of the main actors in Kista, in the wider Stockholm region and those engaged in ICT and medtech. It should be

[58] Toivonen (2001)

[59] Strambach *et al.* (forthcoming)

[60] Norén (2008)

[61] Wilkinson (2009)

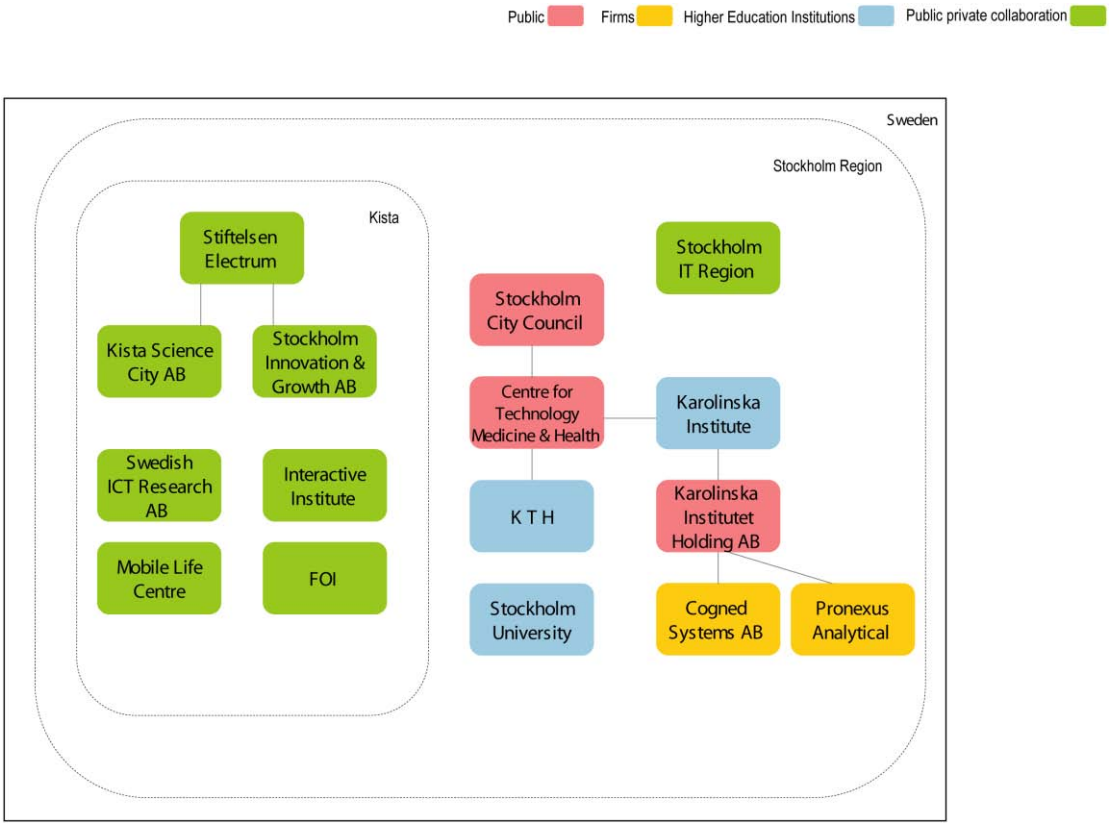
[62] Swedish Medtech (2009)

[63] Norén (2008)

[64] Please note that the figures, including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively, are only snapshots of the actors and interactions involved.

noted that space limitations prevent the inclusion of all actors influencing the industry or full illustration of the extent to which they engage in extraregional knowledge interaction. The territorial knowledge dynamics of ICT and medtech are further described below.

Figure 6.2: Examples of key actors in the computer and ICT services related to medtech in Stockholm



The ICT cluster is supported by the non-profit organisation Kista Science City AB, which works to promote Kista as an attractive business location and strengthens co-operation among academia, research, municipal and private operations in the area. Kista Science City is owned by the *Stiftelsen Electrum* foundation, which is supported by the Stockholm City Council, Royal Institute of Technology (KTH) and Ericsson among other organisations.

Stockholm Innovation and Growth AB (STING) is an incubator based in Kista under the umbrella of Kista Science City. The purpose of the incubator is to generate growth in Stockholm and it welcomes entrepreneurs from inside and outside the region. However, any new firms approaching STING must be established within the region.

The Stockholm IT region is a collaborative project run by a number of public and private organisations such as Ericsson, IBM, Stockholm Business Region Development, Kista Science City and the Stockholm City Council. It was established for the purpose of strengthening competitiveness in the ICT industry in the Stockholm region by ensuring qualified skills, marketing and infrastructure.

Several research institutes are based in Kista. A major institute is Swedish ICT Research AB, which mainly focuses on ICT but also considers the areas of linguistics, physics, electronics, mechanics and mathematics. Other research institutes are Acreo, the Swedish Institute of Computer Science, The Interactive Institute (Tii), the Mobile Life Centre and FOI. These institutes are mainly public–private collaborations funded by universities, Swedish research funds, EU funds and private firms. R&D projects are conducted by researchers, many of whom are affiliated with KTH and Stockholm University.

In Stockholm, the Karolinska Institute is a major player in the area of health research with a strong national and international reputation. Karolinska Institutet Holding AB (KIAB) was

established by the Karolinska Institute to commercialise ideas from research conducted at the institute. KIAB is funded by Karolinska Institutet Innovation and Karolinska Development, and is based in Karolinska Institutet Science Park.

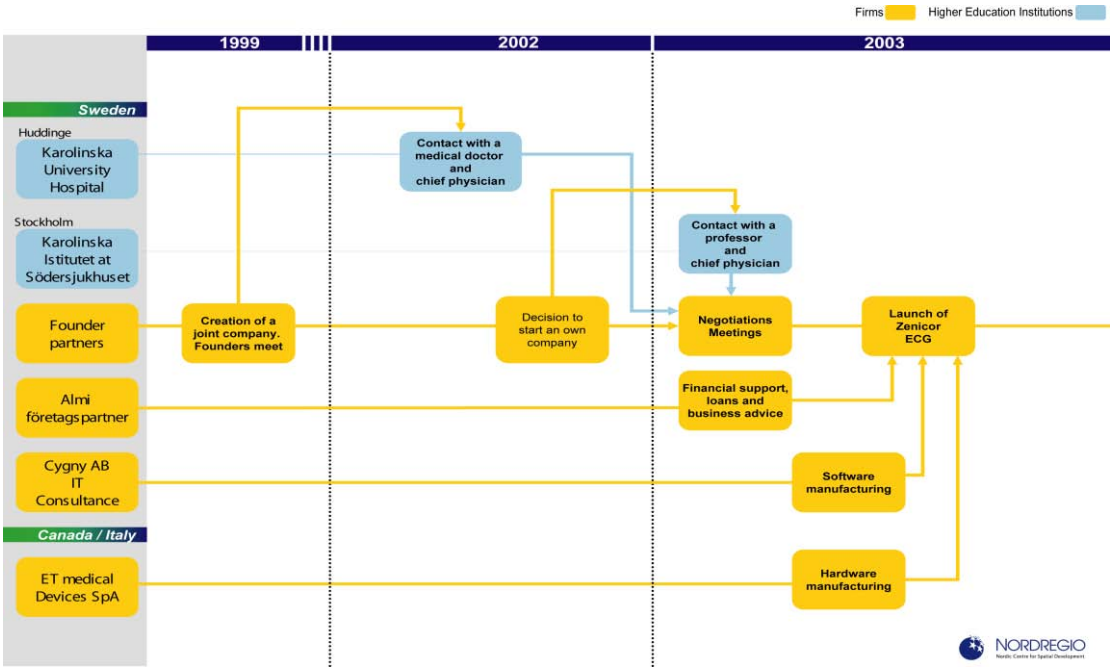
Examples of firms engaged in medtech based at KIAB are Cogmed Systems AB and Pronexus Analytical AB. Cogmed Systems produces scientifically developed and clinically validated software to support memory training for people with attention deficits. Pronexus Analytical offers services to pharmaceutical companies and research organisations for in vivo monitoring and allied bio-analytical techniques. The firm has three partner firms located in the USA, Finland and Denmark.

In 2007, the increasing interest in and attention to medtech as a significant growth area led to the establishment of an additional network in the Stockholm region, the Centre for Technology in Medicine and Health. It was established as a collaboration project among the Karolinska Institute, KTH and Stockholm County Council. The main goal of the Centre for Technology in Medicine and Health (CTHM) is the creation of a dynamic medtech network in Stockholm as a means to develop Stockholm as a world-class medtech cluster. The network includes researchers and students from the Karolinska Institute and KTH, physicians from the region's health care sector and representatives from the industry.

6.4 Firm-level knowledge dynamics: the development of the Zenicor ECG

The firm-level knowledge dynamics analyses the interactions dynamics behind the innovation, development and dissemination of the Zenicor ECG. The product is a medtech system for monitoring and analysing heart arrhythmia (i.e. irregularities of heart rhythm) from a distance. Zenicor Medical Systems AB is the host firm but the product has been developed through a network of actors. Figure 6.3 illustrates the development of the product and the knowledge interaction among the actors involved, from 1999 when the main actors met, until 2003 when the Zenicor ECG was established.

Figure 6.3: Knowledge biography of the Zenicor ECG



6.4.1 From idea to prototype

The three founding partners met personally in 1999 when the insurance company Skandia and the telecommunications company Ericsson established a joint company in collaboration with Karolinska University Hospital. The idea behind the collaboration was to apply and use Ericsson's ICT competence in the health care and medical sector. Skandia had an interest in creating new insurance solutions. The main focus was on elderly care and technology. It was at the height of the dot.com era and there were many ideas and visions but fewer concrete results. Most problematic was the financing and funding for the different projects that emerged.

At the end of 2002, the three partners decided to launch an independent firm as they believed they would develop similar solutions and applications more efficiently, focusing on medical technology. At that time they were employed in the Ericsson/Skandia company. The partners had different work and life experiences; one came from Ericsson and the other two from Skandia. Their professional background was in civil engineering, business economy and ICT. The objective of establishing the firm was clear from the beginning: to concentrate on distant monitoring and diagnostics. The partners knew the potential uses of technology in the medical sector and their intent, but lacked a ready-made product. All partners had experience working on projects but none had medical expertise or qualifications and they realised the need for medical competence at an early stage.

Working in the joint company of Ericsson and Skandia, the partners had contact with a medical doctor and chief physician at Karolinska University Hospital Huddinge. The doctor was enthusiastic about their ideas and immediately saw a market for the proposed product. In early 2003 they also initiated and established contact with a professor and chief physician in cardiology at *Södersjukhuset*. Both doctors are involved in research and affiliated with the Karolinska Institute but are also engaged in practical clinical care at the two hospitals. During the collaboration, the professor from Södersjukhuset has functioned mainly as a researcher, while the doctor from Karolinska University Hospital Huddinge has played a supporting and advisory role.

The initial meetings with the medical experts were held in early spring 2003. The doctors had many ideas and recognised the need for the solutions that Zenicor offered. Nurses became involved in the discussions with the doctors at an early stage; this was perceived as vital because in practice it is primarily the nurses who use and operate the products. Their contributions to the discussion around user interface and management of patients was useful throughout the development of the product. The first half of 2003 was an intensive period of discussions, when the firm tried to meet the requirements of the medical experts and develop a prototype of the material product.

In the summer of 2003, Zenicor had developed a functional product—the Zenicor ECG. The product was displayed and launched at Riksstämman—the exhibition and annual meeting of the Swedish Society of Medicine—in November 2003 at the Stockholm Södersjukhuset, and the Karolinska Institute had already begun clinical studies of the medical system and held a presentation at the congress about the use of the product. The magazine *DagensMedicin* at the same time held a contest for the best IT solutions in the health care sector, which Zenicor's ECG won. The product consequently received considerable attention and verification from the medical sector in only its first year.

6.4.2 Establishing Zenicor Medical Systems AB

Alongside the development of a prototype, the firm worked to develop a business plan and secure financing. The firm realised at an early stage the need to focus the business strategy and identify a niche for the products because of the scope and scale of the medical sector. This was perceived as especially important because it was a small, newly founded, entrepreneurial firm seeking to establish itself in a strongly regulated market. In a market with lengthy procurement procedures and rigorous verification processes, and that demands extensive research, it was necessary to be focused and to establish good personal contacts and acquire

knowledge about the sector. Its focus became cardiology and more specifically heart arrhythmia.

In 2003, during the business establishment phase, the partners discussed various locations. Zenicor pursued an offer from a business hotel in Mörby, a suburb in the north of Stockholm city, which had a rent-free trial period of six months. After the trial period, the rent was considered too high and the location unsuitable so the firm relocated to Stockholm city. Its main software consultancy partner offered Zenicor the lease of some of its office space. This also meant that Zenicor now had the IT consultancies that developed its software in the next room and its personnel could have daily contact, even between formal contracts. This arrangement lasted for three and a half years until the software company expanded and needed all its office space.

None of the partners had any previous experience of running a business. Through ALMI Företagspartner Stockholm AB, the firm received financial support in the form of loans and business advice. ALMI is a state-owned company with the objective of promoting economic growth, entrepreneurialism and innovations through financial support and business advice. ALMI offered a programme called Stockholm Innovation with an innovation loan designed so that firms or individuals with innovative ideas could obtain loans, and if their projects did not succeed they did not need to repay the money.[65] In total, Zenicor borrowed around SEK 600,000 from ALMI (400,000 in innovation loans and 200,000 as a business loan).[66]

6.4.3 Product development

Zenicor ECG is a holistic solution or product system intended to solve a real and specific problem. The development of the solution occurred mainly within the firm. It was a strategic and conscious decision to establish a product-based company rather than work as consultants. To invest and develop the hardware within the firm was, however, seen as strategically impossible. The solution was to find a rather simple product to which functions could be applied and added, and which would make the product system unique. Through this solution the firm could also avoid becoming a mere distributor of an existing similar product.

Although the firm developed the solution, the software was developed in co-operation with a software company on a consultancy basis and the hardware was licensed from an external manufacturing company. Zenicor specified the product's requirements in collaboration with the medical experts, who had many ideas on the design and how the product should fit the medical organisation, as mentioned above.

Three candidates for hardware manufacturing were found through the Internet, and were contacted via mail. Only one company responded and a meeting was set. The company—*ET Medical Devices SpA*—is an international medtech corporation with offices in Canada and Italy, with its hardware manufacturing located in Canada. The hardware was adapted and developed specifically for and by Zenicor. A significant amount of the initial financial investment was used to fly to Canada to meet the manufacturer in person. All three partners and the cardiologist from Karolinska University Hospital Huddinge went on the week-long trip. Agreements were made and contracts signed confirming sole license to use the hardware in northern Europe. The firm was similar to Zenicor but roughly five years ahead with a slightly different focus on the consumer market and thus, not a competitor. A buyer–supplier relationship was established.

Because Zenicor is a small firm it required support to develop and maintain the software system. The IT consultancy firm Bluefish, which became Cygni in 2006, has regularly been subcontracted to develop substantial parts of the software for the ECG system. Zenicor has been responsible for all the application knowledge and detailed demand specification. The consultant, whom the partners knew from previous work, has worked on a project basis. The same software consultant has remained throughout the development process, and consequently

[65] See ALMI (2009).

[66] Palerius (2008); see also Affärsdata (2009).

has specific competence regarding the product. The collaboration has mainly been in the form of a client–supplier relationship.

During the development of Zenicor ECG there have been two other collaborations, one for long-term management support and one short-term R&D project. The operation and management of the servers for the ECG system is undertaken by another external partner in Sundbyberg, a small municipality adjacent to Stockholm. The partner has the facilities to handle 24-hour back-up systems and safe storage of machinery and data. Two master's students from the Department of Biomedical Engineering at Linköping University developed a module for the software system. To develop an algorithm for an ECG signal, such specific technical competence was necessary. A new function was required.

6.4.4 Marketing and testing

To develop medical technology and sell it to the professional market, it is necessary to have clinical studies and medical verification of the product and the system. The firm learnt this through their intensive contacts with medical experts, especially through the contacts with the researchers at Södersjukhuset. The demand for the product also increased after the publication or presentation of a research report that verified its benefits, usage and application. Medical experts have a double function in the process; they test and verify the product but by doing so, they also market and promote it.[67]

The initial studies pertaining to Zenicor ECG had to be found through the firm's initiative. Investing a large amount of capital in clinical studies and obtaining clinical verification of the product was a significant initial strategic decision that has proved to be absolutely necessary. It was also an issue of trust in relation to the medical partners and for the future marketing of the product. The collaboration between researchers and medical experts is still important and a significant part of the product's continuous development. Through the research projects, new and alternative applications for the product have been discovered, which has resulted in new research projects and product development.

The funding of the research projects has otherwise used traditional channels. However, Zenicor has, through its competence and background, transferred information and knowledge about alternative funding resources to the medical experts. For example, the professor at Söderjukhuset who is affiliated with the Karolinska Institute, in collaboration with Zenicor applied for a project in the *IT för sjukvård i hemmet* research programme funded by VINNOVA, after being made aware of the funding opportunity by Zenicor. The project started in 2005 and was presented at the Euroscience Festival in 2008.[68]

In 2008, VINNOVA granted funding for another research project concerning IT support for stroke prevention, which is a collaborative project between Zenicor, the Karolinska Institute and the pensioner organisations National Pensioners' Organisation (PRO) and *Sveriges Pensionärsförbund* (SPF).[69] These projects have strengthened the collaboration between the firm and the medical researchers on the basis of mutual benefits.

6.4.5 Product and knowledge diffusion

In the spring of 2008, the Zenicor ECG was in clinical use in more than 40 different hospitals in Sweden. During the autumn of 2008 the firm expanded into Norway, and then into Finland in winter 2009.[70] In spring 2009, Zenicor ECG was in use in at least 50 hospitals in Sweden, four in Norway and two in Finland. The firm hired a sales person and is searching for one more employee. The development of the product has been continuous and new packages of functions have been added successively, which has been relatively easy because the system is

[67] Rasmanis (2008), Affärdata (2009)

[68] See VINNOVA (2007), Nelson (2008), and ZMS (2009).

[69] VINNOVA (2008)

[70] ZMS (2009)

web-based. Approximately one new package of functions has been added each year. The new functions are developed according to demand from the clients—medical staff and patients—and from the research projects. The partners have also had their own ideas about improving and developing the product, which, however, have always been tested and discussed with the medical experts.

What has changed since 2003 is where and how the device is used. New applications that the firm did not foresee at the beginning of the project have been developed on the basis of ideas from the medical experts. The development of new areas of application has been a development of the project. A research project is established to test the application of the device in a new area, which leads to further studies that may generate new ideas related to the function or application development of the product. New application areas have also meant new markets, for example in preventive health care.

Since 2003, the research has spread to other university hospitals such as Umeå University Hospital and Danderyds Sjukhus through research collaborations and with the use and diffusion of the product.

For the past two years Zenicor has had premises in central Stockholm in the financial and business quarters, just a block away from its previous location. The rent is lower at the current central location than at the business hotel in Mörby outside the city, which, however, included more support services. The location was chosen for both social and economic reasons. It is easy to reach the central city from most of the residential areas in and around the city.

6.5 Concluding comments

To summarise the Stockholm case, three points are stressed. First, considering comparisons with the other REKENE case study regions, the Stockholm region is different in terms of size, magnitude and political status. A major capital region has local access to various resources contributing to knowledge dynamics. These resources are connected to organisations such as existing major firms, universities, main hospitals and political bodies. Such a regional presence provides many possibilities for actors to connect and interact, in both cumulative and composite knowledge processes.

Second, referring to 'regional trajectory' in the sense of path-dependency in the direction of knowledge development, Stockholm, primarily representing the city but also the country as a whole, has a strong tradition of engineering expertise and engineering-based industries. This means that synthetic knowledge is significant and such knowledge is evidently supported by policy measures. The stability of political support for Kista Science City, regardless of political majority in Stockholm municipality, is an indicator of the consensus on the importance of engineering expertise and synthesis of knowledge.

Third, although the network relations in the knowledge biography discerned in the firm-level knowledge dynamics and for Zenicor ECG primarily seem to be regionally contained, it should be stressed that knowledge among actors in this network develops through international interactions, because research in the fields of medicine and technology is strongly international. In addition, many firms are international.

The territorial and firm-level knowledge dynamics involving KIBS, ICT and medtech in Stockholm are further elaborated in connection to the analysis of the empirical material in Part III. However, it can be concluded that firm-level knowledge dynamics in Stockholm are an example of anchoring, defined in terms of 'knowledge coming from outside a region, somehow 'sinking in' and being recirculated within the region' (see Chapter 10). In the knowledge biography of Zenicor ECG, it has been shown that actors have the capability to make use of knowledge produced elsewhere for their interaction among actors within the region.

7 Knowledge dynamics in KIBS and computer and technical services in Åland

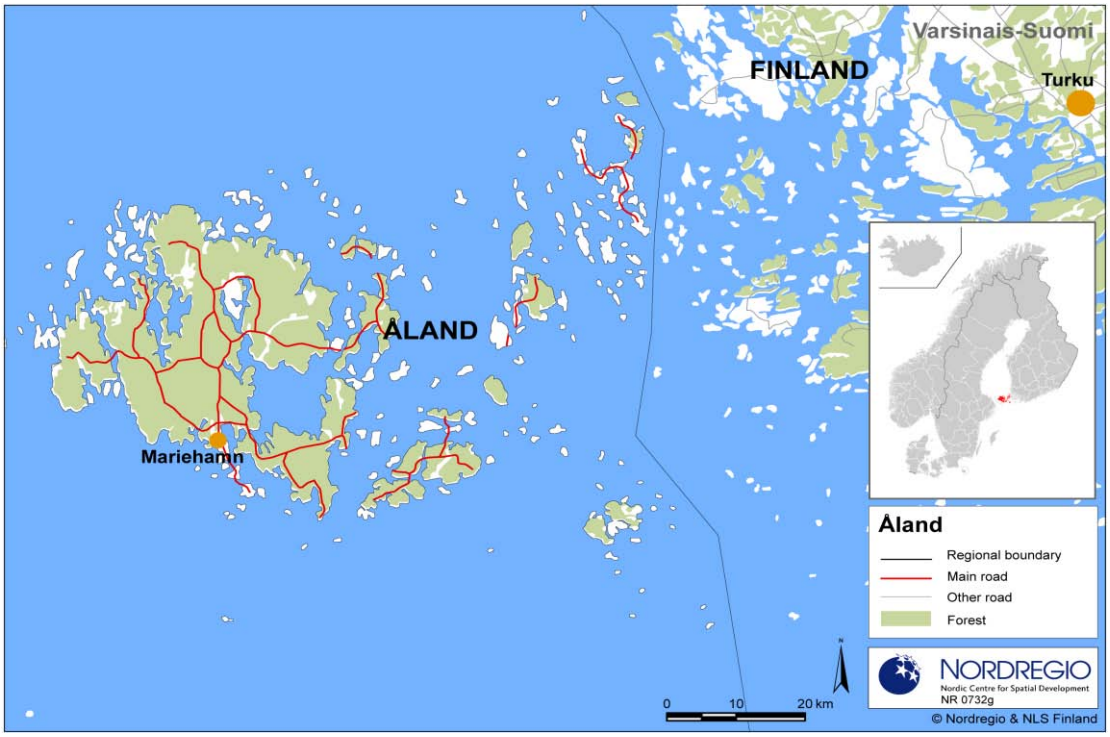
By Katarina Fellman

This section introduces the 'regional' context of Åland, the sectoral characteristics of KIBS in Åland, territorial knowledge dynamics in the subsector of computer and technical services and KIBS, and finally a case study of firm-level knowledge dynamics in the development of licensed interactive gaming solutions on the Internet.

7.1 The 'region' of Åland

The Åland Islands are located in the northern Baltic Sea, at the entrance to the Gulf of Bothnia between the Finnish mainland and Sweden. There are approximately 27,730 inhabitants on the 6,500 islands.[71] Åland consists of a main island, surrounded by approximately 6,500 smaller islands. Just over 60 of the islands are inhabited on a year-round basis. The total land area is 13,300 km², of which slightly more than 1,500 km² is land surface. In other words, Åland is small and diffuse.

Figure 7.1: Åland



[71] ÅSUB (2009a)

Åland has 16 municipalities. Ten municipalities constitute, or are connected to, the mainland of Åland by bridges, while six municipalities are situated in the 'archipelago region' and are not connected to the main island by road. Transport to and from the archipelago region is dependent on a network of car ferries. Mariehamn, which is the political, administrative, and economic centre of Åland, is located on the main island. Approximately 40 per cent of the inhabitants of Åland live in Mariehamn, while 52 per cent live in the countryside on the main island. The remainder, slightly more than 8 per cent, live in the archipelago.

Despite its geographical location in the Åland Sea, Åland has relatively good external communications. There are daily ferry services to Stockholm, Turku, Helsinki and Tallinn, and daily flights to the first three cities.

The region has had special status in Europe since 1921. The islands are demilitarised and neutral. The inhabitants of Åland have the right of domicile (regional citizenship), which among other things allows them the exclusive right to own real estate. Swedish is the official language.

Åland has its own parliament (*Lagtinget*) with its own political parties and government (*Landskapsregeringen*). Åland's legislative powers include areas such as environment, health care, local government, policing, postal services and radio/TV broadcasting. The autonomy also covers legislation, administration and policy development concerning education and the promotion of industry and labour market.

In 1995, Åland joined the EU, together with Finland. However, Åland joined the EU according to a special protocol that regulates Åland's relationship to the union. The protocol states that Åland shall be regarded as a third territory with respect to indirect taxation. It also contains derogations concerning the right to conduct business in Åland and to own real estate.

Åland's geographical position between two economic centres, southern Finland and the Stockholm region, offers certain advantages but also makes the islands vulnerable. On one hand, there are two large markets at close quarters. On the other, Åland is dependent on economic conditions in adjacent markets, and the population varies with fluctuations in the economy. Migration has become an increasingly important determinant of labour supply in Åland. During the period 1999–2008, net immigration averaged 0.58 per cent of the population. Migration has become a way of escaping the limitations of the small-scale labour market. The unemployment rate was very low during the past 10 years; the unemployment rate is currently 2.7 per cent on a yearly basis (2009).[72]

The production structure of the Åland economy is dominated by the shipping sector. Compared with other shipping clusters, Åland is very much focused on the shipping companies, and especially on passenger shipping. However, over the past few years, the competitiveness of the shipping industry in Åland has declined, and a process of 'out-flagging' has commenced. These changes pose a clear threat to Åland´s labour market and economy. In spite of the decreasing size of the shipping sector, Åland's economy has not declined. The service sector has compensated for the reduction of the shipping industry, especially in the knowledge-intensive areas of the service sector.[73]

Shipping is of great significance to Åland's economy, because the sector is strongly linked to land-based industries: tourism, trade and industry. The financial sector is also closely connected to ship-owning operations. Shipping accounts for almost 30 per cent of value added and 11 per cent of employment. Service industries, which are all the industries save primary production, manufacturing and construction, generated around 80 per cent of the value added in 2007. The manufacturing industry accounts for less than 7 per cent of total employment in the region.[74]

The Åland economy is characterised by both a few relatively large companies mainly in shipping, and a great number of very small businesses. Åland's company structure has very few

[72] ÅSUB (2010)
[73] ÅSUB (2009b)
[74] ÅSUB (2009b)

medium-sized companies compared with surrounding economies.[75] Many successful small businesses began as suppliers to the shipping companies, for example in computing and other areas of technology.

7.2 The KIBS sector in Åland

The KIBS sector in this study is defined in quite a narrow sense, including computer services, R&D, economic services, technical services and advertising. In 2005, there were 295 companies active in the KIBS sector in Åland, which accounted for about 9 per cent of the total number of companies. The sector is growing at a relatively rapid pace, given that in 2000 the number of companies was 227. The largest number of firms is found in the sector of economic services, but even architecture and engineering firms (technical services) and computer services account for a fair number of companies.

Employment in the sector has risen from 350 people employed at the end of 2000 to 474 people in 2005, a change of 35 per cent. Thus, in 2005, employment in the KIBS sector accounted for 3.6 per cent of total employment in Åland. The number of employed people in 2007 from the register of enterprises was estimated to be 516, a growth of 10 per cent. Men comprise the majority of the work force in computer services (68 per cent) and technical services (63 per cent), whereas women constitute a majority among those employed in economic services and advertising.

The majority of the companies in the sector are very small firms in terms of employment; more than 90 per cent of the companies employ fewer than five people. Only two companies have over 100 employees.

Most of the growth in employment is explained by the development of ICT services. The employment in that sector has more than doubled during the period, whereas the number of companies has increased mainly in 'other business activities'. Of those employed in the KIBS sector, 5 per cent are self-employed, which is notably lower than the average of 12.8 per cent of employment in Åland as a whole.

The turnover in the sector has increased by more than 160 per cent and wages have risen by some 220 per cent since 2000. The most profitable area of the KIBS sector in Åland is ICT services.

The economic growth of the KIBS sector in Åland depends upon the expansion of a few larger companies ('larger' relative to local conditions) and new businesses. This means that entrepreneurial growth based on small business and the routinised economic expansion based on more established and larger companies are of great importance for growth in the KIBS sector in Åland.[76]

A significant proportion of the firms began as suppliers to, or were outsourced from, the shipping sector. The shipping companies open up international networks and opportunities in various sectors. The development of the Internet has also opened new markets. The KIBS sector has, to a great extent, compensated for the reduction of the shipping industry during past years. Hence, Åland's economy is developing towards a less vulnerable, more diversified structure and the knowledge-intensive service sector is of growing importance for Åland and has demonstrated significant growth potential.

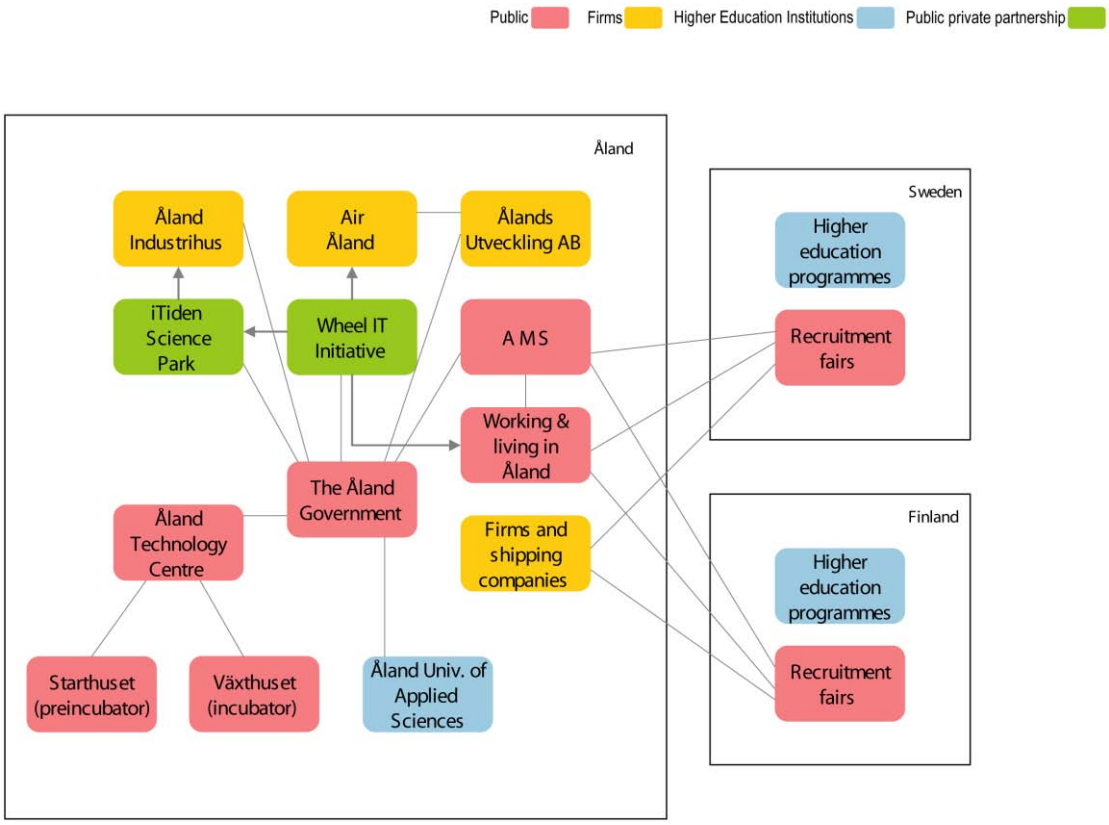
[75] Fellman (2004)

[76] Fellman (2004)

7.3 Territorial knowledge dynamics in computer and technical services[77]

As described above, the KIBS sector in Åland comprises different sectors but the most international in nature are computer and technical services, which are the focus of this study. The case study exploring the territorial knowledge dynamics was selected primarily on the basis of a growth theory approach. This section introduces the main actors in the KIBS/computer and technical services sectors in Åland and provides examples of extraregional knowledge interaction. The actors are illustrated in Figure 7.2.

Figure 7.2: Examples of key actors in computer and technical services in Åland



The Åland University of Applied Sciences offers a variety of higher education programmes, including technology and engineering-related programmes. The university maintains close contact with the surrounding business community. Thus, expert councils including representatives from the business community have been established for each education programme, and they meet several times a year to comment on potential changes in the programmes to ensure that the education opportunities are in tune with the needs of the surrounding community.

In spite of the presence of the Åland University of Applied Sciences, most young people leave Åland to attend university in either Sweden or southern and western Finland. A challenge

[77] Please note that the figures, including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively, are only snapshots of the actors and interactions involved.

is to encourage these individuals to return to Åland after they finish their studies or when they acquire several years of work experience.

Åland Technology Centre (ÅTC) is a regional triple helix organisation. The objective of the organisation is to promote the commercialisation of innovations and start-up businesses. ÅTC promotes education and initiation of R&D projects and provides consultancy services. The organisation runs the *Växthuset* incubator (the greenhouse) and the *Starthuset* pre-incubator, which offers an opportunity for entrepreneurs to develop ideas and new knowledge before taking the next step and establishing a firm through the incubator. ÅTC is based at the ITiden science park in Mariehamn.[78]

The ITiden science park is owned by *Ålands Industrihus AB* (a commercial property company), which offers premises and buildings for rent to businesses. ITiden was set up in 2004 and expanded in 2007. It hosts a number of KIBS firms.

Ålands Utvecklings AB (development company) is a company that provides venture capital, focusing on the development of young firms engaged in technology, maritime services, ICT and environmental sectors.

The demand for labour in the ICT sector is considerable in Åland, and in this connection, AMS—Åland's authority for the labour market and student services—is a significant actor. Moreover, the government has launched the 'Working and Living in Åland' initiative to encourage emigrants and students to return there. Within the framework of the initiative and in co-operation with AMS, a number of firms have participated in various recruitment fairs and campaigns in Sweden, Finland and other European countries.

The Wheel IT initiative was initiated at the beginning of the 2000s to increase collaboration to generate growth in Åland. Thus, the ITiden science park, Air Åland, which has frequent flights to Helsinki and Stockholm, and the 'Working and Living in Åland' project are results of the Wheel IT initiative. This initiative served as a starting point for enhanced interaction between policymakers, public organisations and the business community.

Finally, the business networks, clients, customers and groundbreaking technological developments such as Internet opportunities in developing markets and products, are significant parts of the knowledge dynamics of the computer and technical services in Åland.

7.4 Firm-level knowledge dynamics: Developing Internet gaming

The firm that is the focus of the firm-level case study in Åland is Paf, which is a membership organisation for gaming machines.[79] Paf has existed since 1966 and is permitted to develop gaming by the government of Åland. The firm exclusively operates government-licensed games. Originally, Paf offered gaming solutions such as slot machines and casino games to shipping companies. Today the company consists of the parent company Paf, which operates gaming in Åland, onboard Åland- and Finnish-owned ferries and via the Internet and mobile phones. The subsidiary Paf Consulting AB, with its foreign owned subsidiaries and associated firms, manages the international gaming operations, including those in international waters. The aim of the Paf Group is to generate funding for non-profit humanitarian causes and social welfare in Åland.

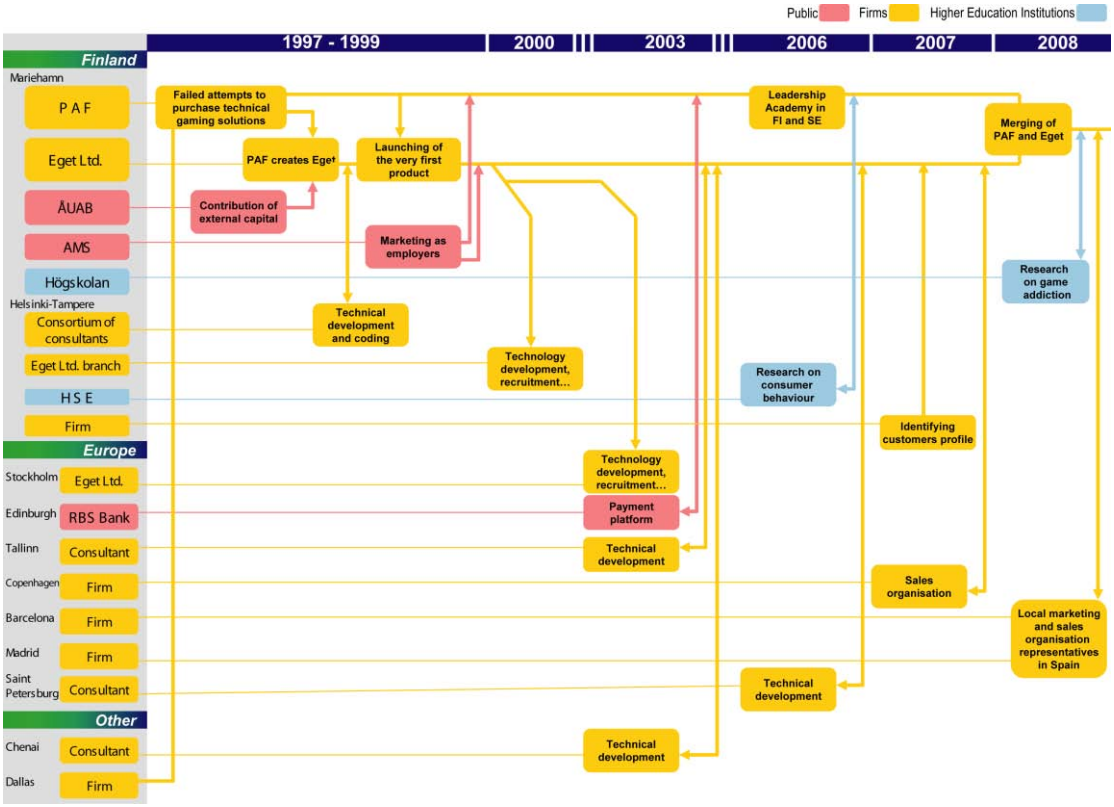
The case study explores the development of licensed interactive gaming solutions on the Internet initiated by Paf in 1996. The study ended in 2008, when the supplier Eget merged

[78] Åland Technology Centre, www.atc.ax

[79] Examples of member organizations are Folkhälsan på Åland (public health on Åland), Finland's Red Cross—Åland district, Cultural associations, Save the Children—Åland district, Åland's Sjöräddningssällskap (Åland's coast guard association).

with Paf and a new phase of market development was initiated. Figure 7.3 provides an illustration of firm-level knowledge interaction in the development of Internet gaming by Paf.

Figure 7.3: Knowledge biography of Internet gaming



7.4.1 Developing the idea

During the 1990s, various factors, such as the Estonia tragedy,[80] lowered alcohol taxation in neighbouring countries and increased competition in the passenger traffic of the Baltic Sea, led to a crisis in the passenger ferry industry. At this time, more than 90 per cent of the total income of Paf came from passenger ferries. Because the firm operated within the area of government-licensed lotteries, only lotteries and games were allowed on board Åland-registered ferries on the condition that they took place through face-to-face contact.

The idea of developing Internet gaming originated from the Business Development Manager in 1995, when discussions were held in the firm. The firm intended to crossbreed its traditional gaming activities in Åland and at sea with digital interactive gaming. Paf received approval from the Government to build on its core competences utilising new channels and markets. In 1996, Paf tested the idea in a 'trial and error' process through a local website (www.aland.com). This test revealed the potential of the game but that more technical knowledge was needed.

7.4.2 Developing the technology

To obtain the right technology for the interactive gaming solutions, Paf was interested in purchasing a complete so-called 'turn-key solution'. In 1997, a firm in Dallas, Texas, was hired to develop the product through the combined efforts of a number of consultants. Meanwhile,

[80] This tragedy occurred on 28 September 1994, and claimed 852 lives when the MS Estonia sank in the Baltic Sea.

the firm in Dallas was not able to handle the complexity of the task, and after a year Paf abandoned co-operation with the firm.

In late 1998, Paf found another technology supplier, a consortium of consultants located in the Helsinki-Tampere area in Finland. However, the parties quickly realised that the consultants were unable to deliver what Paf wanted.

As a final solution to the problems of developing the appropriate technology for the game, the subsidiary partly owned by Paf, Eget AB (European game and entertainment technology Ltd.), was established in 1999. Some of the Finnish consultants became engaged in Eget AB as shareholders and worked as consultants. In addition, Eget hired a number of other consultants to develop the technical coding of the games and the gaming platform. At this stage, the venture capital firm Åland's Utvecklings AB contributed external capital to support the development process.

7.4.3 First launch and product development

In December 1999, the first version of the Internet game, Version 1.0, was launched. With this launch, Paf wished to test the conditions for Internet gaming. The solutions were simple at this time. However, Paf became aware of the opportunities in interactive gaming on the Internet, and wanted to utilise its experience in gaming for further product development.

From 2000 to 2008, comprehensive product development was conducted. In this period, Paf was the purchaser that generally decided which games the company wanted developed, and Eget delivered the products. Eget, depending on the product, developed it in-house or hired consultants outside Åland to deliver the products and simply adopted the user interface and image. These consultants were in places such as Helsinki, Tallinn, Chennai and St Petersburg. Paf held the gaming licence and always marketed the games.

Eget was not able to recruit the requisite number of experts for Åland during this period. Therefore, in 2000 it established a branch in Helsinki, and in 2003 a partly owned subsidiary in Stockholm. It was easier to attract technical experts to work in these two capitals.

In 2003, a subsidiary of the Royal Bank of Scotland became responsible for the payment system for e-commerce. The bank's system became integrated with Paf's, and thus, it appears as though Paf manages the payment.

7.4.4 Market development

In 2008, Paf and Eget merged. This entailed the abandonment of the 'purchaser–provider' model, which made the process more efficient and prevented misunderstandings with business partners.

The gaming market reached maturity at this stage, and it has not continued to grow as it did in the start-up phase of Paf's development of Internet games. Moreover, the firm must concentrate on retaining costumers. To identify specific customer segments on which to focus, Paf has bought a service from a Finnish firm. This firm used a tool to identify the 'luck and entertainment' segment that Paf began targeting in 2008. Paf also wanted to reduce its dependence on the Scandinavian market and explore new markets. The procedure now used by the firm is that it invests in market knowledge from the markets that it plans to enter, and it establishes internal market entry organisations to ensure successful launches into the new markets. The purpose of this is to act 'locally' in the globalisation process. Furthermore, attending trade fairs and conferences outside the region and meeting different actors at these events is an essential part of observational learning.

Paf adopted an 'agile development process' originating from the lean production process, which means that the direction of the entire development process is evaluated and checked continuously, and that products are developed within four weeks from the time they are ordered.

Paf has changed its business model to include a number of competence centres. Thus, the Helsinki division focuses on technological development, while the Stockholm office specialises

in business-to-business sales. A subsidiary in Tallinn operates in the field of on-board gaming on Estonian passenger ships. Moreover, in 2007, a large sales organisation with extensive language skills was established in Copenhagen. The subcontractors in Tallinn, St Petersburg and Chennai are still employed on a project basis when there is a need for their specialist competences. The firm continues to develop its competence network, which now includes Spain.

This phase also includes collaboration with HEIs, both with the local university and with institutions outside the region. These collaborations include research projects on consumer behaviour on the Internet and on gaming addiction and risky behaviour.

7.5 Concluding comments

In the Åland case study, the knowledge dynamics and development in computer and technical services has proved highly dependent on interaction with firms, clients, business networks and HEIs outside the region. The firm-level knowledge biography provides an interesting view of the kind of knowledge that has developed locally, and shows that firms have preferred to or been forced to acquire from other regions and locations.

Analytical science-based knowledge is a combination of distant and proximate knowledge interactions; HEIs inside and outside the region were engaged. The synthetic knowledge has been critical for the development of licensed interactive gaming. The generation of this knowledge is very much an international phase of the knowledge biography because partners and subcontractors from diverse parts of the world have been involved. The firm has made use of branches and subsidiaries outside the region, in conjunction with wide-ranging knowledge networks, as a fertile base for the growth of the synthetic knowledge.

In addition, HEIs have been essential for recruiting a workforce with the appropriate skills. The symbolic knowledge generation started as a predominantly local effort. However, when developing the international markets for business, the firm has found that local symbolic knowledge is a prerequisite to act in other markets. Finally, strategic knowledge is mainly based on local interactions. There are strategic elements in all knowledge types; in the kinds of research for which the firm is recognised, in the types of technical skills it develops and in communication of the products on the Internet. Hence, a locally anchored strategic view of the development is obviously crucial.

Further exploration of the firm-level and territorial knowledge dynamics in Åland is undertaken in the analytical chapters in Part III. To summarise, the overall picture of the sector and the knowledge dynamics in the Åland case study is that knowledge generation and growth in the small-scale region are strongly driven by complex and intensive knowledge interactions with various actors outside the region.

8 Knowledge dynamics in new media in Östergötland

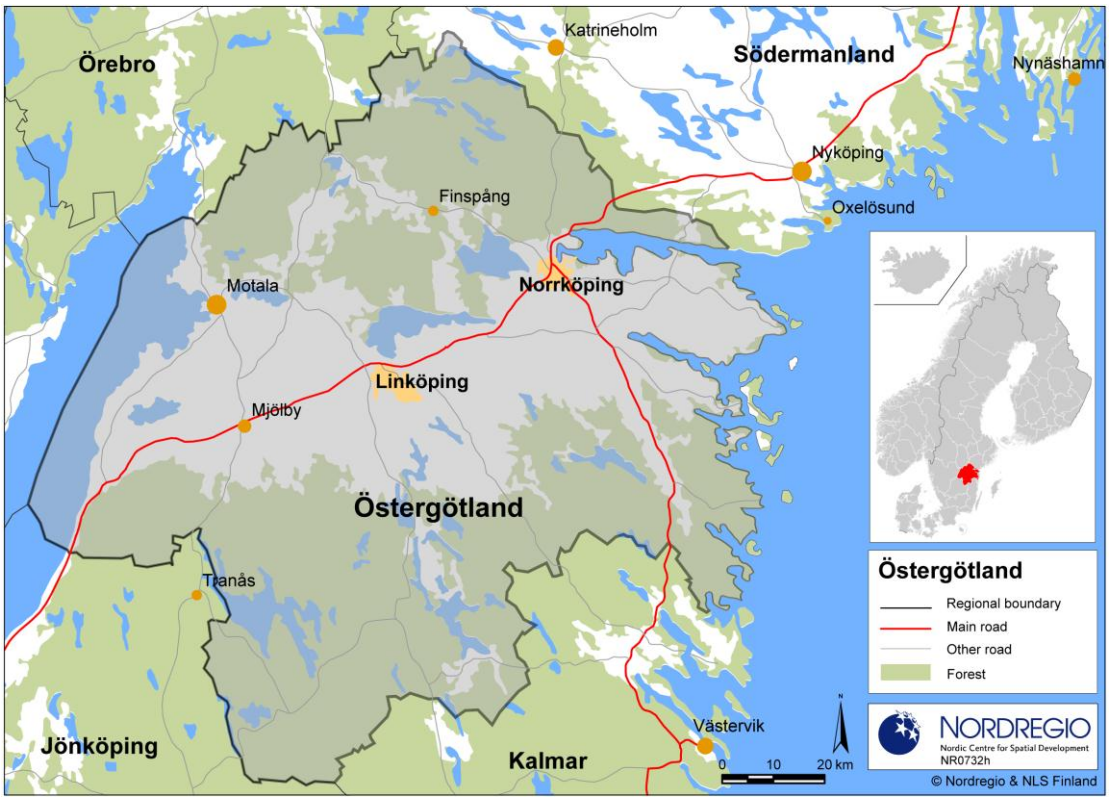
By Josefina Syssner

This section introduces the region of Östergötland, including: the new media sector in the region, the main actors engaged in territorial knowledge dynamics in the field of visualisation technology, and a case of firm-level knowledge dynamics involving a number of public and private actors in the development of an annual new media event, the New Media Meeting.

8.1 The region of Östergötland

Östergötland County, located in the eastern parts of Sweden, consists of 13 municipalities, of which Linköping (population 138,805 in 2007) is the largest. Norrköping is the second largest municipality (population 126,680 in 2007). These are the two main cities in the county. The rest of the county consists of countryside and smaller towns such as Finspång, Motala, Vadstena and Söderköping.

Figure 8.1: The Östergötland region



Historically, Linköping was the administrative centre of the county. Norrköping, located approximately 50 kilometres to the east, developed into the industrial centre of Sweden in the nineteenth century. Much later, from the 1950s onwards, Norrköping has suffered from the consequences of deindustrialisation with rising unemployment, a declining tax base, redundant urban spaces and a decrease in population. From the early 1970s, the city experienced a growing demand for technically skilled people. At this time, Norrköping gained from the decentralisation of government authorities, and a number of substantial government bodies were based in the town. The most prominent of these were Swedish Maritime Administration, the Swedish Migration Board, and the Swedish Prison and Probation Service. These authorities had a great demand for IT system solutions.

Today, there is an ambition among Norrköping and Linköping municipality representatives to merge the two municipalities functionally. The two municipalities would then constitute a twin city region, or, as they put it, 'the Fourth City Region of Sweden'. The decision to support further integration of the two municipalities was made on the basis that a high level of functional interaction between the two cities already exists. On a daily basis, 5,000 individuals commute between Norrköping and Linköping by car, railway or bus.[81] In many contexts, the efforts by Norrköping and Linköping municipalities have been met with enthusiasm by representatives of the other 11 municipalities in the county.

At the county level, Östsam, the regional development council, constitutes the regional political administration. Östsam has operated in its present form since 2003 and it unites all thirteen municipalities in Östergötland as well as the county council. The county council is responsible for matters concerning health and medical services in the county, whereas Östsam is responsible for long-term development and co-operation within the region. The overall mission of Östsam is defined as one of enhancing 'long-term sustainable regional growth and development' in the county. Along with this mission, the activities of Östsam should also seek to create a 'region in balance' and 'good living conditions for the inhabitants'.[82] The main areas in which Östsam works are business development, communications and infrastructure, lifelong learning and employment, and arts and culture.[83] Apart from the two institutions mentioned above, the County Administrative Board is a central government agency that functions as the representative of the Swedish Parliament and the central government at the regional level, but also has 'a parliamentary mandate to work for the county's best interests'.[84]

Of great importance for the region is the presence of Linköping University. The university acquired full university status in 1975 and is renowned for its interdisciplinary tradition. The university comprises four faculties: Arts and Sciences, Educational Sciences, Health Sciences and Technology. To encourage interdisciplinary collaboration, some research and education departments span several faculties. Linköping University is spread across three main locations: Campus Valla (Linköping), University Hospital Campus (Linköping) and Campus Norrköping.[85]

8.2 The new media 'sector'

New media is a small but growing sector of the regional economy of Östergötland.[86] A wide range of actors, such as public institutions, university departments, science parks, non-profit

[81] Twin Cities of Sweden Linköping-Norrköping, http://www.fjarde.se

[82] Regionförbundet Östsam, http://www.ostsam.se/default_en.asp

[83] Regionförbundet Östsam, http://www.ostsam.se/default_en.asp

[84] Sweden's County Administrations (2005); see Syssner (2006).

[85] Linköping University, http://www.liu.se/polopoly_fs/1.22605!bas-eng.pdf

[86] See Legnér (2008).

organisations, NGOs and private companies, contribute to the development of new media in the area.

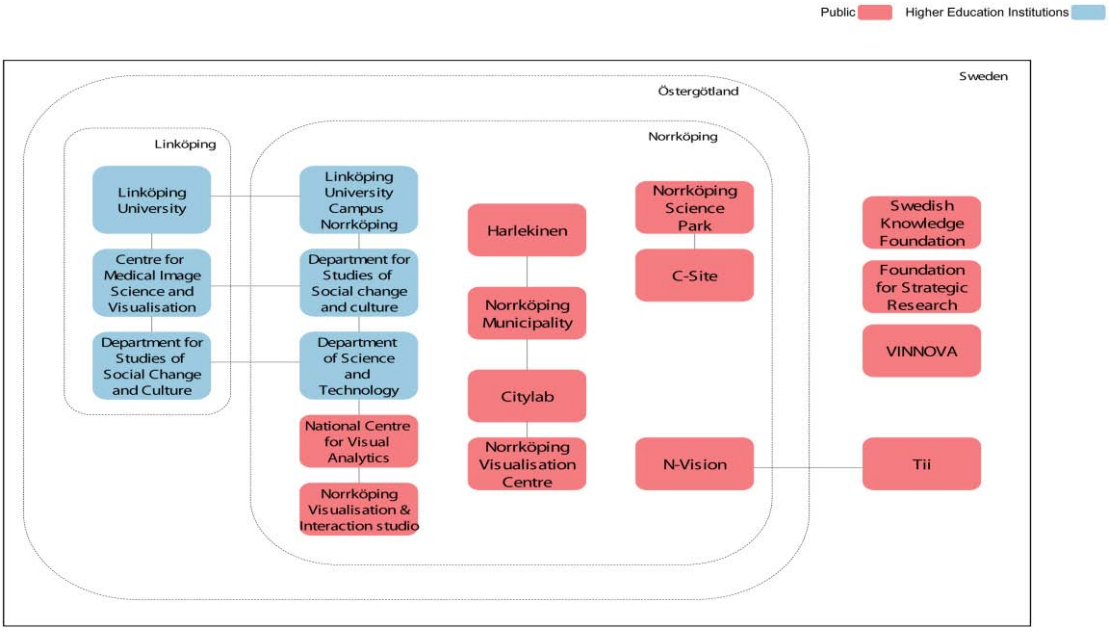
New media is a delicate concept. In some contexts, the concept has been used to describe the emergence of 'digital, computerised, or networked information and communication technologies'.[87] It has also been stressed that 'most technologies described as "new media" are digital, often having characteristics of being manipulable, networkable, dense, compressible, and impartial'.[88] Specifically, new media is understood to be applications of media such as the Internet, visualisation technology, audio technology, mobile TV, interactive TV, IPTV, digital radio and 3G mobile technology.

All in all, new media may be understood as a generic term that covers a wide range of technologies that, in turn, are applied in a multitude of ways in different sectors. The focus of this study is on new media referred to as visualisation technology. In many cases, visualisation technology refers to technology that can support innovation in the medical industry. However, it is also emphasised that visualisation technology can be applied in education, in the entertainment industry, in logistics and in general business and production development.[89]

8.3 Territorial knowledge dynamics in the field of visualisation technology[90]

This section introduces the main actors engaged in territorial knowledge dynamics in the field of visualisation technology. The actors are centred in the town of Norrköping; however, as illustrated through examples in Figure 8.2, links are established to actors outside this area.

Figure 8.2: Examples of key actors in the field of visualisation technology in Östergötland



[87] Flew (2002)

[88] Flew (2002)

[89] Norrköping Science Park, www.nosp.se/Profilområden/Visualisering/tabid/2827/Default.aspx

[90] Please note that the figures including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively are only snapshots of the actors and interactions involved.

Campus Norrköping was established in 1997 as part of Linköping University. The Department of Science and Technology was established in the same year, and since 2007 has hosted the National Centre for Visual Analytics (NCVA) research group. NCVA is financed by the Swedish Knowledge Foundation's Visualisation Programme, which among other organisations involves VINNOVA and the Foundation for Strategic Research. The ambition of NCVA is to spread geo-visual and visual analytical technology into industry and government agencies.

The Department of Science and Technology and National Center for Visual Analytics (NCVA) host Norrköping Visualization and Interaction Studio, which is also used by other research groups at Campus Norrköping. This studio aims to make research results in visualisation technology more accessible to groups outside the university. Examples of visitors to the studio are high school students who are introduced to the science programmes at Linköping University. The studio is financed by Norrköping Municipality, the Swedish Research Council and by EU funds.

The Center for Medical Image Science and Visualization is another department at Linköping University that influences the development of visualisation technology. In addition to technological skills, knowledge about cognition, learning, arts, design and public relations is also significant in the field of visualisation technology. Therefore, the Department for Studies of Social Change and Culture is a collaboration partner with the above-mentioned departments. This department is located in both Linköping and Norrköping.

Norrköping Municipality supports the development of new media, especially the Department of Culture and Leisure. This department deals with issues relating to recreation and sports facilities, libraries and the new media. As early as the 1960s, the department restored a local arts museum to house the movie theatre, Harlekinen.

Another initiative of the Department of Culture and Leisure is Citilab (Citizen, Community and Laboratory). Citilab has been created to develop the Norrköping Visualization Centre. The centre was developed as a hands-on science centre where visitors have the opportunity to experience and explore different applications of visualisation technology. At the time this study was conducted, the centre had not yet opened but was scheduled to open in the spring of 2009. Citilab is responsible for collecting and producing the exhibitions, films, experiments and visualisation projects that are displayed at the centre.

Norrköping Science Park (NOSP) is located near Campus Norrköping. It hosts approximately 90 firms, of which most are ICT firms. Visualisation technology is one of four focus areas of NOSP. Linköping University is regarded as one of the leaders in the country in the field, and this was recognised in 2007 when NOSP became the host of the 'national meeting point for visualisation technology', called C-Site. The meeting point was funded by the Swedish Knowledge Foundation, the Foundation for Strategic Research, VINNOVA, the Swedish Foundation for Health Care and the Invest in Sweden Agency. The main objective of C-Site is to disseminate knowledge, build networks and support business start-ups.

Tii was established in 1998, following a decision by the Swedish Foundation for Strategic Research. The purpose of Tii is to function as a non-profit, experimental IT research institute with an interdisciplinary focus. Six Tii research institutes were established across the country. The institute in Norrköping is called N-Vision. The institute has some collaboration with C-Site.

8.4 Firm-level knowledge dynamics: Developing the New Media Meeting

This section introduces a case of firm-level knowledge dynamics in the town of Norrköping involving a number of public and private actors. The case study explores the development and organisation of the annual New Media Meeting (NMM).

8.4.1 Developing the idea

The idea of organising an annual new media event in Norrköping was generated in an informal discussion in 2005. The idea was launched within a relatively small group of people. Two of the members of the group were musicians who were interested in electronic music and active in the local club scene. Another member in the core group worked as an art director, using a computer to design and create visual concepts. Yet another member had for a long period worked with films and the Harlekinen cinema in Norrköping municipality. During a conversation among these individuals, the idea to initiate NMM came up. They all shared a profound knowledge of digital culture and the local subcultural context and its relation to similar contexts in other cities and regions.

The idea of NMM was linked to the municipal's ambition to commemorate the Norrköping Exhibition, which was held in 1906. Similar to, for instance, the larger Stockholm Exhibition in 1897 or the World Fair in Paris in 1900, the Norrköping Exhibition was organised to exhibit technical innovations from different countries, and to relate these innovations to developments in art and culture. The core group behind NMM saw a clear thematic link between the Norrköping Exhibition and NMM and suggested that NMM should be organised as part of the celebration of the 100 year anniversary of the Norrköping Exhibition. This idea was well received by Norrköping municipality.

In the end, NMM was not included in the anniversary of the Norrköping Exhibition, but the good contacts with the municipality remained. Leading politicians and civil servants were enthusiastic about the idea, and decided to support the group in the concept development phase. The concept was developed and the first festival programme later arranged. In the programme development phase, the individuals involved in the group made use of their contacts, insights and familiarity with their respective fields

8.4.2 Organising the event

The NMM event was held for the first time in September 2006. By this time, the core group behind the idea had formed an NGO named Resistans, of which the main objective was to organise the NMM. Since then, Resistans has owned the name and the concept of the NMM, although the event is arranged in collaboration with several of the actors mentioned above. Tii, Citilab and Norrköping Science Park are among its co-partners. The festival is also promoted and sponsored by Norrköping Municipality, the Regional Development Council Östsam and Destination Norrköping.

A number of committees have been established to solve specific tasks in relation to NMM. One committee is responsible for designing the festival programme, another is responsible for logistics, a third is responsible for technical solutions, a fourth group is responsible for administrative issues and a fifth is responsible for PR and marketing. Apart from the committees that engage a number of individuals in the region, 25–30 individuals assist with practical, organisational matters during the festival. All individuals work voluntarily in the project on a non-profit basis.

9 Knowledge dynamics in the food and drink sector in Zealand[91]

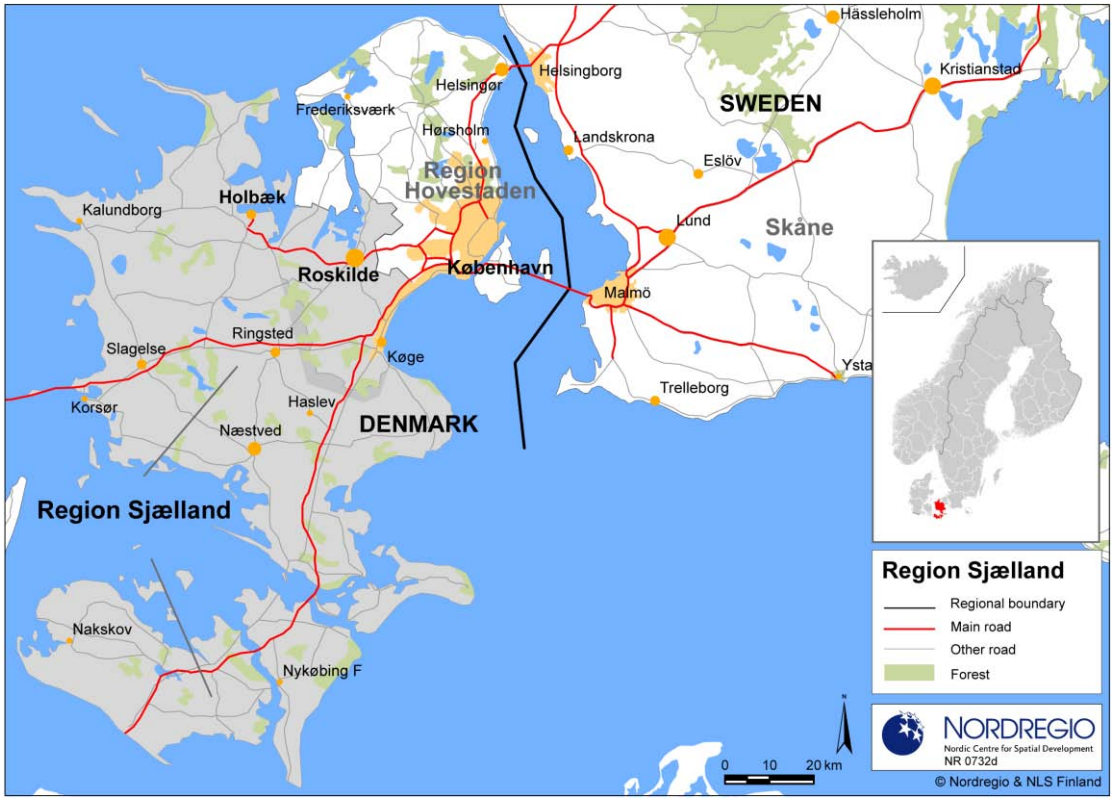
By Lene Ekholm Petersen & Henrik Toft Jensen

This section introduces the Zealand region, the characteristics of its food and drink sector, the territorial knowledge dynamics in relation to the specialised food and drink production and a firm-level case study of the establishment of the Holbæk Brew House microbrewery.

9.1 The Zealand region

The Zealand region consists of 17 municipalities, and has 821,000 inhabitants.[92] The administrative centre of the region is in the town of Sorø.

Figure 9.1: The Zealand region



[91] See Jensen & Petersen (2010).

[92] Statistics Denmark (2008)

The Zealand region occupies approximately three quarters of the Island of Zealand. It also includes the islands Lolland, Falster and Møn together with 110 smaller inhabited and uninhabited islands,[93] covering a total of area of 7,273 km². The nearest neighbour is the capital region, which occupies a quarter of the north-east of the island of Zealand. To the west, a bridge connects Zealand with the island of Fyn and the rest of Denmark. To the east, the Øresund Bridge from the capital region connects Sweden with the region. The Zealand region is located between the capital and the rest of Denmark and the arterial roads of the region play an important part in connecting the traffic between the western and eastern part of the country.

In the past 10 years the population in the Zealand region has increased by 5.2 per cent.[94] The Zealand region is covered mainly by farmland and the agriculture and food industries play a substantial role in the region's economy. The region has 17.9 per cent of Denmark's farmland. There are approximately 800 companies in the food and drink industry and 6.8 per cent of the working population are employed in agriculture and 2.6 per cent are employed in the food and drink industry. The region accounts for a substantial part of the country's primary production. Denmark exports agricultural products to 150 countries, which is a total export value of 100 billion DKK and approximately 20 per cent of total Danish exports.[95]

The industry in Zealand is influenced by large industrial companies based in Copenhagen that have established production plants in the region. Other companies in the region provide services for the development of Copenhagen and other larger towns.[96] The construction sector is also significant in the region. During the period 1997–2008, the region experienced a total increase in employment of 6.8 per cent. During the same period, the increase in employment for the whole country was 7.0 per cent. Because of the economic crisis, the unemployment rate changed in the region, from a low of 1.3 per cent in August 2008 to 4.5 per cent in March 2010, which was also in line with the national development.[97]

Commuting plays a central role in the economy and the occupation in the Zealand region. Twenty-three per cent (2008) of the total number of employed people who live in the region work outside the region in the capital area. This presents certain challenges for the municipalities in the region. A considerable amount of income is being moved to the region from the capital region, which leads to outcomes such as higher tax incomes for the municipalities, but the commuters make little or no contribution to social life in the municipalities. That is an important limitation to the possibilities of strengthening local business development and promoting further increase in the population.[98] Compared with the large number of people commuting out of the region (98,000 in 2008), only 31,000 people commute in to work. Since 1996, the number of people commuting out of the region has increased by approximately 15 per cent, and that into the region by approximately 20 per cent.[99]

In 2006, the average disposable income per capita in the Zealand region was 173,300 DKK and for the whole country the average was 172,800 DKK.[100] Meanwhile, there are intraregional differences. The average income is highest in the north-east, which is the area closest to Copenhagen and where a majority of commuters live, while the income level is lower in the south and west of the capital region.

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[93] Statistics Denmark (2008)

[94] Statistics Denmark (2008) and Statistics Denmark (1998)

[95] Landbrugsraadet og Dansk Landbrug (2006)

[96] Tomlinson (2008)

[97] Statistics Denmark, www.statistikbanken.dk

[98] Jensen (2007)

[99] Statistics Denmark (2008)

[100] Statistics Denmark (2008)

9.2 The food and drink sector in Zealand

The food and drink industry in the Zealand region is mainly dominated by breweries, slaughterhouses, dairies, mills and bakeries. The industry has seen several mergers between companies, resulting in the sector today consisting of a few large international industrial groups. The mergers have made room for a new trend, where small companies with a special brand such as a traditional, ecological or gourmet style have been established. This tendency has mostly taken place in the same professions so several breweries, small slaughterhouses and dairies have been established in the Zealand region.

Microbreweries are also connected to the tourism sector. A trend in this sector has been orientation toward people who want to watch and understand the production process, and in some cases attempt to produce the product themselves. A concept where people are both learning and being entertained has developed in the tourism and food and drink sectors. The microbreweries are selling this 'edutainment' experience together with the beer. The microbreweries are mainly located in the north-east of the region, close to the capital region. In 2008, there were 20 microbreweries in Zealand. After the onset of the global financial crisis some have closed but new ones have opened.

9.3 Territorial knowledge dynamics in specialised food and drink production[101]

The focus on territorial knowledge dynamics in Zealand is based on the specialised food and drinks sector. Figure 9.2 illustrates the main actors in the region and examples of extraregional interaction.

As described above, the presence of international production companies in the food industry has influenced the establishment of a number of specialised microfirms in the region. The main large companies are the Danish Crown slaughterhouse, the Arla dairy, the Bisca cake and biscuit plant, and the Harboe and Royal Unibrew breweries. Now Harboe also owns the microbrewery Gourmet Brewery, which it bought in 2009. Examples of some of the microbreweries established in the Zealand region are the Herslev Brew House, Holbæk Brew House, Brew House Møn and Søkildegaard, four of 20 founded after 2000.

A number of education institutions in and outside the region have programmes that focus on production or marketing of specialised food and drinks. The Scandinavian School of Brewing, based in Copenhagen, is a private education institution owned by the Danish, Norwegian, Swedish and Finnish Brewers' Associations. It offers a Diploma Master Brewer Course, which is an education for microbrewers. The Danish Meat Trade College is a vocational education institute owned by the Danish Slaughterhouses. The Danish meat Research Institute originally owned by the Danish Slaughterhouses is now a part of the publicly supported Technological Institute. Moreover, the Danish Meat Trade College offers a management course entitled 'Cranfield Fellowship for the Red Meat Industry' in co-operation with Cranfield and Cambridge Universities.[102] *Landbrugsskolen Sjælland* (the agriculture college of Zealand), a part of Roskilde School of Technical Vocational Training, is another relevant education institution.

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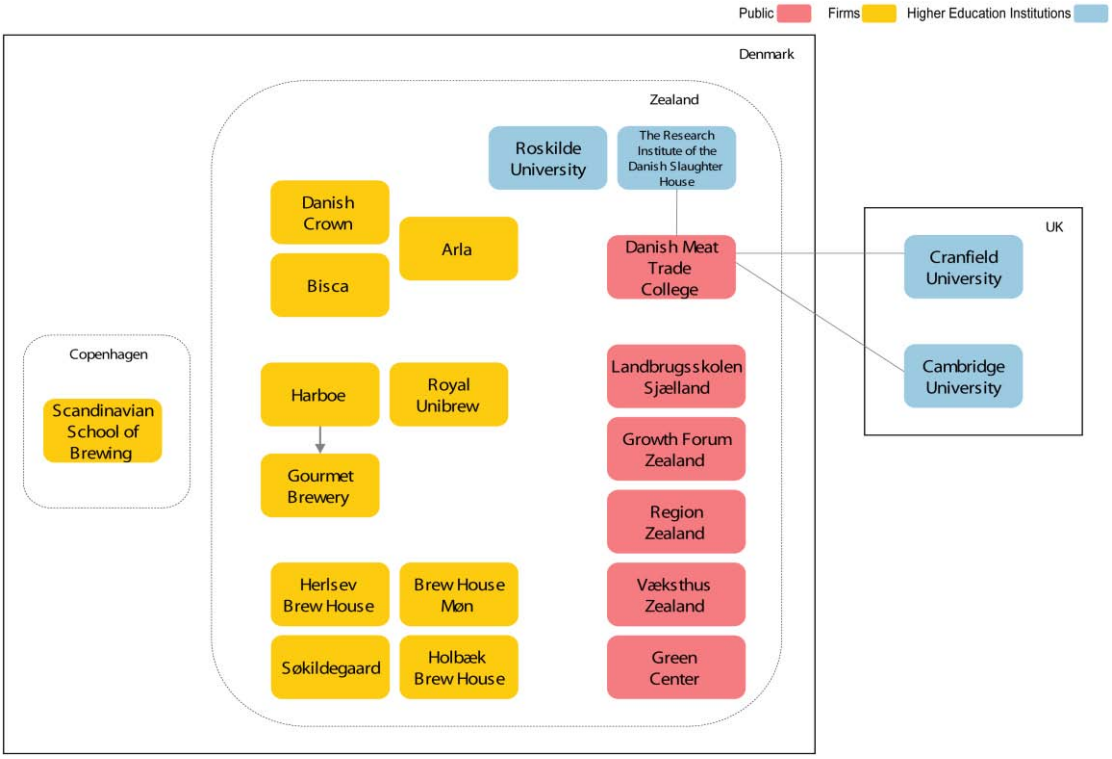
[101] Please note that the figures, including the actor maps and knowledge biographies illustrating the territorial and firm-level knowledge dynamics respectively, are only snapshots of the actors and interactions involved.

[102] Danish Bacon and Meat Council, http://www.dbmc.co.uk/trade_info/corporate_information/meat_trades_college.asp

Figure 9.2: Examples of key actors in specialised food and drink production in Zealand



Growth Forum Zealand supports economic growth in the region. Growth Forum Zealand has adopted a number of initiatives to support the food and drink industry. An example of this is support for the independent R&D institution Green Center, which is engaged in innovation within the food and agro industry and plant production. The institute has received funding from Region Zealand and other public actors.[103]

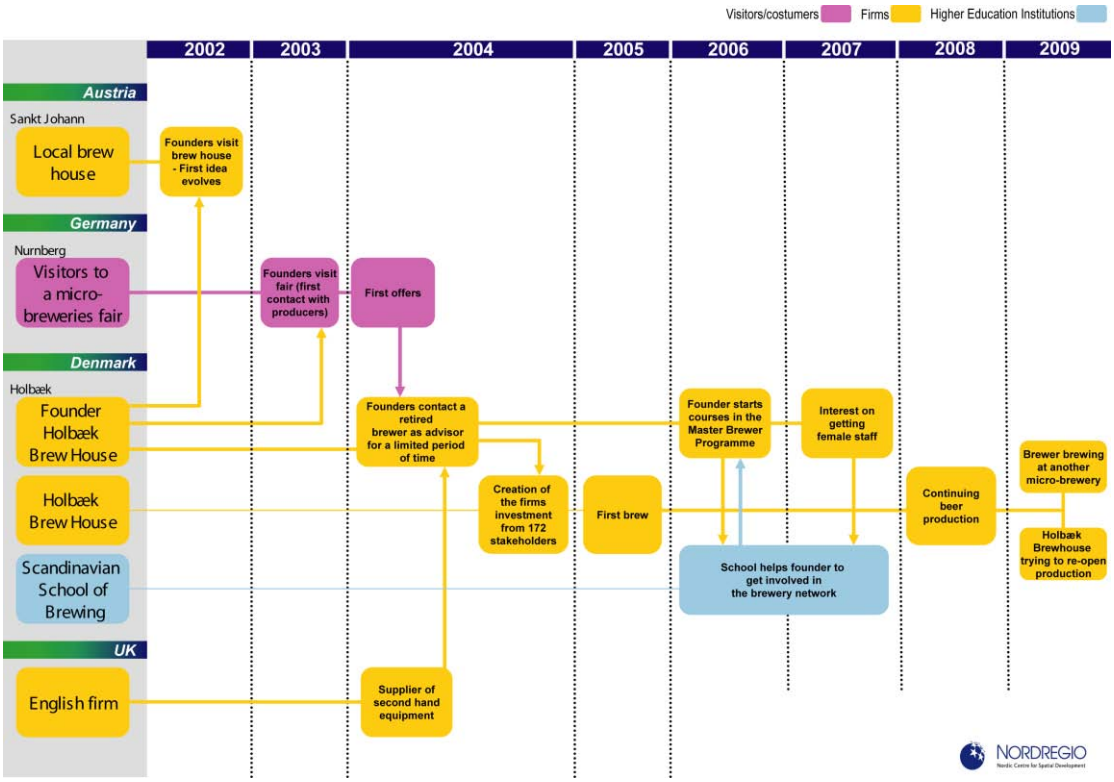
Væksthus Sjælland (Growthhouse Zealand) is a regional organisation that is part of a national network of organisations established by the Danish Enterprise and Construction Authority, with a board composed of members appointed by Growth Forum, the municipalities and business organisations. Væksthus Sjælland has three focus areas, which are entrepreneurship, business development and 'growth business', providing advice to these firms in addition to events, courses and similar activities for entrepreneurs and small businesses.[104]

9.4 Firm-level knowledge dynamics: Establishing a microbrewery

This section explores the establishment of a microbrewery in the town of Holbæk in Zealand. The timeline of the story begins in 2002, when a married couple first had the idea to establish the microbrewery, and ends in 2008, when the firm had been established and the marketing of the brew house, which involved 'storytelling', had been initiated. Figure 9.3 illustrates the firm-level knowledge dynamics involved in the development of the microbrewery.

[103] Green Center, http://www.greencenter.dk/index.php?mod=main&top=80&parent=80&id=102
[104] Startvækst, http://www.startvaekst.dk/vhsjaelland.dk/aboutstartvaekstto

Figure 9.3: Knowledge biography of the establishment of the Holbaek microbrewery



9.4.1 Developing the idea

The idea to establish a microbrewery first came to a married couple, who later established the brewery, in 2002 during a skiing holiday with friends in Sankt Johann, Austria. The couple planned to establish a microbrewery in the town of Holbæk and initiated talks with friends and acquaintances to involve more stakeholders in the establishment. In 2003, two of their friends decided to become involved in developing the business idea.

In November 2003, the four people who had now formed a working group attended a fair in Nuremberg, Germany, which was a good opportunity to establish contacts with equipment manufacturers for microbreweries.

In January 2004, after communicating with firms at the fair, the group received various offers for brewery equipment. However, none of the four people were able to fully understand the offers because they were not yet familiar with the technicalities involved in brewing. Through their personal networks, the group came into contact with a retired brewer who had previously worked at the two major companies, Tuborg and Faxe. He provided crucial assistance in understanding the product offers, selecting an offer and assembling the equipment, which was bought second-hand from an English firm.

9.4.2 Establishing the firm

The firm, first called No. 5, was formally launched at its first annual general meeting in November 2004. It was set up as a co-operative involving several stakeholders in the town. Thus, 32 A-stakeholders and 140 B-stakeholders constituted the firm. The brew house was established in a cellar downstairs from a café.

The woman of the couple who first had the business idea was unemployed at this time, and became the main person involved in the brewery. As a biochemist, she was qualified to learn the profession. Brewing was initiated at the beginning of 2005. The retired brewer helped with the initial development of this process until he moved later that year.

The friend in Sankt Johann with whom they had originally enjoyed the beer that inspired the couple to establish a business is an art director. He developed the marketing of the firm, delivered booklets and labels for the bottles and created the firm's slogan: 'Denmark's smallest microbrewery'.

9.4.3 Product development and marketing

After the retired brewer left, the woman had sole responsibility for brewery production. To adopt this role, she needed further education. In 2006, she began the one-year postgraduate Diploma Master Brewer course at the Scandinavian School of Brewing and built a network with people from other microbreweries in Denmark.

The firm buys most of the raw material for beer production from firms in a German town that specialises in malt production. The firm normally produces three permanent brews and various seasonal beers. Most of the beers have local names, often historical places, which implies 'storytelling' and creates the impression that the raw materials come from the region. They do to a certain extent—for example, the summer brew contains elderflowers picked by stakeholders in the local area.

To strengthen the local storytelling surrounding the names of the different brews, the name No. 5 was changed in 2006 to Holbæk Brew House, and the firm was given permission by the Municipality to include the town logo on its label. Holbæk Brew House began to sell its beer in the café in the building in which it is based. The floor of the café was glass, making it possible to observe the brewing process from the café.

The firm has limited financial means for marketing, and therefore participation in various events is significant in terms of promoting the products. The brew house delivers beer to various beer tasting events. In addition, beer is sold to places such as local restaurants, other cafes, supermarkets, amusement parks, camping sites, and at open air markets.[105]

9.5 Concluding comments

Until 15 years ago, there had for many years been a situation in the food and drink sector in Denmark where food and drink production had been concentrated through amalgamations to a few big firms with a limited number of locations for production. The breweries, dairies and slaughterhouses in particular were amalgamated to form very big production plants and firms producing standardised food and drink products.

However, during the past 15 years, there has been a development in the opposite direction. Several small firms have been created producing specialised products, where the 'story' about the product has been an important element. In addition, the consumers as 'guests' or 'tourists' have been able to visit the production plant, where viewing production and buying the product are sold as an experience or as edutainment. In this way, a close connection with the customers is established. Part of the marketing is the story related to the product, that the production is

[105] In August 2009 a female brewer was dismissed from Holbæk Brew House. A month later, Café No. 5 renounced their co-operation with Holbæk Brew House. In November 2009, Café No. 5 had its own brew made by the former female brewer from Holbæk Brew House. The brew is now made at other facilities at Rørvig and Ørbæk Breweries and the glass in the floor has now been covered. Later, in November 2009, three members of the Holbæk Brew House board resigned and the board then consisted of only one person. Holbæk Brew House never hired a new brewer. For a while it borrowed a brewer from another microbrewery but in January 2010, Holbæk Brew House was closed. In February, six investors in Holbæk Brew House, attempting to recommence production, bought new equipment and are now looking for a new location. It is not yet clear what will happen with the brewing equipment in the basement. The café is considering buying it.

well crafted and the raw materials specially selected. This is partly correct, but at the same time the production is well controlled by modern technology.

By performing the empirical case studies, we have learned that informal networks are very important for the knowledge dynamics in the food and drink sector. Synthetic and tacit knowledge is very important for the beer brewing process, but there has also been a need for symbolic knowledge for the generation of relevant knowledge, especially in the exploitation phase; in this case the marketing of the products. However, because of the strong connection with a story, symbolic knowledge is also strongly connected with the development of new products.

Most of the 20 microbreweries in the Zealand region have survived the economic crisis and new ones have been established in the past two years. It therefore appears that the development from only large food and drink producers to co-existence of big and small producers, even if the latter only engage in niche production, will prevail. The revival of the small-scale production started with the microbreweries and dairies have followed. The next to follow may be the slaughterhouses.

The territorial and firm-level knowledge dynamics in the food and drinks industry in the Zealand region is further explored in Part III.

Part III: Knowledge dynamics, analyses and practice

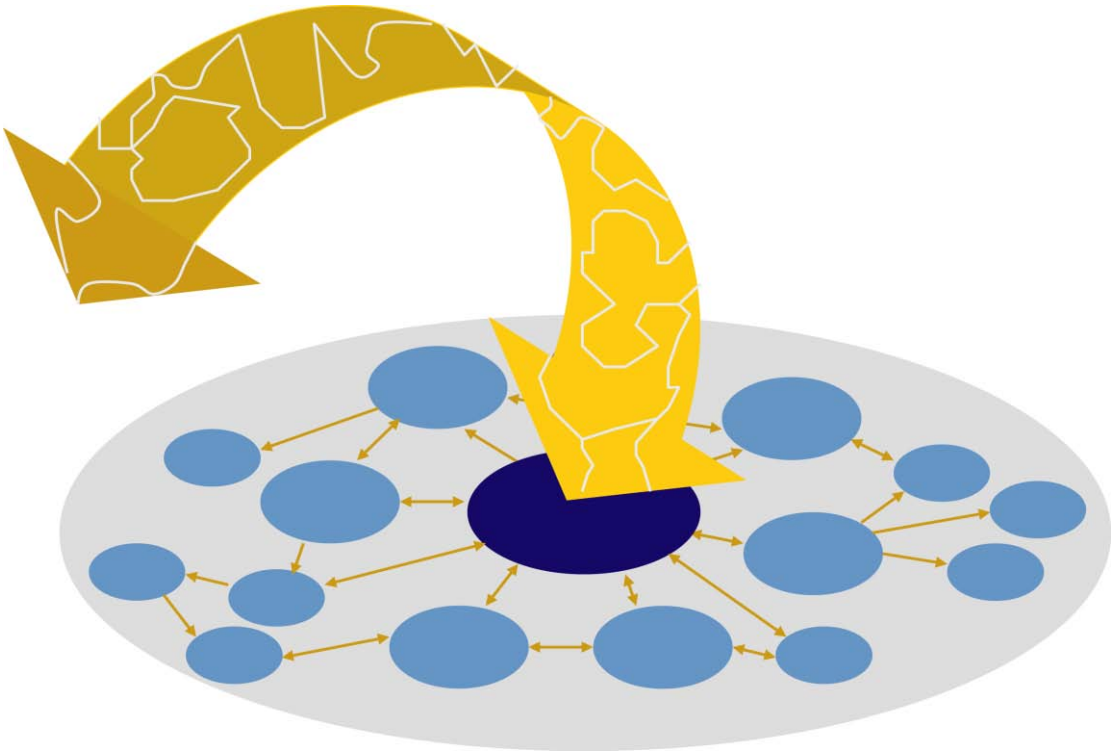
Part III of the report consists of four chapters including analysis of the empirical case studies presented in Part II. In the analysis, we draw on the results of the EURODITE project. As discussed in Chapter 1, the reasons for exploring the dynamics of knowledge are that a knowledge-based economy is considered vital for competitiveness in the global economy and that knowledge is crucial for innovations. By studying knowledge dynamics, processes of knowledge interactions can be unravelled. In Chapter 10, we closely examine activities mentioned in the case studies covering the territorial knowledge dynamics. Special attention is paid to mechanisms and activities that may be related to various channels that are of relevance to the flow and recirculation of knowledge, that is, for knowledge anchoring. In Chapter 11, we closely examine the empirical case studies investigating firm-level knowledge dynamics. What conclusions can we draw regarding knowledge interactions and dynamics, for instance in relation to knowledge types, phases and processes? In Chapter 12, we analyse the case studies exploring the territorial and firm-level knowledge dynamics from a gender perspective. What role does gender play in the knowledge interactions in the cases? In Chapter 13, we discuss the main findings regarding knowledge dynamics and policies for regional development. In Chapter 14, a discussion of the REKENE work with policy tools is presented.

10 Knowledge anchoring, territorial knowledge dynamics—inflow and recirculation of knowledge[106]

Margareta Dahlström, Sigrid Hedin & Lise Smed Olsen

In the following chapter, the main findings regarding the territorial knowledge dynamics of the case study regions are analysed and discussed. The starting point for the analysis is the concept of 'knowledge anchoring', which, as discussed in Chapter 2, is a concept developed within the EURODITE project. Knowledge anchoring refers to knowledge from outside a region somehow 'sinking in' and being recirculated within the region. Recirculation of knowledge means the processes by which knowledge is used by firms and institutions within a region other than the firm or organisation that found or adopted the knowledge from an external source. Recirculation may include using the accessed extraregional knowledge to develop new knowledge, or recombining it with existing knowledge, as well as general diffusion within a region.[107]

Figure 10.1 Knowledge anchoring



[106] The framework of this chapter is based on the work performed within EURODITE resulting in James *et al.* (2010a) and James *et al.* (2010b)

[107] James *et al.* (2010a)

Figure 10.1 shows the inflow of knowledge into a region and its subsequent recirculation within it. We make no assumptions about the length of time between knowledge entering the region and its being recirculated. This may happen immediately or over a number of years.[108] The arrow symbolising knowledge that comes into the region points in two directions. This represents the fact that extraregional knowledge can be accessed both from within the region and by travelling outside; for example, to attend a conference or fair. The patterns on the arrow signify that knowledge can enter through a multitude of different actions or processes, a point discussed in greater detail below. The dark blue central circle is a receptor node for the extraregional knowledge. This is typically a firm or an HEI that initially receives the knowledge. The light blue circles represent other firms or institutions located within a region (the bounded shaded area) among which the knowledge is recirculated.

We suggest that there are three common ways in which knowledge comes into a region. First, it may be embodied in people who temporarily or permanently move in from elsewhere. Second, it may be acquired when people leave the region—for example, to attend a conference—and bring new knowledge with them when they return. Third, it may come into a region with no physical movement of people through knowledge in codified form; for example, in a book, a patent or via the Internet.

We argue that recirculation of the knowledge outside the receptor node in the region is a necessary criterion of the anchoring process. Hence, recirculation involves many interactions among various actors in a region. This may be the relatively simple or static diffusion of the 'new' knowledge or may involve more interactive relations and learning processes in which two or more parties collaborate to recombine the new knowledge in some way. This is where territorial knowledge dynamics become important. Where rich knowledge interactions among various types of actors are in place, there is a greater chance of recirculation of new knowledge.

10.1 Channels and mechanisms for inflow and recirculation of knowledge

The content of the territorial knowledge dynamics is of special use in discussing knowledge anchoring because it provides insights into the role that various actors may play in anchoring processes. In the case studies, we see both key knowledge interactions performed within and outside the region. In addition, each actor may solve the accessing of extraregional knowledge in different ways, which may not be visible in the actor maps of the territorial knowledge dynamics in Chapters 3–9.

The inflow and recirculation of knowledge can occur through various channels or mechanisms including a variety of activities. In the analysis of the territorial knowledge dynamics developed within the REKENE and EURODITE projects, the following four 'channels' were identified.

- Firm-level interactions
- Workplace or job-related mobility
- Acquisition of codified knowledge
- Events

There may be other channels or mechanisms available for the inflow and recirculation of knowledge but we found these four in the empirical material. We would also like to stress that knowledge anchoring is a multidimensional and multiscalar process. By this, we mean that knowledge inflow and recirculation often do not occur through only one channel or one activity. In addition, actors from several geographical levels are involved. Knowledge can enter

[108] If there is no recirculation, then there is no anchoring of knowledge.

through one channel and be recirculated by another, or it can enter or be circulated through a combination of channels or activities. A channel can also be used for both inflow and recirculation of knowledge. We recognise that there is some overlap among the channels, but argue that they should be considered separately for analytical purposes because each has special features.

Furthermore, our ambition is to compare the examples found in the REKENE cases with those in the EURODITE case studies,[109] contributing to a wider European perspective on the REKENE cases. We have sought to streamline the analysis in each channel below. However, there are overlaps and links among the various channels. We therefore provide pointers and cross-references among the types of channels to highlight such links.

10.2 Knowledge anchoring through firm-level interactions

The *firm-level interactions* channel includes interactions among firms, referring to organisations and various HEIs in addition to companies. A decisive part of this channel is that the individuals that interact do this in their capacity as employees in a firm, organisation or knowledge institution. In other cases, individuals may interact in manners that are guided by their own agenda; for example, when they are freelancers. We can see a distinction between unmediated and mediated interactions at the firm level. Examples of unmediated firm-level interactions are supplier–buyer relationships and technological alliances between firms. In the REKENE cases we find some examples of direct interactions. In the *Akureyri* region, specific co-operation in monitoring drilling projects and geological research between ÍSOR and Iceland Drilling is displayed. Another example of direct firm-level interaction is *HRV engineering*, a joint venture initiated by engineering companies that also operate separately to tackle large and complicated projects. Also, the *Samorka* federation of Icelandic energy companies contributes to knowledge inflow and recirculation through the arrangement of collaborations between the member companies.

Mediated firm-level interactions occur when, for instance, consulting firms are involved in knowledge interactions. These consulting firms are often known as KIBS firms. Other important examples of mediated firm-level interactions are various types of cluster management organisations, networks and platform organisations in which policy actors often play an important role. In the case studies we find many examples of mediated firm-level interactions, in which public actors of partly publicly funded activities function as facilitators. This function is also seen in many of the EURODITE cases, for example in the biotech cases in Aquitaine (France), Bavaria (Germany) and Veneto (Italy). In these cases cluster organisations or network agencies play a decisive role in connecting actors. These mediators focus on building regional clusters, but also on strengthening international ties among biotechnology firms and thereby facilitating the building of extraregional knowledge networks. HEIs and R&D institutes are often members of these networks and sometimes also work as facilitators or co-ordinators for firm-level interactions. In the following sections dealing with inter-firm interactions, we first address the role of networks and cluster management organisations and second, the role of HEIs and R&D institutes.

10.2.1 The role of networks and cluster management organisations

Various kinds of collaborations or networks are important for knowledge interactions contributing to inflow and recirculation of knowledge. However, networks exist in many shapes and sizes. They may be small or large, formal or informal, open or restricted, issue- or

[109] Please see Appendix 2 and 3 for lists of EURODITE and REKENE case studies.

sector-based. They also fulfil different tasks, for instance promotion of members' interests, performance of R&D projects and supply chain tasks.[110] In the EURODITE and REKENE cases, many of the networks mentioned are homogeneous, meaning that the network consists of organisations belonging to a single sector.

Various types of cluster policies are widely used to promote and stimulate knowledge interactions in networks of firms and other actors.[111] Within these networks public institutions often act as facilitators.[112] Many of the networks found in the EURODITE cases, such as the cluster organisation BioM AG, which assists biotech companies in Bavaria, were initiated to promote interests or provide administrative services and not primarily to exchange knowledge. However, the exchange of knowledge may be facilitated by the activities performed within the network.

Examining examples found in the REKENE cases reveals how networks emphasise knowledge exchange. For instance, in the Akureyri case, the national *Innovation Centre Iceland* supports co-operation with companies in various fields with the aim of diffusing knowledge and supporting entrepreneurs and innovative enterprises.[113] In the Värmland case, covering ICT and SERVITech, a number of mediated firm-level interactions in the form of collaborations and networks are also displayed. An example is the *Compare Karlstad Cluster initiative* foundation, of which ICT companies are members. However, the network is not exclusive to the region of Värmland because it includes extraregional partners. In addition, member companies may have their markets and headquarters in other regions, implying that for firms the borders of administrative regions are of limited importance. Within Compare, a number of facilities have been developed, such as C-BIC, which is a regional innovation and competence centre within ICT run in co-operation with Karlstad University. Another is the Compare test lab in Sätterstrand, which is an independent test lab for innovations such as software products run collaboratively among industry, public actors and academia. The funding for activities comes from various sources ranging from the local to the international level. The international connection is highlighted by partnership in the E-CLIC project, in which eight European innovation centres for broadband and media services co-operate. Another collaboration project between companies is *Framtidens Arena* (Future Arena), in which Compare and Tii, a non-profit research institute, have investigated how ICT knowledge can be connected to the development of arenas such as the Färjestad Trotting Course and the Löfbergs Lila Arena. There are also cross-sectoral collaborations among the different cluster organisations in the region that began in 2008, such as COPPS (Compare and Paper Province i Samarbete).

An almost endless number of formal networks are displayed in the *Stockholm* case study dealing with knowledge intensive business services (KIBS). Many companies, both large and small, located in Kista have international contacts and belong to international networks. Kista Science City is a public–private collaboration that markets and supports Kista. Kista Science City organises various events including seminars, study visits and match-making. There are also initiatives to connect firms or organisations with international actors or milieus. For instance, the STING incubator in Kista has the *Go Global Medtech* programme with specific emphasis on the US market. Another uniting actor is the business association for Medical Technology in Sweden, *Swedish Medtech,* with the headquarters in Stockholm. Swedish medtech and other firms seek political support and more resources for research, innovation and investments in the medtech sector. In addition, the *Stockholm IT region* regional network, consisting of a number of companies and public actors, constitutes an arena for knowledge interactions in the region. Examples of collaborations between research institutes, such as Swedish ICT Research AB, Acreo, the Swedish Institute of Computer Science and Tii can be found. Resources for

[110] James *et al.* (2010a). p. 32.

[111] Vissers & Atzema (2008)

[112] Raines (2002)

[113] Innovation Center Iceland, www.nmi.is

activities performed in these institutes come from universities, national and EU research funds and private firms. Many of the researchers are also affiliated with HEIs located in Stockholm or the neighbouring city of Uppsala. Hence, we see potential for knowledge recirculation through the job-related mobility channel (see Section 10.3). There is also co-operation between the STING incubator and the incubators of the medical university Karolinska Institutet. Karolinska Institutet, KTH and the Stockholm County Council co-operate in the CTHM.

For the food and drink sector in the Zealand region, joint marketing projects can be considered a type of mediated firm-level interaction. Examples are the 'Regional Food Culture Zealand' and 'Knowledge Centre for Food Development', which were financed by the Ministry of Food, Agriculture and Fisheries. In addition, *Vaekst Forum*, a regional growth forum to facilitate triple helix collaborations, has supported projects in the food sector. For example, the *Green Center*, which is an autonomous trade promotion institution for the agro-food industry and is working on creating good conditions for firms' access to knowledge. Furthermore, *Growth House Zealand*, an advising agency for development of business and industries, has been engaged in advising microbreweries in their business development. Local business development institutions such as business development consultancies, where the microbreweries may have obtained start-up assistance, have facilitated contact between the breweries and the agency. Some more examples of collaborations are the *Culinary Network* and *Slow Food Lolland and Falster* in the southern part of the Zealand region. Jointly organised fairs are an example of activities performed within these networks. In addition, activities including testing products from other producers are mentioned.

Also in Åland, business interactions within the subsector of computer and technical services are important for recirculating knowledge. A number of public mediators are available to facilitate these interactions. The Wheel IT initiative, for instance, was launched in the early 1990s and resulted in the establishment of a science park and better communication and co-operation among decision makers in the business life and the public sector in Åland. The ÅTC is a regional triple helix network located in the ITiden science park, which offers education, initiation of projects, consulting and technical analyses. Furthermore it runs the *Växthuset* business incubator and the *Starthuset* pre-incubator. The ÅTC also creates and maintains local and international networks. Another important actor in firm-level interaction is Ålands Utveckling AB (ÅUAB), a venture capital company focusing on young companies in technology, maritime services, ICT and environmental sectors.

In the case study of new media and visualisation technology in Östergötland, networks and the role of some specific individuals, for instance a professor, are mentioned for pushing the development of the sector. Physical establishments are mentioned for uniting diverse kinds of actors. The *Science Centre*, which was established in the end of the 1990s, enabled visitors to be interactively exposed to scientific findings and to use technology. This centre created the base for the 'C' Visualization Centre, which opens in 2010 and will be a meeting place for actors and sectors. An important actor in the development is Linköping University, which is known for its multidisciplinary tradition. This tradition is important because actors from different disciplines have been involved in the visualisation fields. The division for Visual Information Technology and Applications (VITA) at the Department of Science and Technology (ITN) at Linköping University has been an important actor and has strong credibility with other actors. ITN hosts bodies such as the National Centre for Visual Analytics (NCVA), financed by national organisations such as the Knowledge Foundation and VINNOVA. In addition, Norrköping Science Park (NOSP) is an important hub for the development of the visualisation sector. It started C-Site as a forum for facilitating interaction between industry and new technology.

10.2.2 The role of HEIs and R&D institutes

HEIs are in many cases a receptor node for incoming knowledge. This function may be connected with the co-operation of HEIs with other national or international HEIs. National and international co-operation among HEIs concerning renewable energy issues is evident in the Akureyri case and in the co-operation between the UNGTP and the University of Iceland

(Reykjavík). In addition, the local RES has co-operation agreements with leading universities both in Iceland and worldwide, to guarantee future research collaboration and faculty and student exchange.

HEIs have been allocated a role in 'triple helix' co-operation. As discussed in Chapter 2, triple helix is a concept that deals with the intertwined relationships among industry, universities and policy actors. The concept has been closely linked with science and technology policies.[114] Another characteristic of triple helix thinking is the movement of individuals among the three spheres.[115] This aspect of knowledge recirculation is also reported in many of REKENE and EURODITE case studies. A special emphasis of triple helix thinking is the role of HEIs in contributing to wider society, particularly at the regional level. This is in line with the increased focus on knowledge as a key asset for economic development. The focus on knowledge generation among actors is crucial for regional growth.[116]

The role that an R&D institute plays in the development of a regional business environment is highlighted in the Oulu South region. The establishment of the Oulu Southern Institute in 2000 and the ELME Studio (a production laboratory of electronics' mechanics and metal) and RF Media laboratory (an R&D group in the ICT industry) has contributed to co-operation and a network culture in a region that has traditionally had rather limited access to R&D resources. The R&D groups of the Oulu Southern Institute act as knowledge hubs and have attracted researchers from other parts of Finland, and from other industries even abroad, who bring their knowledge and networks. In addition, the co-operation of the Oulu South Educational network consisting of educational institutes in the region suggests the existence of improved opportunities to create inflow and recirculation of knowledge in the region. This co-operation includes a joint strategy and the definition of seven innovation environments (ICT, metal, wood, tourism, humanist-culture, welfare and agriculture and forestry). A specific example of one such activity is a pretesting service offered to the companies in the region by the Centria R&D unit of Central Ostrobothnia University of Applied Sciences in co-operation with the RF Media laboratory. The tests are performed by students and their teachers with assistance from researchers from the R&D group. This advantage of this activity is that it provides immediate evidence of the beneficial interaction between the R&D groups and companies. In addition, it constitutes a step in the trust-building phase, which implies that it will be easier to circulate knowledge in the future. That not only regional interactions are important is exemplified by the participation of the R&D groups in national and international programmes such as the national Finnish Academy of Science and the Finnish Funding Agency for Technology and innovation (TEKES), and the 6th and 7th Framework and Interreg programmes provided by the European Union. The R&D groups are also members of national networks. ELME Studio, for instance, is a partner in the ProMetal Network (Finnish Maritime Cluster) and the RF Media laboratory belongs to the RFM Polis network (northern Finland Multipolis programme).

In Värmland, the presence of Karlstad University is important. However, in the firm-level case study, collaboration with HEIs in other parts of Sweden such as Uppsala University is mentioned because the necessary expertise was available there. In general, there appears to be strong co-operation among Karlstad University, firms and the cluster initiatives available in the region. This co-operation is visible, for instance, through the teaching curriculum influenced by the needs of companies belonging to TPP and TPA cluster initiatives. In addition, initiatives for student placements and mentorship have been developed. There is also a *Compare Academy*, where educational institutions provide courses free of charge in exchange for connections with firms. The CTF research institute at Karlstad University also receives research funding from industries in the region and beyond, as well as from Region Värmland and EU Structural Funds. Furthermore, continuing professional development courses are developed at the

[114] Etzkowitz (2002)

[115] Etzkowitz & Dzisah (2008)

[116] Cooke (2002)

university with industrial partners. Karlstad University and the CTF have research co-operation with the Compare and Packaging Arena cluster organisations.

The Åland University of Applied Sciences co-operates with different institutions. There is, for instance, a student exchange programme with a university in Madrid's information technology programme. This exchange has had a special impact on the companies covered in the firm-level knowledge dynamics, because the exchange has facilitated their recruitment of skilled IT staff and hence the acquisition of synthetic knowledge for product development. At the regional level, Åland University has close co-operation with working life and society. The expert councils of the university are important for the knowledge networks between education and business life and may influence the offering of programmes and courses. However, companies in Åland co-operate with universities and HEIs outside Åland, mainly in the most important neighbouring Finnish and Swedish urban regions. The company studied in the firm-level case study, for instance, finances research projects both in Åland and abroad. Because of relatively high labour mobility there is competition among employers for skilled staff. This has stimulated knowledge interactions and development. For instance, employers have brought higher education courses to Åland to provide opportunities for professional training. The competition for the workforce may thus trigger the development of a creative and attractive working milieu.

In the specialised food and drink sector in the Zealand region, knowledge institutions of various kinds are acknowledged as having an important role in the knowledge dynamic. In particular, the Scandinavian School of Brewing located in neighbouring Copenhagen is mentioned as a source of knowledge. However, several other education institutions are important for the food and drink industry. For instance, Roskilde University educates people in project organisation, management, marketing and accounting for the sector. In addition, the Faculty of Life Science (Copenhagen University) educates people in biology about food and drink safety. Furthermore, University Colleges are offering a three-year Bachelor's degree in food and the technical schools train people in food handling and hygiene.

10.3 Knowledge anchoring through workplace or job-related mobility

The channel of *workplace and job-related mobility* includes ways in which knowledge flows in and is recirculated by individuals who are self-employed, workers or students. Examples of activities relevant to this channel are people moving to the region, the movement of employees within an organisation with outlets or offices in different places, establishment of a branch plant by a firm, and business trips by employees (see also Section 10.5) and consultants working for a few days or for a longer period.

10.3.1 Inmigration

HEIs or research institutes can play an important role by encouraging inmigration of people with particular skills or knowledge to a region. This was the case in the EURODITE case studies in Centro (Portugal) and Aquitaine (France). The role an education facility plays is also seen in the Oulu South region where the establishment of the Oulu Southern Institute, the ELME Studio (metal) and the RF Media laboratory (ICT) have contributed to an inflow of visiting researchers from other parts of Finland and abroad. Researchers from the ELME Studio and RF Media laboratory have also worked abroad. In addition, the R&D groups help students to practice placements and thesis work in companies or other organisations located in the Oulu South Region. This contributes to knowledge transfer between the university, the polytechnic, the R&D groups and companies. The presence of this milieu also encourages

graduates to return or move to the Oulu South region after completing their studies at other universities.

In some of the REKENE case studies, the challenge to recruit people with the right competences to the region is mentioned. For instance in the Akureyri region, it is difficult to recruit skilled people because of a small local labour market and a limited number of workplaces. However, the role that an HEI may play in attracting students and skilled staff is, stressed. Educational institutes such as UNGTP in Reykjavik and the RES in Akureyri attract students from around the world to Iceland. However their stay is mostly temporary and most leave when they finish their studies. Many lecturers are also foreigners who work for shorter periods on these programmes. In Åland, many young people who want to study leave for universities in Sweden and Finland because of the rather limited education facilities in Åland. Consequently, it is a challenge for businesses to encourage people to return after finishing their studies and some years of work experience. However, a number of projects have been initiated to work on this issue. The 'Working & Living in Åland' recruitment project was initiated to attract people to Åland. In addition, joint recruitment campaigns from firms such as IT companies, often with a 'family perspective' have been launched. The Åland authority for labour market and student services (AMS) is an important actor in this process. In addition, a temporary agency that focuses on computer services and staffing of temporary jobs for students has been established. Despite the outflow of students there is also an inflow of foreign students to Åland because of Åland University.

10.3.2 Freelancers, consultants and KIBS

Freelancers, consultants and KIBS play an important role in knowledge interactions. Simmie *et al.*[117] introduce the following indirect functions that KIBS may have in innovation systems. First, they may transfer knowledge in the form of expert technological knowledge and management know-how. Second, they may contribute to an exchange of empirical knowledge and best practice from varying branch contexts. Third, they may integrate stocks of knowledge and competences that exist in innovation systems. Finally, they adapt existing knowledge to the specific needs of the client, which may result in the development of new knowledge. In the EURODITE cases we also see that freelancers and consultants do not constitute a homogeneous group. In some cases they are highly paid individuals travelling internationally (for instance, working for automotive KIBS in the West Midlands and south-east Lower Saxony). In other cases, they are relatively low-paid freelancers working as subcontractors for regional firms (e.g. game development in the West Midlands or film workers in Skåne).

In the REKENE cases, KIBS are not frequently mentioned compared with examples from the EURODITE cases. Interactions related to KIBS firms are found in those cases that focus on KIBS per se. For instance, external expertise plays an important role in the geothermal industry in Akureyri. The national power company *Landsvirkjun* is dependent on external knowledge from engineering offices and ÍSOR in geothermal projects. In addition, foreign companies based in Norway and the USA operate in Icelandic geothermal projects and bring in new knowledge from oil drilling. In addition, Icelandic companies undertake geothermal projects in other countries. This contributes to both an inflow and recirculation of knowledge.

Because of the limited labour market, freelancers and subcontractors comprise an essential part of knowledge inflow and recirculation in Åland. The system forms part of a model of accessing competence. In addition, firms tend to use freelancers, subsuppliers and other forms of partnerships to minimise risk. Furthermore, companies based in Åland have established subsidiaries and affiliations abroad, mainly in larger cities such as in neighbouring Helsinki, Stockholm and Tallinn, to access the right competences. These strategies can be seen as a means to keep the competence 'in-house' and to become less dependent on external expertise.

[117] Simmie & Strambach (2006)

10.3.3 Inter-firm mobility

Despite the rather limited labour market and the difficulties of attracting skilled labour to some of the regions in the REKENE project, it seems possible for inter-firm mobility to exist in one way or another. In addition, the limited access to skilled people may hamper local firm expansion but can contribute to the recirculation of knowledge between firms when staff members are 'pinched' from companies.

Considering labour market mobility, we see that some individuals work for more than one firm or institution, implying that it is possible to circulate knowledge from one context to another. The presence of an HEI or research institute especially seems to encourage inter-firm mobility, both temporarily and permanently. In the Stockholm case, the multiple roles some people play are evident. Medical experts at research hospitals are frequently involved in medical treatment and research. Some people start their own businesses. The same kind of phenomenon was also frequently found in the EURODITE case studies, where we found examples of people teaching at university and working in companies in the cases of the automotive sector in Västra Götaland, the new media in Skåne and the ICT sector in Bratislava (Slovakia).

In addition, in the REKENE case studies we have several examples of this type of labour market mobility. In the Akureyri case study, staff at ÍSOR combine this work with lecturing at RES, the University of Akureyri, the University of Iceland and UNGTP. In Östergötland there is an exchange of staff and competencies among some of the institutions and organisations involved in the visualisation technology. Tii, for instance, is a spin-off from the visualisation studio of the division for Visual Information Technology and Applications (VITA) at the Department of Science and Technology (ITN) at Linköping University. The role of some specific individuals and their inter-personal contacts is stressed as important for the early development of new media and the visualisation 'sector' in Norrköping. The Culture, Society and Media educational programme at the University of Linköping is the background for many people working with the municipal body Citilab and the 'C' Visualization Centre. In addition, in the case of the food and drink sector in the Zealand region it appears that people do not always have full-time employment in firms such as the microbrewery. Often this work is combined with another job or is part of another business such as a restaurant, which may contribute to recirculation and inflow of knowledge.

Another type of inter-firm mobility is work placements for students. In the Oulu South region, the R&D groups aid students with placements and thesis work in companies or other organisations. Thus, the students contribute to transferring knowledge from the university campus in Oulu, and the R&D groups at Oulu Southern Institute to companies in the Oulu South region, while completing their work placements and theses in companies and R&D groups.

Spin-off firms may be seen as representing inter-firm mobility and can be a means of anchoring knowledge within regions. There are some examples of spin-off firms by former employees of large organisations such as companies and HEIs in the EURODITE cases, such as the Skåne new media case and that of the biotech sector in Bavaria. Initiatives encouraging the establishment of companies, such as spin-offs from universities, are frequently found in all REKENE cases. For instance, in Värmland the *Drivhuset* placement centre run by Karlstad University facilitates the start-up of companies for innovative students and researchers. There is also co-operation with the innovation and incubation centre *Inova* run as a foundation by national, regional and local actors, where promising ideas can be developed further. Some IT professionals, who were working at Telia and Ericsson when these companies either relocated or closed down, remained in the region and could develop the ICT sector further.

10.4 Knowledge anchoring through acquisition of codified knowledge

The *acquisition of codified knowledge* channel deals with the process of gaining access to knowledge through, for instance, browsing the Internet and reading publications such as scientific journals or trade magazines. As in the EURODITE case studies, activities that may be connected with the acquisition of codified knowledge are seldom mentioned in the REKENE case studies. One reason may be that such activities are taken for granted to such an extent that they are not mentioned by the interviewees.

When acquisition of codified knowledge is mentioned, it is often connected with academic activities such as events or publications. In the EURODITE cases of north Jutland (tourism) and Västra Götland (automotive) it was mentioned that academic conferences are a way to access extraregional codified knowledge. However, the transfer of such knowledge to other important actors in the region is limited. This has also been seen in a study of the construction industry in Australia.[118] It is argued that industry actors may not tap into knowledge from academic conferences to a particularly great extent. The successful case reported in the article is partly explained by the fact that the industry organisation is open to knowledge from external sources through involvement in a joint industry–university research programme. It seems there is an issue of facilitating interaction and familiarity among partners from the various spheres, and learning the ways in which actors from the industry and academia can utilise each others' knowledge production.

With regard to the REKENE cases, there are some examples of the 'acquisition of codified knowledge' channel. In the food and drink sector in Zealand, the brewers at the microbreweries stated that they acquire codified knowledge on the Internet. In the Oulu South case, reading international publications is mentioned as an activity for accessing codified knowledge. In the firm-level case study it is also shown that the entrepreneur bought codified knowledge about 'fuzzy logic' from the Jyväskylä University of Applied Sciences. In the Akureyri region case study, acquisition of codified knowledge also takes place during participation in scientific conferences and by acquiring publications. The publication of research findings related to the geothermal industry may, however, have been hampered in Iceland during the past few years as a consequence of ÍSOR developing into a more market-oriented institute. Moreover, clients of ÍSOR consider themselves to be in a competitive environment. There are signs that there is less willingness to share knowledge. Possible explanations behind this development are that there is less funding available for academic publishing. This development may in the long run hamper both inflow and recirculation of knowledge.

10.5 Knowledge anchoring through events

Another way of tapping into extraregional knowledge and recirculating knowledge within the region is through various events. By 'event', we mean an organised and temporary event of some sort—for example, a fair, conference, seminar or a study tour—at which people physically meet and interact. Extraregional knowledge can be accessed either through people from the region travelling outside the region to attend events and bringing the knowledge home, or through the organising of events within the region, which brings knowledge to the region through presenters and participants.

[118] Maqsood *et al.* (2007)

Events are by definition arenas for recirculation of knowledge. Compared with ordinary meetings, events are characterised by the fact that people who would not otherwise meet are brought together. Consequently, expected as well as unexpected knowledge interactions can occur. Examples of expected knowledge interactions are lectures, presentations and sales pitches,[119] while informal, sometimes unexpected knowledge interactions may occur, for instance through mingling. Relying on the academic literature as discussed briefly in Section 2.2.3, we argue that events are characterised by the coexistence of intertwined buzz and pipelines.[120] Another feature of events is that they combine tacit and codified knowledge exchange through interaction among individuals and the availability of published material.

In all REKENE cases, we find various examples of events that may contribute to the inflow and recirculation of knowledge. We see that public actors, HEIs, R&D institutes and networks have an important role in organising events. In the Värmland region, Compare organises workshops to initiate co-operation among member firms and researchers affiliated with Karlstad University.

We also see that events, because they include both expected and unexpected knowledge interactions, constitute a hub for inflow and recirculation of knowledge. It is also shown that events take place both inside and outside the region. As in many of the events found in the EURODITE case studies, policy plays a role in organising and co-funding events, such as in the new media case studies: the 'Medientage München' annual international media convention in Bavaria, the annual 'Nordic Game' conference in Skåne (funded by the Nordic Council of Ministers), the 'Serious Virtual Worlds Conference', and 'Digital Event' in the West Midlands (funded by the regional development agency).[121] Furthermore, within the biotechnology sector there are policies that support the organising of events to attract extraregional knowledge. In Aquitaine, the international 'Invest in Photonics' convention, which focuses on information in market trends and deals with the financing of development projects, is organised and supported by public funds. It was first held in 2008 and specifically aims to support the development of networks.

In the REKENE cases, several examples of events are found. In the Akureyri case study it is stressed that international conferences in geology, geothermal energy and related fields contribute to inflow and recirculation of knowledge. Because of the geological features of Iceland, these conferences are also held there. In addition, seminars and courses organised by RES contribute to knowledge flowing in and out of the region, for instance by bringing in foreign teachers and students. Furthermore, *Samorka*, the federation of Icelandic energy companies, contributes to knowledge inflow and recirculation through the arrangement of events.

In the Oulu South region, annual events of the ELME Studio and RF Media Laboratory such as the ELME Laser workshop and RF Media laboratory 'Wireless Applications for Machines and Systems' seminar, contribute to an inflow and recirculation of knowledge. In the laser workshop experts from different parts of Finland participate, and during the seminars exchange opinions and discuss new ideas and applications. During the international 'Wireless Applications for Machines and Systems' seminar, there are presentations of international research departments and companies, and also examples of implemented applications.

In the Åland case study, the Wheel IT ICT initiative launched in the early 2000s is seen as a starting point for enhanced interaction and partnerships between decision makers in business life and the Åland public sector. A number of events such as seminars and network meetings among stakeholders representing different sectors were organised in connection with this initiative, which contributed to improved communications with Åland, the development of the ITiden science park and cross-sectoral actions to attract skilled people to the islands. Public

[119] In connection with such activities, codified knowledge may also be acquired. Compare Section 10.4 discussing anchoring of knowledge through codified knowledge.

[120] Bathelt (2007) and Owen-Smith & Powell (2004).

[121] James *et al.* (2010a)

actors also organise various other events. For instance, the ÅTC organises seminars, workshops and other activities in co-operation with the Government of Åland and Åland University to inspire and train local actors. In the firm-level case study the importance of participating in events organised outside the region is stressed. Here the importance of observational learning through attending business-specific trade fairs and conferences outside the region, for instance in Malta and Spain, and interacting with other business actors at these events is mentioned.

In the food and drink case study in the Zealand region, it is stressed that events entail meetings between producers and consumers. This is also the case in the EURODITE food and drink case in Bornholm, the film tourism case in Skåne and the new media/tourism case of watches in West Switzerland. Networks and organisations are important for arranging fairs. For instance, the Culinary Network, Slow Food Lolland and Falster networks arrange food festivals and Christmas markets where products are displayed to customers. During these events, feedback on the products is often delivered to the producers from the consumers. Because of the strong relationship between producer and customer there are other events connecting customers and producers such as 'edutainment', which includes selling the experience of observing and learning about the production process and is practised by many producers. In the Zealand case study, it can be argued that events fulfil two functions: marketing when people come to the event and taste beer; and as a product when the event itself is being sold. The importance of fairs is stressed in the firm-level dynamics covering the development of a microbrewery. The trade fairs for the brewery sector are mentioned as an example of a situation in which both tacit and codified knowledge is exchanged.

In Östergötland, we see how events facilitate inflow and recirculation of knowledge. In the firm-level case study, the annual NMM, an event intended to bridge the gaps among science, industry, culture, technology and 'rational fun', is described. Here various kinds of actors meet and interact. In addition, other actors in the region arrange events. C-Site, for instance, is involved in diffusing knowledge, building networks and supporting start-up businesses. Moreover, C-Site organises seminars, web communication, information events, cluster development and training events.

10.6 Concluding comments

To summarise, in this chapter we have examined how extraregional knowledge is anchored—how it is accessed and recirculated in a regional context. In the empirical case studies we have seen that anchoring takes place through activities that may be related to channels; firm-level interactions, workplace mobility, acquisition of codified knowledge and events. In the REKENE and EURODITE case studies we have, above all, seen examples of how activities related to the same kind of channel may be used for both close and distant interactions and to create inflow and recirculation of knowledge. Consequently, the empirical richness has shed light on the knowledge interaction processes, indicating that it is not possible to see them clearly as either local buzz or global pipelines. Instead, close and long-distance knowledge interactions are intertwined and combine both tacit and codified knowledge in complex manners.

For all channels, the presence of HEIs and R&D institutes is important. HEIs and R&D projects function as mediators between firms, organisations and networks. R&D projects funded by EU research funds appear important for promoting international contacts. Regarding the firm-level interactions, we can observe that these interactions in many cases are facilitated by public actors or publicly supported organisations and HEIs. Concerning workplace mobility, there was a lack of skilled people in some of the REKENE case studies. This may hamper workplace mobility, but we find examples of inter-firm mobility; for instance, people work as lecturers at HEIs at the same time as starting a company or having another job.

The importance of networks for recirculating knowledge can also be observed. The acquisition of codified knowledge is seldom mentioned in the REKENE and EURODITE cases. This may be explained by the fact that this channel may be taken for granted to such an extent that is not mentioned. The emphasis in the projects to investigate knowledge *interactions* may also explain why this channel has received little attention. To some extent, the development towards open source practice concerning codified knowledge can be seen. However, tendencies towards greater protection of codified knowledge, such as in the case of geothermal drilling in Iceland, can also be observed. Regarding events, public organisations are important for organising and funding the events mentioned in the empirical case studies. Many of the privately organised events take place with some kind of public support.

Regarding the importance of the regional context and geographical distances for the different channels, we can observe traces of path dependencies in a region, both in facilities or in institutions, and more physical assets such as resources related to the paper and pulp industry and the volcanic environment necessary for the harnessing of geothermal electricity. Despite the fact that some REKENE case study regions are rather remote and small, for instance Akureyri, Åland and Oulu South, we find multiscalar relations such as interactions with national and international actors also present there. We return to this dimension in the next chapter when we examine the findings of the firm-level case studies.

11 Knowledge dynamics and interactions seen from a firm-level perspective

By Margareta Dahlström & Sigrid Hedin

In this chapter, the firm-level dynamics cases are further explored. As mentioned in Chapter 1, firm-level knowledge dynamics concern the development and transfer of knowledge at a micro level within a firm, organisation or network. By studying knowledge interactions at this level, it is possible to obtain greater detail on knowledge dynamics than is the case at the level of territorial knowledge dynamics. The cases[122] presented in the firm-level knowledge dynamics are analysed with the analytical framework of *types of actors*, *geography* of knowledge interactions and the *types*, *phases* and *processes* of knowledge. Examining closely the *types of actors* involved in knowledge interactions provides a clear view of the processes and a good understanding of how knowledge interactions occur in practice. We also elaborate upon the *geography* of the knowledge interactions and the actors involved in these. Furthermore, the project analytically examines knowledge from different perspectives. As discussed in Section 2.1, it is recognised that there are different *types*, *phases* and *processes* of knowledge. We explore whether the research using this framework provides any further understanding of various aspects of knowledge dynamics. In addition, we briefly compare the findings from the research into firm-level knowledge dynamics with the case studies in EURODITE.

11.1 Types of actors involved in the knowledge interactions

In the following section we examine the kinds of actors involved in knowledge interactions. A mix of types of actors are involved in the firm-level knowledge dynamics in the REKENE case studies. The types of actors that are most important for each case vary somewhat.

11.1.1 The role of private companies

In most cases *private companies* play an important role in knowledge interactions. Most 'hosts' of the firm-level knowledge dynamics are firms. In the Åland case, examining the development of interactive gaming solutions on the Internet, we see strong activity in the business sector, even if one of the companies involved is legally a public association, and that the firms are active players in the knowledge interactions. The knowledge dynamics in this case are to a high degree dominated by the business sector and most of the knowledge interactions are realised through business networks. This can clearly be seen in the knowledge biography map, which provides an overview of interactions in the firm-level knowledge dynamics (Figure 7.3). The importance of a strategic decision to start a process, in the Åland case interactive gaming, is

[122] Please see Appendices 2 and 3 and Figure 1.3 for an overview of EURODITE and REKENE case studies.

also seen in the cases performed within the EURODITE project covering new media[123]. We also see examples of *co-operation among private actors*. In an analysis of the case studies in the EURODITE project, it is stated that interactions among private companies are mainly related to the provision of complementary knowledge or to an alliance with an additional partner.[124] This is also seen in the REKENE cases. For instance, in the case of the Holbaek Brew House microbrewery in Zealand, some microbreweries belong to an informal network where production is discussed and developed through mutual inspiration. This kind of interaction is also mentioned in a EURODITE case concerning the creation of the Lille Gadegaard vineyard in Bornholm.[125] In the case of the Holbaek Brew House, there is also an example of consumer-driven innovation through extensive conversation with the end consumer during production and product development. This kind of strong relationship with the customer is also seen in the Värmland case, where the company responsible for renovating the shopping centre in Vällingby and Benefit AB performed qualitative research through interviews and focus groups, to seek and test new ideas and products. In the Stockholm case, the firm developed the software solution for the product in co-operation with a software company on a consultancy basis, and the hardware was licensed from an external manufacturing company. Consumer–producer interactions are also important for product development within the firm-level knowledge dynamic 'the Film Track' in the Skåne EURODITE case study.

11.1.2 The role of public actors

In almost all cases, *public actors* are involved in the firm-level knowledge dynamics, which indicates that there is scope for policy strategies and initiatives within knowledge dynamics. However, in the case of Oulu South, investigating the development of a PC-free forester harvester there is an absence of involvement of public actors and the available regional innovation network has hardly played any role in the process. However, the business incubator of Nihak helped Crelea in its foundation phase. The important role of public actors is seen in the Akureyri case concerning the development of geothermal drilling. In this case, a few power companies owned by government or municipalities were the major buyers of services and knowledge provided by the engineering firms. The role of public actors as facilitators of interactions, by providing financing and match-making for example, is also seen in some cases. For instance, in the Värmland case, the 'host' firm Matglädje participated in a match-making programme organised by the Inova incubator, which is supported by international, national, regional and local actors. This participation resulted in contacts with potential investors in the company. In the Stockholm case, the public actor VINNOVA (The Swedish Governmental Agency for Innovation System) has played a role in the further development of the product by granting funding for a research project. In addition, the importance of policy start-up support for the development of the firms is mentioned in this case study.

Local and regional authorities are also involved in knowledge dynamics at the firm level. Compared with EURODITE cases covering non-Nordic regions, there is a trend for the local level more often to play a role in the knowledge interactions. This may be because the local level in the Nordic countries has comparatively large scope and responsibility in working with economic development matters. The role of facilitating knowledge interactions, for instance by providing funding for events, is seen in the case study of the NMM where the festival is promoted and sponsored by the Municipality of Norrköping, the Regional Development Council Östsam and by Destination Norrköping. The importance of public, financial and business support is also seen in some EURODITE case studies concerning the development of new media-related products, such as the 'E-train' in the West Midlands of the United Kingdom and the 'Agent O' serious game in Skåne, Sweden.[126]

[123] Butzin & Widmaier (2010)
[124] Butzin & Widmaier (2010)
[125] Butzin & Widmaier (2010)
[126] Butzin & Widmaier (2010)

11.1.3 Collaborations between private and public actors

There are also some examples where different kinds of collaborations between private and public actors play an important role in the firm-level knowledge dynamics in the REKENE case studies. In the Stockholm case, a joint venture in collaboration with Karolinska University Hospital began to develop the product. The doctors involved performed research and practical clinical care at two hospitals in the region. The medical experts had a double function in the process; they tested and verified the product, and by doing so, marketed and promoted it. One of the doctors, who is a member of the firm's board, recognises this complex relationship. There are a multitude of actors involved in the health and medical sector, ranging from research institutions and hospitals to governmental institutions such as the Stockholm County Council, and the large and hierarchal organisation of these actors may be a barrier to efficient business relations, especially for a small new firm.

The most significant difference with the case dealing with the NMM is the strong involvement of volunteers, NGOs and non-profit organisations in the innovation process. However, the governmental interests in supporting a broader development of new media and visualisation technology have been pivotal for the further development of NMM. In addition, in the case of Matglädje in Värmland, a complex network of actors, including public, private and NGOs, is included in the knowledge interactions ending in the developed service.

11.1.4 The role of HEIs

HEIs are important actors in the knowledge interactions in many of the cases. However, the functions of these actors vary. In Östergötland we see the important role that education and research performed at Linköping University and the Norrköping campus played in the development of the NMM. However, this interaction includes close co-operation among leaders at the university and the municipality, for instance in the facilities of the Norrköping Science Park and Tii. The inclusion of HEIs is seen in cases related to the new media sectors performed within the EURODITE project.[127] In addition, in the development of Holbaek Brew House in Zealand, the role of an HEI is evident, especially that of the specialised industry institution, the Scandinavian School of Brewing. In the Åland case we see that the HEIs, both inside and outside the region, were involved quite late in the firm-level knowledge interaction process. A possible explanation is that the Åland University of Applied Sciences is a rather new university not yet deeply anchored in business life. This situation also implies that there is an extended co-operation with HEIs located to neighbouring metropolitan areas such as Stockholm and Helsinki. In the Värmland case we also see the use of research on nutrition at an extraregional HEI as an element of product development. The most important role of HEIs in the Akureyri case seems to be the education of a specialised labour force. A similar observation is made for the case studies performed within the EURODITE project based on the automotive sector.[128] The lack of involvement of a regional HEI is seen in the case study in the Oulu South region. The HEIs operating there played no role in the development of a PC-free control system for forest harvesters. However, two institutions from other parts of Finland provided background material to the entrepreneur developing the innovation.

11.1.5 The role of personal contacts and networks

Because firm-level knowledge dynamics offer opportunities to study knowledge interactions at a detailed level, it is clear in the REKENE cases that *personal contacts and networks* are crucially important in the firm-level knowledge dynamics. The importance of entrepreneurs, or 'fireballs', who lead a process is evident, especially in the cases involving smaller firms. These circumstances are also linked to the issue of transfer of tacit knowledge and knowledge sharing in general. Personal knowledge of people within the networks facilitates such knowledge

[127] Butzin & Widmaier (2010)

[128] Butzin & Larsson (2010)

sharing through a certain level of trust. An example of expertise sharing can be seen in the Stockholm case where the partners had dissimilar work and life experiences; one came from a telecommunication company and the other two from an insurance company. They also had varying educational backgrounds such as civil engineering, business economy and IT technology. The role of existing personal and business contacts is also evident in the Oulu South case. The whole innovation process is based on one person's knowledge and skills. Moreover, the group of key people worked quite closely during the process, but the most important key person was very independent during the process and did not seek help from sources such as public support initiatives. Parts of the development of the Holbæk Brew House are also a result of using personal networks. It is owned by stakeholders with different backgrounds, of whom many from the beginning belonged to the personal network of the brewer. A friend with knowledge of marketing, for instance, assisted with the layout of labels and booklets and the concept of the brewery.

11.2 Geographical patterns of knowledge interactions

In the following section we discuss the geographical patterns of knowledge interactions among the actors. For example, do the knowledge interactions occur within or outside the region?

We conclude that the knowledge interactions in the case studies are not geographically contained within the case study regions. The combination of important intra- and extraregional knowledge interactions is present in all seven knowledge dynamics studied in the REKENE project. These case studies provide evidence from sectors such as ICT and KIBS that regional knowledge interactions are linked with knowledge interactions at great distances when necessary. Actors within the regions have actively sought knowledge where necessary, and have connected with it.

In addition, we see a trend towards 'large provincial cities and global villages'. For example, because of a lack of critical mass in both competent labour force and home market, there is a need for actors in more peripheral and sparsely populated areas to leave the regional context to obtain the requisite knowledge. This is seen in the Åland case where the small home market stimulates a search for knowledge and markets in other countries and markets. Overall, in the Åland case we see that external knowledge and actors are more important than local policies and local educational institutions, and from an international perspective the development began fairly early. A contrast here is the Stockholm firm-level knowledge dynamics case, in which all the key actors, except the hardware manufacturer, an international Medtech corporation with regional head offices in Canada and in Italy, are located in the Stockholm region. In the Oulu South case, the individual entrepreneur seems to have little knowledge interaction with actors within the region. This rather limited interaction may be related to the basis of the innovation process in one individual's knowledge and contacts, mainly located in Finland. A reason for this 'closed' process may be that because the entrepreneur operates in a rural region, he or she must seek partners from a larger area, especially when the innovation is rather advanced ('first of its kind') and requires extensive knowledge.

The development of the NMM displays how intra- and extraregional sources are combined in the planning and performance of the festival. The actors use knowledge derived from many places and sectors. Above all, the case hosts many short distance knowledge interactions. The actors who elaborated the idea of NMM were and are now to an even greater extent involved in firms and organisations situated in the very same neighbourhood. However, each and every actor behind NMM has its own network for knowledge interaction within and beyond the region. Different parts of these networks have been mobilised at various points in time, implying that the case hosts several—and over time varying—geographical patterns of

knowledge interaction. The close, rather short-distance and informal connections among some individuals resulting in the development of a product at the beginning of a process is seen in the EURODITE case of the 'Agent O' serious game in Skåne, Sweden. In the Zealand case the local market is important for selling the microbrewed beer. However, in the development of the brewery we see that there is a combination of long and short distance knowledge interactions because the production is based on analytical and synthetic knowledge generated elsewhere. However, the knowledge must be used and adjusted to the local business life.

There is also a trend that specialised knowledge stems from distant sources. A similar observation is made in an analysis of the cases performed within the EURODITE project. Here it is also clear that in some cases the extraregional knowledge interactions are related to the fact that the knowledge was not available in the regional context.[129] In the Akureyri case interactions with distant actors are used, for instance, to acquire specialist competence not available in the region or even the country. In the Åland case we see that extraregional knowledge has been recruited from different parts of the world depending on the character of rather specialised knowledge. This concerns not only technical solutions but also knowledge about market conditions. Branches were also founded outside the region to develop relevant knowledge inside the firm. Thus, the capacity to interact at a distance to participate in learning processes is essential. In addition, strategic knowledge, largely developed locally, is needed because licensed gaming is dependent on local government and policymaking.

11.3 Knowledge types represented in the knowledge interactions

In this section, we briefly analyse the knowledge types represented in firm-level knowledge dynamics. As discussed further in Chapter 2, EURODITE has used the analytical distinction of three different types of knowledge; *analytical* or research-based knowledge, *synthetic* or 'engineering-type knowledge' derived from the application of research, and *symbolic knowledge* that relates to representations such as the 'styling' and marketing of a product.[130] There is an increasing body of academic literature dealing with these knowledge types, but in the following short analysis, we rely on two main sources of knowledge phase research.[131]

In the majority of cases most types of knowledge are represented. However, it is also obvious that it is not easy to distinguish the kinds of knowledge generated and used in a knowledge interaction. The presence of examples of knowledge interactions including *analytical knowledge* is not very common, but in the Oulu South case there are some examples of analytical knowledge interactions, for instance a long period of self-studying and working experience. In the Stockholm case, analytical and synthetic knowledge such as medical research and soft-ware engineering are very strong elements. In the Värmland case, there is an example of research performed at universities used to develop food products for elderly people.

All cases involve *synthetic knowledge*. In the Åland case, the synthetic and symbolic categories of knowledge are more relevant than the more traditional research activities and analytical knowledge. Synthetic knowledge is critical for the development of interactive gaming and is the most extensive knowledge category in the process. In the NMM, synthetic engineering knowledge is used in the development of the concept. There is also a great degree of symbolic knowledge involved, because the image should be developed in a way that makes it appeal to certain consumers. The development of NMM also demanded high degree of tacit knowledge embodied in people. The individuals in the *Resistan*s association all had considerable knowledge

[129] Butzin & Larsson (2010)

[130] Collinge *et al.* (2008)

[131] The two sources that we chiefly use are Asheim *et al.* (2007) and Strambach (2008).

derived from practice. Through their involvement in the local club scene and local cultural life, they had developed knowledge based on experience. In addition, in the development of the microbrewery Holbaek Brew House in Zealand, we can observe that the use and generation of synthetic knowledge concerning technological issues occurs in combination with an application and generation of symbolic knowledge concerning story-telling about and marketing of the products. There is a lack of counselling not only around starting a business but regarding regulation and legislation when it comes to concrete production. In the Akureyri case covering drilling technology, the role of using engineering knowledge is displayed.

In all REKENE cases, the importance of *symbolic knowledge* was clearly stressed. In many cases, symbolic knowledge is of importance in relation to marketing, a knowledge area that can be underestimated in knowledge economy thinking. It is also seen that marketing can take many shapes and forms. For instance there were examples of the importance of symbolic knowledge in relation to very technical firm-level knowledge dynamics, for instance those of the gaming operator licences in Åland. In this case, there were complex product and market conditions and symbolic knowledge was required and used in intensive examination and exploitation activities. The technical development included a significant element of symbolic knowledge such as branding and the communication of brand values. In addition, strategic knowledge such as market intelligence is stressed in the beginning of the biography in the Åland case. However, there are strategic elements in all the different phases. In the Oulu South case, fewer knowledge interactions regarding symbolic knowledge were present. This may be because the innovation in this case is not a saleable product but a new part of an existing product. However, in this case and in that of the microbrewery, we see how entrepreneurs use fairs to market their products and obtain knowledge.

11.4 Phases in knowledge interactions

In this section, we briefly analyse the knowledge phases represented in the knowledge dynamics. As discussed further in Chapter 2, EURODITE has used the analytical distinction of three phases of knowledge: *exploration*, *examination* and *exploitation*. The *exploration phase* is characterised by the search for new knowledge. The phase may but does not necessarily include scientific knowledge. The *examination phase* is understood as a testing phase. An example may be stress testing of a new material or component. Finally, the *exploitation phase* can be seen as the 'selling' or 'using' phase in which knowledge is put to use. This may be for financial return but may also, as in academia, be for status, position or recognition.[132] However, it is important to stress that knowledge dynamics seldom entail a linear process. Instead, the development may take place in different phases at the same time, and there may be loops between the phases. This development pattern is also confirmed in an analysis of the firm-level knowledge dynamics case studies performed in the EURODITE project.[133]

That the three knowledge phases are interlinked and cannot be seen as a linear process starting with examination is also clear in the seven REKENE firm-level knowledge dynamics cases. All cases included aspects of all three knowledge phases, and there were loops, spirals and overlaps among the three. The details that concern studies of firm-level knowledge dynamics clearly shed light on complexity. For instance, even if the Icelandic case spans a long period, exploration and examination is still important and it seems as if the 'product' is constantly being developed. In the NMM and Stockholm heart device case, there is constant product development and loops between the phases.

More examples of knowledge interactions related to the examination and exploitation phases can be seen. In the Oulu South case, the knowledge interactions may be related to

[132] Collinge *et al.* (2008)

[133] Butzin & Larsson (2010)

examination, because it was important to test a new system. In the Stockholm case, the examination phase is particularly critical because it required 'contact capital' with hospitals and medical doctors.

In the Åland case, examination dominates the beginning of the product development and later there is a greater emphasis on the exploitation of knowledge. There is a trend in which the development over time moves from synthetic–explorative, via examination, towards a strong emphasis on the symbolic–exploitative knowledge. The product involves rather complex market conditions and product development.

11.5 Processes in knowledge interactions

In this section, we briefly analyse the knowledge processes represented in knowledge dynamics. As discussed in Chapter 2, EURODITE has used an analytical distinction of knowledge processes: *cumulative* and *composite* knowledge. Cumulative knowledge is where new knowledge builds and depends directly upon existing knowledge within the same field or discipline. Composite knowledge depends upon several disciplines or functional areas of knowledge.[134] Typical of the generation process of composite knowledge is that diverse and basically separate knowledge stocks are brought together. However, each knowledge stock may be rooted in a cumulative knowledge process.[135] It is argued that the capacity to develop and utilise composite knowledge is a good base for innovation.

In all cases, we see examples of combining knowledge interactions building on existing knowledge in one sector with knowledge from other sectors to develop a good or service. It seems there may be stages in the knowledge dynamics characterised by cumulative knowledge processes, while others are characterised by composite knowledge interactions where complementary knowledge is needed to develop the good or service further. However, it is not easy to distinguish whether a process is cumulative or composite, and it is likely that both types of knowledge processes are often intertwined.

In some cases the knowledge process becomes more composite at the end of the development. This may be seen in the Oulu South case, which includes a rather cumulative knowledge process because the process is mainly based on one person's knowledge. However, a composite knowledge process starts when the entrepreneur interacts with his business contacts. In the Akureyri case we can observe such a cumulative knowledge process. However, as the development progresses, composite knowledge processes may be seen, especially in the last phase where we see an export of knowledge in the geothermal field to other countries.

Some cases include a mixture of cumulative and composite knowledge processes. The most obvious case in terms of composite knowledge process is the New Media Meeting in Östergötland. In format, the NMM is the result of composite knowledge because it combines insights and knowledge from various fields and allows these fields to interact and create something qualitatively new. An example of a mixture of cumulative and composite knowledge processes is the Värmland case, where knowledge from logistics and services has been combined with ICT to develop the product. In the Zealand case, it is interesting to note that composite knowledge processes may be seen in relation to the different stages in the beer production, for instance in the marketing and branding of the beer and in combining production with an attraction for visitors. Moreover, in the Stockholm case we see how the cumulative process regarding hardware development and the specific medical function is developed both in parallel and symbiosis. In that sense, it is also a composite knowledge process because knowledge from the medical and health sectors has been combined with engineering knowledge mostly related to ICT to develop the product. In the Åland case, the

[134] Collinge *et al.* (2008)

[135] Strambach & Stockhorst (2010)

product development includes an intensive mix of interactions of cumulative and composite knowledge. Above all, we can observe combination of gaming knowledge with technological novelties from the digital world. In the establishment phase, knowledge was built on existing knowledge but engineering knowledge was required. In the launch phase, the company accessed and used new knowledge to add to the core competence of gaming. In market development, the firm moved towards the use of knowledge at a distance when entering new markets.

11.6 Concluding comments

To summarise the main finding of a comparison with firm-level knowledge dynamics, we conclude that in terms of the types of actors involved in the knowledge interactions, almost all cases have a multi-actor character. The knowledge interactions include participation by a variety of actors, representing businesses, higher education and research institutions as well as public actors such as national agencies and regional and local authorities. The role that the public actors play in the knowledge biographies also implies that policy is important for the development of products. The policy measures mentioned include activities such as provision of research funding, match-making and support for start-ups of companies.

Concerning geographical distance, there is a multiscalar character of the knowledge interactions. In all knowledge biographies, close knowledge interactions are combined with more distant ones. We also see that peripheral areas seek extraregional knowledge and engage in long-distance knowledge interactions. Most cases include a mixture of knowledge types. However, the most intense focus has been on synthetic and symbolic knowledge. The role of symbolic knowledge in the development of a product is also stressed. Regarding knowledge phases, the performed knowledge biographies show that product development processes are seldom linear, starting from exploration, moving to examination and ending in exploitation. Instead, loops between the phases may be observed, and different knowledge phases may take place simultaneously, such as in producer–consumer interactions. It is also interesting to note that the various knowledge types may be applied in all knowledge phases.

Finally, we conclude that the application of the knowledge biography approach has enabled us to achieve a greater understanding of knowledge interactions among varying fields of expertise. Many cases include both cumulative and composite knowledge processes. In many cases, for instance Akureyri, Värmland, Åland, Stockholm and Oulu South, we have seen how the application of ICT has implied development possibilities in production that has a strong tradition in the regions. Consequently, geographical and regional preconditions seem to be relevant for knowledge development and interactions. For instance, in the Akureyri case the knowledge development and interactions are strongly related to the prevalent volcanic activity. In addition, in the case from the Oulu South region, we see that the new product is closely related to the strong tradition of forestry in the region. In other case studies, important preconditions for knowledge interactions relate to the presence of critical mass in terms of the size of market, for instance in Stockholm. In many cases development may be connected to a strong business tradition. In the Åland case the interactions relate to regional business traditions such as shipping and on-board entertainment. In addition, the supply of venture capital is good. We can observe how knowledge development is possible because of technological development. The cases of Åland, Stockholm and Värmland are well connected to the opportunities that the ICT sector creates, such as international Internet gaming and e-commerce. This is relevant to the discussion of path dependency and the ability to avoid 'lock-ins' by recombining existing strong traditions of knowledge and/or physical geographical/geological preconditions with new types of knowledge and sectors.

After the analyses of the territorial and firm-level dynamics in Chapters 10 and 11, we now examine the contribution of a gender perspective on new knowledge dynamics.

12 Gendered knowledge interactions[136]

By Margareta Dahlström & Sigrid Hedin

One may question why a gender perspective is important for understanding knowledge interactions. In the EURODITE project a gender perspective has been applied to investigate the role of gender in organisations, networking, and in institutional systems and practices relevant to knowledge dynamics.[137] It is important to stress that gender issues concern not only women but also men. By using a gender perspective it is possible to reveal a more nuanced picture of the knowledge economy. When focusing on entrepreneurship and innovation, and when determining policies to support regional development in the knowledge economy, there is a risk of misinterpretation if a gender perspective is not considered. It is not only for reasons of equal opportunity that a gender perspective is relevant. One reason for gender perspectives to be on the EU agenda regarding the knowledge economy and regional development is to acknowledge that women are an untapped resource in many economies. This is first simply attributable to a considerably lower participation rate in many regions and countries, and second because many women tend to be over-represented in less powerful segments of the workplace. Another reason to apply a gender perspective on issues relating to the knowledge economy is the gender segregation in the education system and in the labour market. Mixed workplaces and work groups are likely to provide a broader knowledge perspective and more innovative work teams simply because diversity promotes creativity. It can be seen as another source of composite knowledge.

Concerning knowledge interactions, studies have shown that innovation may be strengthened by diversity. A heterogenic composition of a team and diversity within a group in gender and ethnicity has been revealed to potentially pay large dividends in encouraging innovation.[138] Examining knowledge interactions from a gender perspective may also help to shed light on conditions that may be reconsidered when developing a knowledge economy from a policy perspective. If gendering of society and social relations is not considered; there is, for instance, a risk of 'promotion of men and males as a policy norm' and more specifically that 'only certain people, e.g. highly educated men in technical sciences, or men entrepreneurs, are supported by innovation policies'.[139]

In the guidelines produced for the empirical research with firm-level knowledge dynamics, four dimensions for dealing with gender issues were stressed: gender segregation, gendered knowledge contexts, work–life balance and gender roles, and gendered networks and social capital. We have utilised this structure to sort the REKENE findings in relation to territorial and the firm-level knowledge dynamics. In addition, the findings refer to compiled statistics regarding education for each country and region studied. Because of the rather small firms and rather unique cases studied in the firm-level knowledge dynamics, it may be difficult to draw any general conclusions regarding gender issues. However, by looking at both the firm-level and territorial knowledge dynamics we can see some patterns. These patterns are to some extent also confirmed by aggregated statistical data displaying gender segregation in education

[136] The application of a gender perspective in the REKENE cases was based on the work performed by Alison Parken and Teresa Rees on the EURODITE project and the assistance of Katarina Pettersson, Nordregio.

[137] Parken (2010) p. 5.

[138] See Danish Agency for Science, Technology and Innovation (2007) and Kempinsky *et al.* (2005).

[139] Pettersson (2007). p. 9.

and work life. The comparisons with EURODITE cases are based on the gender synthesis[140] and work performed in the policy analysis of this project.[141]

12.1 Gender segregation

Under *gender segregation* we mainly examine where men and women are active in territorial knowledge dynamics and the knowledge biographies elaborated in the firm-level knowledge dynamics case studies. A key question concerns whether there is horizontal segregation, implying the occupation of different kinds of jobs, and vertical segregation, referring to occupation of jobs higher or lower in the hierarchy, between men and women.

In many of the REKENE and EURODITE cases, there is an absence of women in knowledge interactions described in the firm-level knowledge dynamics. This may be related to the sectors from which the cases were selected. The EURODITE sectors are automotive, biotechnology, food and drink, ICT, KIBS, new media and tourism. Employment in many of these sectors is dominated by men.[142] Traditionally, the perception of the *knowledge economy* has been connected to activities and work related to the technology sector, often dominated by men. Regarding employment patterns in the EU, women tend to be over-represented in the public sector and especially in public administration, health and education occupations.[143] In addition, *knowledge workers* have been seen as managers and senior officials, professional and associate professionals and in technical positions, which often have been occupied by men. Women are generally absent from places where decisions about and involvement in the transition to knowledge economies is taking place.[144] In the seven sectors in the EURODITE cases, vertical segregation was reported, implying that men occupy lead or higher management roles, whilst women work in support roles to the knowledge economy.[145]

In the Nordic countries there is high labour market participation by women. However, despite the high activity rate in the labour market, the territorial and firm-level knowledge dynamics studied in the REKENE project seem to be characterised by high gender segregation, concerning both horizontal segregation (variety of jobs) and vertical segregation (level in the hierarchy). Examining the national level for the Nordic countries covered in REKENE, this pattern is also confirmed.

Regarding vertical segregation in the REKENE case studies, women tend to be under-represented in higher positions as professors or top-level management in private firms. In the Åland case, where the territorial knowledge dynamics covering the subsector of computer and technical services and KIBS is dominated by technical activities, women are under-represented in the case study in general and in top positions in particular. About 68 per cent of the workforce in computer services and 63 per cent in technical services are men, whilst women dominate in economic services and advertising.[146] This picture is also verified by firm-level knowledge dynamics, where one firm studied where men mainly work. The highest level of management in the 20 largest firms in Åland is dominated by men.[147] All senior managers of the firm studied in the firm-level knowledge dynamics were men at the time of the interviews

[140] Parken (2010)

[141] Halkier *et al.* (2010)

[142] Often the measure of 40–60 per cent participation, for instance regarding students in a specific education, is used to estimate bias in the dominance of women or men.

[143] Parken (2009)

[144] Parken (2009) p. 6.

[145] Parken (2010) p. 7.

[146] Fellman & Miiros (2008)

[147] ÅSUB (2008)

in this study. However, in middle management there were more women, but primarily in the area of marketing and business activities.

In the cases of Stockholm, Värmland and the Oulu South region, partly covering the ICT sector, horizontal and vertical segregation can be seen. In the Stockholm case study it is stated that women are basically absent from the interaction and activities of the knowledge dynamics in Medtech and ICT. In the Värmland case study, it is mentioned that industries dominated by men, such as forestry and the paper and pulp industry, are important for the development of the region. Thus, many of the companies that today belong to the cluster management organisations such as TPP and Compare are dominated by men. In the Oulu South region there is a tradition of industries dominated by men, one of which is the metal sector. However, differences between the ICT and metal sectors can be seen. The metal sector is dominated by men to a higher degree (88 per cent of employment) than the ICT sector, with 63 per cent. In the case study, it is argued that in sectors that traditionally have been dominated by men, the employment structure is changing more slowly, because men tend to employ other men when recruiting new staff. Compared with the metal sector the ICT sector does not have a long tradition. In the case study it is also argued that metal companies are often small with a rather rough atmosphere and are not considered to offer many possibilities for female participation. The number of women working in the metal and ICT sectors has however increased because of public sector activities, for instance R&D projects. For instance in the R&D groups of the Oulu Southern Institute there is a better balance between men and women, at least in the RF Media laboratory. The Oulu South region is also rather entrepreneurial, but also here it has mainly been men that have become self-employed or started new companies. An explanation for this may be that in the Oulu South region there have traditionally been more children per family than in other parts of Finland. The large family size may hamper women from being active in the labour market and as entrepreneurs.

Gender segregation is not only seen in the technology sector. The food and drink sector studied in the REKENE and EURODITE cases studies is also dominated by men either self-employed or as employees. The specialised food and drink industry is dominated by men, where often they run and own small firms. However, a recent study concludes that women tend to be invisible in these types of firms, even if they are active, because they are not seen in official registers and statistics.[148] In the REKENE case studies there are indications that men and women tend to occupy different jobs in this sector. Women are more involved in marketing, distribution and accounting. In the territorial knowledge dynamics covering new media in Östergötland it is stated that competences and skills concentrated in the new media sector tend to have a gendered organisation, where men dominate the technology skills and software development, whilst the exhibition design skills, public relations and marketing are handled by women. This division of labour corresponds to the pattern found in the EURODITE cases across the sectors covered. This situation is especially stressed in cases of new media such as game development in Skåne and the West Midlands, and in the cross-sectoral case study of new media and watch making in West Switzerland.

12.2 Gendered knowledge contexts

In the framework of the EURODITE project, several so-called 'knowledge contexts' were identified as important perspectives for the development of the knowledge economy. The knowledge contexts should be seen as conditions that may affect knowledge interactions and dynamics. Under the heading of 'gendered knowledge contexts' we have analysed the situation in three of these contexts of importance for knowledge interactions with a particular focus on: gender; *education and science*, which relates to the world of education and research in any region

[148] Lantbrukarnas Riksförbunds Jämställdhetsakademi (2009)

or country; *governance and policy,* dealing with issues of regulation and policies that may affect knowledge dynamics; and *markets*, which relates to knowledge dynamics, for example through interactions between consumers and producers.

12.2.1 Education and science

Within the knowledge context of education and science we have examined gender differences in the disciplines and subjects studied, for example, the number of women and men taking higher degrees and vertical segregation in academia, to assess the impact of the educational system on such factors as labour supply and knowledge networks. Here we can conclude that the gender segregation in the labour market seen in the REKENE and EURODITE cases is to a great extent related to the gender segregation in the educational system. Regarding education and science, education 'choices' cannot be seen as natural, fixed or inevitable and based only on personal choice. Instead, they are influenced by a combination of individual and structural conditions such as regional economy, the valuing of occupations, prevailing gender 'norms' for different kinds occupations, education and career curricula, parental and peer influence.[149]

In the Nordic countries, today more women than men attend higher education. On average 57.7 per cent of the students at HEIs are women.[150] At the EU level, women are in the majority among undergraduates.[151] In the Nordic countries, more women than men hold a degree from a tertiary education.[152] Still, the division regarding disciplines and faculties is very uneven, with a predominance of women in humanities and education and a small proportion in engineering, natural sciences, technology and construction.[153] This aggregated picture is also confirmed by the territorial knowledge dynamics studied in the REKENE cases.

Parken (2010) highlights that the gendering of education is not fixed by the example of the development of biotechnology covered in some of the EURODITE cases. In one of the REKENE cases, Akureyri and the geothermal industry*,* there is a similar change for geology, which is the only discipline in natural sciences and engineering where there has been a development towards an overrepresentation of women during the past decade. An explanation for this may be that this is a part of a general trend, as most university disciplines are now dominated by women, but the few remaining exceptions are primarily within the natural sciences and engineering. The increase in the number of more educated women in geology can also been seen in the labour market, where there has been an increase of women in the geothermal field over past decades, especially in research work. In the development from the 1970s and onwards, two major recruitment phases to ÍSOR have occurred. During the 1970s, mainly men were hired. Since around 2000, half of the new staff members are women. However, because of limited staff turnover there has not been any major increase in female participation in engineering offices in the Akureyri region. Thus, workplace mobility there is rather limited. Despite the increase in the number of women in the geothermal industry there is still a difference regarding work tasks. Men perform more of the work in the geothermal field, which is considered physically demanding whilst women are located in the main office or in field work, which is considered less physically difficult.

Women tend to be under-represented in ICT education. In the Stockholm territorial knowledge dynamics, it is stated that women are basically absent from educational programmes in ICT. This pattern is also confirmed in some of the EURODITE cases on the ICT sector, such as in Bratislava (Slovakia) and in Slovenia.[154] In the Stockholm case, it is stated that there are concerns, from both private and public actors, that so few students (both men and women) choose education programmes in ICT because there is a high demand for this kind of

[149] Parken (2010)
[150] Hedin (2009)
[151] Parken (2010)
[152] Norden (2009)
[153] OECD (2007)
[154] Parken (2010) p. 38.

competence in the labour market. The recruitment base would increase further if more women students could be attracted to ICT education programmes. The Swedish government views the uneven gender structure as problematic and has commissioned the Royal Institute of Technology to design an action programme including suggestions on what would contribute to the development of a more even gender structure in the ICT sector. The Stockholm case study deals with cross-sectoral knowledge dynamics including actors within both ICT and medtech, and therefore the gender structure within medical education programmes is also of interest. In these programmes and health care education programmes, women dominate among staff and students.[155] However, men tend to dominate the higher positions in hospitals, research and research projects.

Various measures have been initiated to deal with the gender segregated education structure by some of the HEIs included in the territorial knowledge dynamics. Karlstad University, for instance, is encouraging women students to apply for programmes dominated by men by having marketing campaigns. Another example of activities performed to increase the number of women students in areas of education traditionally dominated by men is the *Tekla* student network for women engineering students, which began in 2005. The *Gender equality for sustainable growth* project (Jämställd hållbar tillväxt—JämVäxt) financed by EU Structural Funds and Region Värmland, and led by Karlstad University, is conducted with the aim of changing structures contributing to the highly gender segregated labour market in the region.

In the Zealand case study it is stated that brewing is a course heavily dominated by men. If women participate, they tend to participate in some modules of the education programme. In the case study work, no specific concerns about the absence of women within brewing education programmes surfaced, and the Scandinavian School of Brewing does not have any specific initiatives to change the gender balance of students studying there.

12.2.2 Governance and policy

In many of the REKENE case studies, policy seems to play an important role in knowledge interactions. According to EU regulation, gender mainstreaming is compulsory in all EU policies, implying that equal opportunities for men and women must be incorporated in all EU policies and activities. In addition, in all Nordic countries there are obligations for mainstreaming gender, entailing working toward gender equality in all policies. Within the knowledge context *governance and policy* we have examined how policy documents and practice match this demand for gender mainstreaming and what kinds of economic activities are supported and considered to be 'innovative'.

Overall, the application of gender mainstreaming at the EU level and in the EU member countries has so far been rather limited in regional development agency types of actors and cluster policy.[156] Looking at some concrete policy initiatives found in the REKENE case studies, we see that women tend to be absent in economic activities relevant to knowledge interactions supported by public actors, for instance in the incubators. An explanation for this absence may be that incubators and science parks have traditionally been based on transfer and commercialisation of findings from natural sciences and technology.[157] In the Stockholm region, the experience of the STING incubator was that women more frequently presented design-based and service-based and less 'innovative intensive' ideas. Such ideas do not match STING's policy, because the incubator works with ideas based on major technical innovations. A similar situation can be seen in Värmland, where the limited number of women entrepreneurs in the incubation process in Värmland is explained by the focus on the *Inova* incubator, which supports business ideas that can grow and be developed beyond the region of Värmland. According to one of the interviewees, women entrepreneurs do not have the intention or vision to expand their businesses.

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[155] Högskoleverket (2008)

[156] Parken (2010)

[157] Etzkowitz (2002)

In Åland, public actors recognise that women tend to have another perspective when starting companies.[158] Consequently, the ÅTC has begun a project to support female entrepreneurs in networking. In addition, a woman business advisor has been employed in the incubator. Furthermore, the perception of innovation has been broadened beyond work with technical innovations. A pre-incubator has been established to support the development of ideas early in the incubation process. This pre-incubator has attracted more women than the incubator. The rather progressive attitude towards women may partly be explained by the fact that there is competition for skilled professionals in Åland and women are considered a relatively untapped resource, both in starting companies and in employment in technical professions.

12.2.3 Markets

The knowledge context of *markets* refers to the implications of gender segregation for understanding and improving products and services, and the knowledge interactions in the framework of the markets. For instance, does the shift towards perceiving women as 'active' consumers imply an increased role of women in the innovation processes? Some of the REKENE case studies address how consumers and markets are differentiated by gender. In the Stockholm case it is mentioned that the market in medicine and health care involves men and women, and it is also important to integrate women into the knowledge dynamic activities to understand the consumer side and communicate with 'active consumers'. In the Åland firm-level knowledge dynamics it is stated that the awareness of women as customers and clients has grown recently. There is, for instance, a market segment tool with a gender perspective. The gendering of games within segmented markets is also recognised in the West Midland case study of new media and game development, where it is mentioned that women constitute a growing market for games. The emergence of women in the market of new media can also be seen in the Östergötland case and the NMM event. Here it is stated that the initiators and the people belonging to the wider network of the NMM are all men. This is claimed to influence the character of the programme for the meeting. However, lately, there has been more awareness regarding gender bias in the programme committee.

12.3 Work–life balance and gender roles

The dimension of *work–life balance and gender roles* deals with the kind of impact that organisation of work in time and space (e.g. long/irregular hours, peaks and troughs, travel abroad, 9–5, etc.) may have for women's and men's ability to undertake certain roles and kinds of work. Issues such as stage in the lifecycle—for instance, the perception and practice of caring roles with regard to children, elderly relatives or taking care of household activities—are of relevance here.

The Nordic model of a welfare regime characterised by strong social protection, care provision and flexibility is acknowledged to play an important role in the rather fast and inclusive transition to knowledge-based societies in the Nordic countries compared with the rest of Europe.[159] Despite this comparatively favourable outcome in the Nordic countries, we see that work–life balance is influenced by gender in the REKENE cases. We see examples of gender stereotyping that may contribute to maintaining gender-segregated labour markets. In the Åland case study, it is for instance stated that vertical segregation especially can be related to work–life balance. In the firm-level knowledge dynamics, it is mentioned that long working hours and travel is required for the senior positions, especially because the activities are related

[158] Fellman & Miiros (2008)

[159] Parken (2010). p. 6.

to international contacts. In addition, it may be difficult for the organisation of work to match the terms (or the perception) of everyday life for many women, who bear the main responsibility for caring for households.

In the Stockholm territorial and firm-level knowledge dynamics, it is stated that work in ICT and KIBS firms has the reputation of involving long and irregular working hours with multilocal networks that require travelling to meet partners. This image is also seen in the EURODITE cases, such as Bratislava (Slovakia), covering the ICT sector.[160] However, in the Stockholm firm-level case study, gendering of time and space is not obvious. The project and network-based work can contribute to gender imbalances. However, the connection with work–life balance is apparent in the location decision of the firm covered in the firm-level knowledge dynamics. This decision was influenced by the location of the homes of the founding partners, who were all men.

12.4 Gendered networks and social capital

We have briefly considered whether men and women participate in different kinds of networks and interactions. Are there, for instance, factors or structures that constrain women's participation? Do people meet outside working hours or in meeting places that tend to be dominated by men, such as golf clubs? Do mobility patterns of men and women have an impact on knowledge transfers? Research has showed that men and women tend to have different mobility patterns in terms of commuting distances, with regard to travel within work, and in relation to decisions within the households regarding relocation.[161] It is more common that men commute and travel within work over greater distances than women. It is also more common for relocation decisions within households to be based on the man's career rather than the woman's. This is sometimes labelled the 'trailing spouse' phenomenon, in which women move for reasons related to their partner's jobs rather than their own career. Such a pattern may make upward mobility more difficult for women. However, as in any case of mobility, both men and women moving may bring new knowledge to the new area of domesticity (see also Chapter 10).

In the Åland case, it can be seen that social activities organised by one of the firms covered in the firm-level case study display a focus on interests such as Formula I racing and golf that are more common among men than women. However, the awareness of these conditions has risen and strategies, for instance development of a gender equality plan, have been developed by the firm.

As seen in the previous chapters, networks, both formal and informal, are of great importance for knowledge interactions. For reasons described above, many of these networks are also dominated by men. The importance of gendered networks is highlighted in the territorial knowledge dynamics covering the ICT and KIBS sectors in the Stockholm region. Here social networks dominated by men were crucial in the firm-level case study of the development of the innovation. These may be compared with the situation in the Åland case, where it was stated that actors tend to work with people known from previous encounters. For instance, the snowball recruitment mentioned in both the territorial and firm-level knowledge dynamics may contribute to men recruiting other men to leading positions, and the recruitment occurring among friends and acquaintances. The phenomenon also applies to different kinds of subcontractors.

The introduction of specific initiatives shows that companies are concerned with the underrepresentation of women in the ICT sector. The CapGemini company in Stockholm has, for instance, initiated a network for women in the ICT sector, to establish new contacts and

[160] Parken (2010). p. 39.

[161] See, for instance, Friberg (2008).

supporting relations among women within ICT. In Åland, the main firm involved in the case study has initiated an internal network led by a woman management consultant aiming at supporting women in managing positions. Women in managing positions have also created networks both within larger firms and between smaller and larger firms to strengthen women's leadership. There has also been policy support for other networks of women. The ÅTC manages a project to stimulate and support women entrepreneurs in networking. However, few initiatives to include women in networks dominated by men were mentioned. In the Stockholm study, it is particularly stressed that networks in ICT and research in medicine have high prestige and reputation. High status is an important resource when negotiating for high salaries and policy support. There may be a subconscious idea that this favourable position in the network may be threatened by a changed gender structure. Such ideas among actors with influence in these spheres may prevent a transformation towards a more balanced gender structure.

12.5 Concluding comments

To summarise the findings on gender issues and knowledge interactions, women are not frequently seen in the knowledge interactions in the territorial and firm-level knowledge dynamics of REKENE and EURODITE. The absence of women may be explained by the fact that most of the sectors covered in the projects are dominated by men. We see that there is strong horizontal and vertical gender segregation. This situation is also confirmed by the gendered knowledge contexts of education and science, governance, policy and the market. Regarding work–life balance, we see indications that the stereotypical kind of lifestyle needed for specific types of jobs and positions may hamper the participation of women in jobs with high potential for knowledge interactions. In addition, male networks and social capital, which are considered to be of great importance for knowledge interactions, are highlighted in the territorial and firm-level knowledge dynamics studied in both the EURODITE and REKENE cases.

The findings shed light on the situation in which the perception of innovation and the knowledge economy still tend to be focused on technology development and sectors dominated by men. A stronger emphasis on private and public sectors, including services in health and education, would probably contribute to new perspectives developing a knowledge economy in general, and knowledge interactions including women in particular. The inclusion of the service sectors in relation to innovation is also seen by VINNOVA, which through its VINNVÄXT programme funds a project that is driving the development of individually-adapted solutions for the best possible health in the areas of distributed care, personal care and sports.

13 Knowledge dynamics and policies for regional development

By Margareta Dahlström & Sigrid Hedin

The call from the Nordic Innovation Center (NICe) for the *Regional innovation and Regional Innovation Actors of Tomorrow* programme was to develop recommendations for regional innovation policy development in the Nordic countries. In Chapters 10 and 11 we have considered existing policy instruments directly linked to the processes discussed in those chapters. We now turn to a more synthesised discussion of policies in relation to knowledge dynamics and regional development. In this chapter we examine knowledge and policies for regional development in Europe and in the REKENE case studies. In the EURODITE project, there are two sets of data informing this chapter: a survey of regional development agencies in 181 regions of 22 EU countries,[162] and the case studies[163] conducted in 22 regions of 13 countries, including two non-EU members. Both sets of material focus on policies that directly address regional development in the knowledge economy. Other policies that affect such development, for example national policies on education or housing policies, are not addressed. We use this material for a comparison with the REKENE case studies by considering the targets of knowledge-related policy initiatives at a fairly specific level.

13.1 Shifting paradigms of policies for regional development

Over recent decades, policies for regional development have changed fundamentally. From a set of measures to support lagging regions that were intended to reduce regional disparities, they now encompass a plethora of strategies and initiatives for *all* regions and aim to build on regional strengths to support regional growth. Looking at policies to develop innovation systems at the regional level there is also a trend for regional actors to participate frequently in competitive applications for funding, for instance the VINNVÄXT programme run by the Swedish agency VINNOVA.[164] At the same time there has been a change in the composition of actors involved in policy activities for regional development. Furthermore, responsibilities and funding sources have also altered among actors. The states that were previously in charge of designing and funding policies for regional development are still major players in this regard. However, they have been joined by various types of regional actors, some with

[162] In this survey, the concept of 'regional development agency' (RDA) is used to cover the most important of the different types of organizations at the meso-level, i.e. between the national and local levels that are charged with working with regional development. An RDA can, in this survey, be a directly elected regional council, a county administrative board or an agency of another kind. The survey is web-based and was conducted in 2006/07. The four most prominent policies of each RDA were included. The methodology and results are presented in Halkier (2009).

[163] The policy initiatives included in this analysis are those that are mentioned in the case study reports.

[164] See for instance Hedin, S. *et al.* (2008).

devolved responsibilities for regional growth strategies, and by increased importance in terms of both strategies and funding from the EU.

Within the EU, the Lisbon Strategy, and now its follow up Europe 2020, has set out the overarching agenda of promoting competitiveness and regional growth through supporting innovation and entrepreneurship. For EU members, this agenda steers the funding stream of the Structural Funds that are of great importance for policies for regional development. For countries outside the EU, the same ideas of focus on competitiveness, innovation and entrepreneurship, and of the importance of the regional level for policies, underpin these policies. There has been a Europeanisation of policies for regional development including a geographical area wider than just the EU. The EU Interreg programmes are examples of how this Europeanisation occurs both in practice and in the mindsets of those involved in the projects, even outside the EU.[165]

In addition to the increased involvement of different levels of government in processes regarding policies for regional development, other types of actors have become engaged. The regional bodies charged with responsibilities for regional growth strategies and funding come in different shapes and forms. Some are regional councils under directly elected bodies, others are the state representation at the regional level such as county administrative boards, while yet another type is regional development agencies with limited direct involvement of a politically elected body. Furthermore, other important actors with regard to regional economies are now actively working with strategies, programmes and projects towards regional growth. HEIs, key private businesses, chambers of commerce, and the parties on the labour market are all involved in strategic and practical work for regional development. Policies for regional development are now developed and executed within a framework of multilevel governance.

With a focus on competitiveness, innovation and entrepreneurship, issues of knowledge generation and transfer come to the fore. Knowledge dynamics at the territorial and firm levels are at the heart of the matter. Policies for regional development in this context need to be more knowledge intensive. Developing successful policy instruments such as advisory services and network building requires intimate knowledge of local economic activities on behalf of the policymakers and practitioners. In comparison with the 'old' regional policy developed by the national level and characterised by grant schemes, the new paradigm of policies for regional development increases the demands on development bodies. These actors need greater knowledge resources both in relation to the competence of the staff and with regard to access to external knowledge in the region, nationally and internationally.[166]

13.2 Targets of knowledge-related policy initiatives

With competitiveness, entrepreneurship and innovation as leading themes for policies, how are strategies translated into specific objectives for change? This section deals with policies to influence directly or indirectly the behaviour of firms, citizens and public organisations to achieve regional development goals. The European RDA survey[167] showed a strong trend toward policies and strategies that aim for qualitative change, not just a quantitative change of some sort. In terms of the strategies supporting regional development, an analysis was conducted regarding the *target institutions* and the *target capabilities* of the initiatives. Three types of target institutions were identified; individuals, firms and organisations and the system. An example of 'the system' is a cluster formation. The target capabilities, in turn, were divided into

[165] Böhme & Waterhout (2008)

[166] Halkier & Cooke (2010)

[167] Halkier & Cooke (2010)

three main types; hardware, software and 'orgware'. Hardware includes physical and technological infrastructure such as buildings and machinery, but can also include venture capital and financing. Software refers to factors such as knowledge, training and advisory services. Orgware relates to the development of professional networks and cluster organisations. The division of capabilities into hardware, software and orgware will also be discussed in relation to policy tools in Chapter 14.

The European RDA survey revealed that firms and organisations were by far the main target institutions for policy initiatives. Among these, firms in particular were targeted. There were considerably fewer policy initiatives aimed at individuals and the system level, approximately the same number for each of these categories. In the EURODITE case studies,[168] it was also clear that firms and organisations were the main target institutions. However, in these case studies the system was also a common target. There were many examples of cluster or platform-type policy initiatives among the case studies. There were no marked differences among cases from different sectors regarding the target institutions for policies.

In terms of target capabilities, the majority of the policy initiatives in the RDA survey were related to software. Policies supporting hardware were slightly more common than those supporting orgware. Among the EURODITE case studies, the policy initiatives were approximately evenly spread across the three capabilities. However, some differences between sectors could be detected. Policy initiatives related to hardware were most common in the ICT and New Media case studies, while they were least common in case studies dealing with the automotive sector or knowledge intensive business services (KIBS). With regard to software, such initiatives were most common in the automotive, KIBS and food and drink case studies, while they were least common in case studies of the biotechnology and ICT sectors. Orgware initiatives were common across all types of sector cases. Because of the limited number of case studies, particularly in some sectors, these differences should be treated with caution.

Taking the two dimensions of target institutions and capabilities together, the case studies reveal a pattern that is more likely to create systemic changes than those of the RDA survey. Initiatives focusing on the system level and orgware in firms and organisations are frequent. One reason for this difference may be the selection criteria of the case studies intended to find examples of knowledge interactions among people in firms and other actors and at different geographical levels. Such interactions are likely to take place within the framework of networks of various kinds.

In a similar manner to the RDA survey and the EURODITE case studies, policy initiatives targeting firms and organisations were most common among those that the researchers discovered in the case studies of REKENE. There were also many policies targeting 'systems', often in the shape of clusters, networks and initiatives to create and support meeting places. Examples of system-type policies include the Finnish Maritime Cluster and the Pro Metal Network that provide funding for R&D projects in the metal sector of the Oulu South region. In the Värmland region, the cluster initiative Compare plays an important role in knowledge dynamics in the case study, for example through collaboration with the Inova incubator where workshops, seminars and 'matchmaking' events for firms and other actors in the ICT sector occur.

Several case studies include examples of triple helix initiatives that, by definition, are of a system character because they include actors from the higher education sector, private firms and public bodies. ÅTC is such an organisation that provides funding for R&D projects and commercialisation among other things. The Stockholm case study is characterised by many overlapping networks and triple helix organisations. The Stockholm IT Region is a regional network of public and private actors that includes the triple helix organisation Kista Science City. Another organisation is the CTHM, which aims to create a dynamic medical technology network in Stockholm.

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[168] The source of results relating to the EURODITE case studies in this chapter is Halkier *et al.* (2010).

As discussed in Chapter 2, a common measure in triple helix thinking is the establishment of science parks and incubators. Among the REKENE case studies, such measures were noted in five of the case studies. These include well-established science parks such as NOSP, which has visualisation as one of its four focus areas, and the STING incubator and KIAB (Karolinska Institute's incubator) in Stockholm. In addition, the Åland knowledge dynamics include a whole set of facilities to cater for a variety of needs. They range from ITiden, which is a science park, to *Växthuset*, which is an incubator for start-up firms, and *Starthuset*, which functions as a pre-incubator. The science parks and incubators can be regarded as initiatives that mainly target firms. However, at the same time they have a systemic dimension because one of their aims is to bring businesses together and increase the opportunities for interaction among firms based in the science parks or incubators. Furthermore, science parks and incubators function as meeting places where interaction can take place among people from the whole triple helix spectrum and even beyond.

Just as in the RDA survey and in the EURODITE case studies, the least common target institutions in the REKENE case studies were individuals or citizens. However, there were examples of knowledge policy initiatives in the REKENE case studies, in both training and education. In the Zealand region, the provision of education and training for the food and drink industry provided by the technical colleges in the region was mentioned. Of particular importance was the Scandinavian School of Brewing, although this is located in Copenhagen, outside the case study region. It provides a specific example of the importance of extraregional knowledge links. In the Värmland region, the student placements and mentorships for students at Karlstad University were mentioned, and in the Akureyri region the presence of the School for Renewable Energy Sciences plays a role for individuals in knowledge dynamics.

In terms of target capabilities for the policy initiatives in the REKENE case studies, policies focusing on software were most common. This too is in line with the findings in the RDA survey and in the EURODITE case studies. The training and education mentioned above is one example of such software policies. Another common measure was the advice services provided in the incubators and science parks. Hardware was a common target capability particularly in the shape of funding. Among the case studies were many examples of funding for R&D, which can be seen as a combination of hardware and software. Funding from the national level is prominent. Programmes funded by VINNOVA were for example of importance in all three Swedish case studies. Orgware was also a target of several policy initiatives, most often in relation to clusters, networks and meeting places, as mentioned above. Another example of a policy initiative of orgware character is the public sponsoring of the NMM in Norrköping. This is a culture and science festival where artists, media activists, musicians and academics within new media meet and perform their knowledge and art.

13.3 Concluding comments

The shifts in the new paradigms of policies for regional development are multifaceted. Three main trends of importance to knowledge dynamics are:

- *Multi-actor policies.* There are many different actors involved in strategy and policymaking. In addition to policy bodies, actors such as HEIs, private firms, chambers of commerce, the social partners, and others take part in developing policies for regional development in the knowledge economy. Partnerships and governance are key concepts here.

- *Multilevel policies.* In addition to the national policy level, policy bodies at the regional level play an increasingly important role in the development of policies for regional growth. In some countries, such as the Nordic countries, the municipalities at the local level are significant actors in this respect. There is a Europeanisation of policies that

affects the areas outside the European Union. A key concept here is multilevel governance.

- *Policy focus on software.* A third trend is the increasing attention to policies dealing with software factors such as training, education and business advice. Knowledge generation and knowledge transfers are target areas for policies for regional development.

Evidence of these trends is clear from the RDA survey and from the EURODITE and REKENE case studies.

- *Multi-actor policies*. The three sets of data show a strong trend toward multi-actor policies. The many policies, particularly in the EURODITE and REKENE case studies that focus on system-level initiatives and on support for orgware capabilities, underpin this conclusion. Multi-actor policies come in different shapes and forms, and include activities in relation to triple helix thinking, networks and clusters.

- *Multilevel policies.* All three data sets also show that multilevel policies are plentiful. Policy strategies at different levels, range from, for example, the Lisbon Agenda at the EU level, to regional growth programmes aligned around the key concepts of competitiveness, entrepreneurship and innovation. Funding for the policies generated from the strategies is also multilevel.

- *Policy focus on software.* The importance of policies supporting software development is clear in the RDA survey and in the case studies. Software related policies are particularly prominent in relation to firms. Examples include business advice and knowledge generation, for example in research collaborations with universities. Less common, but still important, are the software related policies targeting individuals in support of training and education.

In the EURODITE and REKENE studies we have a particular interest in cross-sectoral knowledge dynamics because of the capacity for such interactions in bringing innovation and novel solutions. Examples of such knowledge dynamics are discussed in Chapter 10. Within policymaking for regional development there is also a trend toward combining policies with a holistic perspective and avoiding restrictive sectoral policy developments. Policymaking within the multi-actor and multilevel framework by definition needs a combined approach, which is both challenging and potentially rewarding through bringing more creative policy solutions and avoiding lock-ins.[169]

The shift in regional development policies can be seen in the REKENE case studies. Some illustrations of policy tools exemplifying this are presented in Chapter 14 where the project's work with policy tools is discussed. We return to this matter in the concluding Chapter 15.

[169] Caffyn & Dahlström (2005)

14 The REKENE policy tool kit — an introduction

By Susan Brockett & Jonathan Metzger

The *REKENE Policy Tool kit* has evolved as a concrete and tangible product of the practitioner sessions of the project. The work with the tool kit went far beyond what was originally planned for the project. This, in itself, is a positive result of the project in which practitioner dialogue evolved, and a sense of the necessity to stabilise the sharing of experiences in a more manifest and resilient form emerged. The purpose of the policy tool kit that evolved out of this process is, therefore, to collect the shared experiences of the REKENE practitioners in a format that encourages institutional learning and knowledge recirculation. Because the work with the tool kit developed beyond the scope of the project, what is presented here should be seen as a status report of the situation in June 2010.

14.1 The goal: Useful policy tools

The concrete tool kit consists of an inventory of policy tools that are particularly aimed at harnessing knowledge dynamics in regional development endeavours. The tool kit is based on the practitioners' own knowledge and experiences and provides new insights into the usability and relative merits of both novel and 'tried and tested' policy measures for regional development in the knowledge economy. There are a plethora of policy tools that are used to promote regional development, but the REKENE study focused on those related to knowledge dynamics. That is, tools that in some way promote the creation, transfer, application, exploitation or combination of knowledge. During the working seminars the participants spent time proposing various ideas about the term, but arrived at the following categories of policy tools.

- 'Software' refers to programmes, incentives, related to factors such as knowledge, training and advisory services.
- 'Orgware' means ways of organising actors and their activities and forging networks and connections among them, thereby facilitating knowledge exchange.
- 'Hardware' implies provision of support for physical facilities, buildings or infrastructure that is used by actors, where knowledge is generated or applied.
- 'Heart-ware' is a term that refers to incentives that may aim at changing cultural attitudes and ways of thinking to promote knowledge dynamics.

14.2 Generating the tool kit: From tasks to tools

Sources for the tools in the tool kit have come from the knowledge and experience of the practitioners, as elucidated in the discussions during the seminars, as well as the showcases in each region and the REKENE case studies (see further in Section 1.3). Early in the project, the practitioners presented and discussed policy tools in use in the participating regions, as well as

'needed tools', that is, a perceived lack of effective means to achieve a particular end. This early inventory provided inspiration for the study as it progressed. Then, when it was time to work more directly on the tools, it became apparent that this allowed an interesting mode of generating the tool kit. When exploring possible candidates, a method was chosen that involved going from *tasks* to *tools*. That is, the working session to generate tools started by creating a list of the tasks necessary to harness knowledge dynamics, as perceived by the participating teams and indicated in the analysis emerging from the study.

As the lists of tasks began to emerge, they were manually clustered stepwise into meaningful categories. Then, from the REKENE case studies and the total frames of reference of all the participants, possible tools for each task were listed. Of course, some tools are applicable to several tasks, and each task may use or require several alternative tools. The exercise produced many ideas: at one point there were 34 tasks listed and over 150 potential tools, and researchers participated in the creative process of generating ideas for tools and tasks, and revising the existing input.

The next step in the process involved critical editing of the total list, followed by specification of each task and retained tools. Additionally, the lists were supplemented with supplementary information about sources, wherever possible. In a quality assurance operation several tasks and tools were deleted, merged or revised. Finally, an editing effort produced the tool kit presented here.

Originally, the task-to-tool approach was chosen as an effective way to harvest the total knowledge base of the participants in the very short time available in the working seminars. However, as work progressed, it became apparent that a new type of tool kit was emerging. The tool kit material has an enormous potential for further development into a fully fledged interactive tool for exploration and inspiration in regional development work (see Section 14.4).

14.3 Structure of the policy tool kit

The tool kit consists of two types of interrelated items: tasks and tools.[170] The tasks and tools are specifically organised as data items entered into standardised forms that were specifically designed for the purpose. The task forms contain cross-references for relevant tools that can be utilised to grapple with a specific task, and likewise all tool-forms are cross-referenced (through HTML links) with one or many task forms.

The specific data fields included in the tool forms were inspired by Halkier's[171] typology for analysing regional development policies in the knowledge economy. For instance, the tool forms contain data on, among other things, applicability at different governance levels, target type (effect on systemic, firm and/or individual level), financing and known limitations. The entries also contain references to at least one known case where in which the tool has been put to practical use, in many cases also containing a clickable hyperlink to link up to web resources (webpage, on-line report, etc.) describing the tool in question. As mentioned above, the tasks and tools are cross-indexed through HTML hyperlinking, which means that when reading through the tool kit entries, a user can jump from a task to a related tool, and vice versa.

14.3.1 Example of some interrelated task and tool entries in the REKENE policy tool kit

As an example of how the tool kit is structured, we begin by showing one of the task form entries in the tool kit.

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[170] See Appendix 4 for a list of the tools and tasks.

[171] Halkier (2009)

Category: Innovation and knowledge: exploitation and funding
Task 5.3: Support for bridging the gap between users and technology development. Promote and support "soft" innovation and "non-patentable" innovation
A more detailed description of the task or motivation or objective: Creating a connection between technology development/usage development and existing needs can be an important impetus for innovation. The traditional view of innovation often involves technological discoveries, while innovation and knowledge about other parts of the value chain (marketing, design, customer needs and behaviour) have been neglected. These are often not patentable, and the inventor may not even think of it as something that is economically exploitable. To harness knowledge in regional business development, these "soft" types of innovation are essential.
Connection to knowledge dynamics: • Knowledge exploitation • Symbolic and strategic knowledge

As can be seen above, one of the tasks included in the tool kit and deemed important for regional development in the knowledge economy by the REKENE practitioners, is to provide *Support for bridging the gap between users and technology development* and *Promote and support "soft" innovation and "non-patentable" innovation*. The tool kit entry contains a short description of the task at hand, justifying its importance in the context of regional economic development in the knowledge economy. In this case the motivation is that in the knowledge economy, much of the useful and potentially economically valuable knowledge is not patentable, which creates challenges because the established view of useful and new knowledge is that this is secured through patents, and existing innovation systems are built upon this assumption. The tool kit entry also contains a data field that, building on Halkier's typologies, states the aspects through which the task is related to knowledge dynamics.

TOOLS for task 5.3
5.3.1 Technology needs inventories/ Needs based procurement and guidelines for public procurement that do not specify technical solutions, but open for innovative ideas
5.3.2 ICT resource centres: the creation of public ICT resource centres, or the use of public institutions such as libraries as ICT resource centres
5.3.3 Technology brokerage: Meeting points/ brokerage events between technical experts/providers & potential users/public actors
5.3.4 Innovation agents give free advice and guidance in how to use other sources to make an innovation economically viable. These agents see the broader spectrum of innovation, not just technological innovation.
5.3.5 There is a need to rethink the whole idea of "patent" innovation. What is patentable? How do the ideas of intellectual property relate to innovations that are not technical items? There is a need to rethink open source as a concept, as well

The second part of the tool kit entry on *Support for bridging the gap between users and technology development* and *Promote and support "soft" innovation and "non-patentable" innovation* lists the known policy tools currently or previously in use to tackle the aforementioned task. In this case it is suggested that for instance *Innovation agents* (5.3.4) and *rethink the whole idea of 'patent' innovation* (5.3.5) may be partial responses to the task of encouraging non-patentable innovation. If one clicks on a blue-coloured tool name in the task entry, the tool kit entry for this particular policy tool is opened. For example, the blue link to *Innovation agents* leads to the following entry.

Tool 5.3.4 Name	Innovation agents give free advice and guidance in how to use other sources to make an innovation economically viable. These agents see the broader spectrum of innovation, not just technological innovation.
Use in tasks	Task 5.3 Support for bridging the gap between users and technology development. Promote and support "soft" innovation and "not patentable" innovation
Level	Currently national. Potentially local, regional.
Used by	Business agencies in attempts to unleash innovation, potentially also RDAs.
Target OI	The individuals with ideas are a target, but the tool targets support agencies.
Financing	Financed public money for business support.
Limitations	The innovation agents need to have an extensive and intensive knowledge of what might be an innovative innovation that is of use in a business. This type of insight is not that common.
Source	Denmark supplies 20 hours free advice. Has been tested four years.
Other	
References	Innovation Agent Programme at the Danish Agency, for Technology, Science and Innovation. http://www.dti.dk/specialists/23937

In this tool kit entry we can find all sorts of information and data items regarding this specific policy tool. We can see the tasks to which it is connected in the tool kit (which can be multiple) and we can also see what level of governance has been tried, how it was financed and known limitations of this specific type of policy intervention.

Finally, there is a link to a specific example of where this tool has been used, in this case to a programme run by the Danish Board for Technology, Science and Innovation. If the link is clicked, the reader is directed to the board's English language webpage that describes this programme and contains contact information for the staff at the agency engaged in it.

The tool kit is, as previously stated, cross-referenced so that a user can switch from tools to tasks, and vice versa. This means that it is possible to browse through the 'toolbox' of policy tools, and if a user finds a tool that seems interesting, they can view and examine the tasks for which the tool is suggested. A user can also begin in the 'challenge inventory' of the tasks and from there, when they find a task for which they require advice, click on the tools that are suggested for handling it.

14.3.2 Some examples of tools for harnessing knowledge dynamics in regional development

The examples found in the text box below have been chosen among all the possible tools in the tool kit, as they exemplify some of the central issues of the REKENE project. Additionally, they illustrate the valuable contributions of the showcases to the study.

- Knowledge dynamics requires tools that cut across traditional sectoral dimensions and contribute to composite knowledge.
- Knowledge dynamics exist in a multiscalar system, requiring tools that operate at more than one level simultaneously.
- Harnessing knowledge dynamics involves multi-actor endeavours, involving both the public and private sectors.

From a cluster to platform approach

A new type of 'orgware' that facilitates knowledge transfer across sectoral boundaries, at differing geographical scales and involves public and private participants is so called platforms. Until recently, clusters have dominated thinking about regional development. However, deeper understanding of knowledge dynamics reveals that it is no longer the connections among producers, clients and suppliers that are the most relevant. Knowledge exchange, especially across sector boundaries, and composite knowledge all indicate that a broader approach is needed.

REKENE examples include the platform created by *Vækstforum Sjælland* (The Zealand Growth Forum) and the Paper Province supported by Region Värmland. In both cases the new 'orgware' is an organisation that crosses not only sectoral boundaries, but connects users and potential innovators or producers.

The Zealand platform includes specific policy tools to facilitate knowledge transfer.

- A yearly contract between the Forum and the Technical University of Denmark provides funding for dissemination of research results and findings directly to businesses in the region, but with clear requirements for results that are of immediate use to these businesses.
- Frequent "technology brokerage events" (7 in one year), which gather businesses, regional public actors and research institutions to exchange and explore mutual possibilities for new application of technological discoveries.
- Emphasis on user-driven innovation, where businesses use the above to present their problems and needs, to find knowledge sources that can address these needs.

The Värmland example promotes connections between existing industries and new uses for the knowledge bank they represent, organising across sectors and between actors in the public and private sectors. Although the activities have their roots in the pulp and paper cluster, they have expanded far beyond this. Specific tools include:

- The Paper Province Competency centre, which offers courses and education to create a workforce with the necessary competences to serve the various needs of many different businesses in related sectors in the region. Courses created or offered by one, become known and available for many other potential users.
- The project 'From problem to product' allows anyone with a problem to submit it to a central address. From here, it is directed to the Technical University, to other research bodies, or to businesses directly. They, in turn, can use the idea as impetus to create a new product or process.
- Facility sharing, where new knowledge can be applied in multiple contexts. For example, the visual perception laboratory which is used to determine how a customers' eyes react to various sorts of packaging and placement of packages in an environment. This can be used by packaging designers as well as businesses.

14.4 Interesting development potential for the REKENE policy tool kit

As described above, the basic tool kit structure is designed to be multidimensionally searchable, and with a minor effort could be placed in a database structure, for instance Microsoft Access, which would create possibilities to sort and group the tool kit entries in all dimensions, according to all data variables.

The scope of the REKENE budget has unfortunately not permitted the development of the full potential of the tool kit within the confines of the project, but rather provides a basis for further efforts in this area. With a small amount of funding, a simple but attractive graphical user interface could be added that would enable the development of an intuitive and user-friendly web-based application that is easily explorable in multiple dimensions. Such a simple effort would make the tool kit even more useful as a practical heuristic and inspirational tool in the concrete design of policies for increasing regional competitiveness in the knowledge economy.

An even less costly development of the tool kit would be to further develop the existing hypertext structure of the data to develop it into a usable hypertext document. As stated above, the REKENE team has laid the groundwork for such a tool kit, and a presentation of the material in its present form is available as an electronic appendix to this report. In any case, tool kits are highly perishable: that is, the field is changing so rapidly that any composite tool kit needs frequent updating. A further possible solution for the future development of the tool kit would therefore be to ensure that it is adopted by an agency that would publish and update the tool kit as development in the field progresses.

After this very brief introduction to the REKENE policy tool kit, we return to the discussion of policies of relevance to knowledge dynamics in the concluding Chapter 15.

Part IV: Conclusions

In Part IV, we conclude by summarising the main findings of the empirical case studies, the analyses and the work with the policy tools. Each thematic chapter (10–13) includes conclusions from the empirical case studies in relation to the topics discussed there. In this final chapter, we draw the main conclusions from the entire project.

15 Regional trajectories to the knowledge economy—the conclusions

In this project, we have investigated regional trajectories to the knowledge economy in seven Nordic regions. We have explored how knowledge is generated, developed and transferred within and among firms and organisations and their regional contexts. As a spin-off project from the EURODITE project, we had the opportunity to utilise the framework and methods developed within that project and this has allowed us to make some Nordic–European comparisons.[172]

The REKENE project has been innovative and explorative in several ways. In terms of the academic research methods and research design focusing on in-depth qualitative case studies of territorial and firm-level knowledge dynamics, it has been possible to gain a deeper understanding of how knowledge processes and interactions really 'happen'. Which actors are involved? Which types of knowledge are generated, communicated and developed, and where are the various actors located? By using these research methods, we can contribute to the literature on the complexity of knowledge interactions through the new concept of knowledge anchoring. We have seen that the processes by which extraregional knowledge is accessed and recirculated between different actors in a region are multifaceted involving different channels. In the knowledge interactions, tacit and codified knowledge is often combined, with regard to both intraregional and extraregional knowledge interactions. The literature discussing local buzz and global pipelines can be modified and developed through this research. The research also supports the theses of cross-sectoral and non-linear innovation processes. The firm-level knowledge dynamics, using a knowledge biography approach, have provided interesting insights into how cross-sectoral knowledge interactions have provided innovative products and services and how, for example, examination and exploitation phases can take place at the same time through producer–consumer interactions.

Another interesting methodological aspect of the project is that through studying knowledge interactions from both the territorial and firm-level perspectives, it has been possible to provide a different perspective to the generation and development of knowledge. A more common approach takes HEIs as producers and diffusers of knowledge as the point of departure.

Furthermore, the design of the project as a joint research–practitioner project (see Section 1.2.1) provided invaluable cross-sectoral and combinatorial knowledge exchange between researchers and practitioners. The research has been enriched by the discussion with practitioners about the issues under scrutiny and by the show cases the project has visited in each case-study region, where we have been able to engage interactively in testing, analysing and developing our emerging knowledge about knowledge dynamics.

We now conclude by addressing the overarching research question of the project: 'How is knowledge generated, developed and transferred within and among firms or organisations and their regional contexts?' We begin the discussion in this chapter from the basis of the conclusions from the empirical case studies and link these findings with results from the

[172] In these Nordic European comparisons we can, in addition to the seven case studies conducted within the REKENE project, draw from the four Nordic case studies within the EURODITE project; the new media sector in Skåne, the automotive sector in Västra Götaland, the food and drink sector in Bornholm and the tourism sector in north Jutland. (See Appendix 2).

EURODITE project and from the concepts and issues that have been introduced in Chapters 1 and 2. This final chapter is organised according to the following structure. In Section 15.1 we discuss the key findings from the empirical case studies, followed by Section 15.2 where we focus on the Nordic–European comparisons of the findings. In Section 15.3, we move to a more general conceptual discussion and consider the contribution of the results of the project to new knowledge in the field of regional trajectories to the knowledge economy in a wider context. Here we recall the raison-d'être for the project outlined in Chapter 1. Following this, we turn to policy implications of the findings in Section 15.4. Finally, in Section 15.5 we indicate issues that require further research in future projects.

15.1 Knowledge interactions across sectors, scales and actors

To summarise the key findings of the empirical case studies performed in the REKENE project and draw on the EURODITE cases, we conclude that the knowledge interactions in the studied regional trajectories have a cross-sectoral, multiscalar and multi-actor character. These are further elaborated below. Because of the project design of REKENE, where researchers and practitioners have worked interactively, and the practitioners have worked in a focused way on identifying relevant policy tools, we contribute examples of policy tools that relate to these major characteristics of knowledge interactions. We also conclude that the newly developed concept of 'knowledge anchoring' is useful for analysing the important aspects of knowledge dynamics that relate to the inflow and recirculation of knowledge in regions.

Knowledge interactions are characterised by the following.

- *A cross-sectoral dimension*. The case studies confirm that cross-sectoral knowledge interactions are innovative and drive product development. We have seen specific examples of composite knowledge processes, meaning that the development of a specific product, a good or service, is dependent upon several disciplines or functional areas of knowledge. The composite knowledge processes can be seen in both high- and low-tech sectors. An example from a high-tech sector is the development of the 'medtech' sector in the Stockholm region connecting ICT and medical knowledge. In the more traditional sector of food and drink, we see how knowledge of brewing is combined with knowledge of marketing or branding a tourist attraction in the development of a microbrewery to become part of the experience economy. There are many tools that address the need for *cross-sectoral, composite knowledge*. One example is the establishment of regional development platforms (see Section 14.3.2) that create links among various businesses and research institutions and consciously cut across traditional sector boundaries. A less obvious example is the cross-sectoral practice in schools that forces interaction and communication both between sectors and between sectoral educations. Special arenas, both physical and virtual, provide linkage and communication across sectors within a locality.
- *A multiscalar character*. In the case studies, it is evident that a region is not a closed container. On the contrary, knowledge interactions are multiscalar. All cases of territorial and firm-level knowledge dynamics in the REKENE project include highly relevant extraregional knowledge interactions. This was also the case in the territorial knowledge dynamics and most firm-level knowledge dynamics in EURODITE. Many of the case studies are characterised by active searches for these extraregional knowledge interactions. This indicates that even actors who are firmly connected to other local and regional actors utilise extraregional knowledge when needed. The search for extraregional knowledge, and development of multiscalar knowledge interactions are present in all types of regions studied. In the REKENE case studies, it

seems that the search for the necessary knowledge is more intense in the more sparsely populated areas such as Åland and Värmland, compared with the metropolitan region of Stockholm where the regional supply of a variety of knowledge is greater. Multiscalar interactions are actively supported by some policy instruments, ranging from the cluster organisations to support for organisations or participation in various events. However, in general multiscalar endeavours remain a challenge. Indeed, the REKENE tool kit includes national funding schemes that are applied at the regional or local level, and there are many policy tools that address the local and regional levels simultaneously. However, actors or endeavours that truly operate at all levels simultaneously are still to be established. From this, it can be seen that the spatial characteristics of knowledge dynamics are not yet perceived in an instrumental way.

- *A 'multi-actor' character*. We conclude that knowledge interactions include many types of actors, both private and public, conducting a variety of functions in the knowledge interactions. Perhaps unsurprisingly in the Nordic countries, we see that public actors, stretching from the national to the local level, play a role in the generation, development and transfer of knowledge. There has been an expansion and diffusion of HEIs in the Nordic countries over the past 20 years. The important roles these institutions play can also be observed in the case studies. HEIs are also important actors in most of the EURODITE cases. These institutions play an indirect role by providing education for the future work force, and a direct role in research and knowledge interactions with firms and other public agencies. The activities performed by various actors also support the conclusion of cross-sectoral knowledge interactions. As discussed in Chapter 10, interactions between firms, for example through knowledge intensive business services, and networks between firms, public agencies and HEIs, are important aspects of knowledge anchoring. In the REKENE case studies, and in some of the EURODITE case studies, we have seen that small and micro-businesses can play an active driving role in knowledge dynamics. Multi-actor, public–private endeavours and triple helix approaches have also become mainstream policies in many places. Examples of these include innovation platforms (see Section 14.3.2), industrial PhDs, science parks and incubators, knowledge brokering activities and user-driven problem solving.

In our studies of regional trajectories to the knowledge economy, we have gained detailed knowledge about knowledge interactions between different actors in various locations. This has made it possible to contribute to the understanding of the processes by which extraregional knowledge is combined with knowledge generated within a region, and also how the extraregional knowledge, in addition to region-internal knowledge, is recirculated among actors within the region. Through analysing the EURODITE case studies, the concept of knowledge anchoring and channels by which knowledge anchoring occurs was developed as discussed in Chapter 10. The detailed empirical case studies facilitated the identification of the concrete mechanisms and processes by which extraregional knowledge is accessed and recirculated.

The concept and framework of knowledge anchoring was also utilised in the analysis of the REKENE case studies, and combining these two studies some important meta conclusions should be highlighted. It can be argued that all the three characteristics of knowledge interactions discussed above—cross-sectoral, multi-actor and multiscalar—come together in the analysis of knowledge anchoring.

We can see how knowledge interactions, developments and innovations of goods and services are results of multiscalar knowledge interactions that include a mixture of local/regional and extraregional knowledge interactions among many types of actors on a variety of geographical scales. We make no distinction of endogenous and exogenous processes as two separate entities. Instead, the research indicates that endogenous and exogenous knowledge processes are interrelated in a complex manner. Knowledge interactions and actors involved in knowledge dynamics are simultaneously inside and outside. Knowledge

dynamics consists of open networks including both private and public actors from different sectors and specialist fields, of both genders, providing opportunities for developing new knowledge and innovations.

15.2 Nordic–European comparisons

An intention of the REKENE project was to compare the processes of knowledge dynamics studied in the Nordic regions from a wider European perspective. On the basis of the empirical studies, we can recognise that there are similarities and differences among the Nordic case studies, and also when comparing the Nordic case studies to wider European case studies. Here we highlight some of the key findings at an aggregate level.

The importance of the national level
The national level is strong in the Nordic countries, and this emerges in many international comparisons, for example in relation to welfare state models. We therefore expect to see a strong presence of the national level in the regional trajectories to the knowledge economies in our countries. This also became visible in the case studies focusing on identifying key actors in knowledge dynamics, and in policy initiatives and programmes supporting regional development. In the Nordic case studies it was confirmed that actors at the national level are important players both in terms of more direct involvement in the territorial knowledge dynamics, for example through the active roles of HEIs and innovation programmes funded by national agencies such as the Finnish Funding Agency for Technology and innovation (TEKES) in the Finnish case, and indirectly as providers of education for the future work force. However, it is also clear that the national level is important in most European case studies too.[173]

Strong local level in the Nordic countries
The REKENE research and the four Nordic EURODITE case studies reveal that the local government level is important for the knowledge dynamics in these countries. Municipalities are actively involved in supporting knowledge interactions. A reason for this is that the municipal level of government may work with issues relating to economic development at the local level. Many municipalities are active in local economic development work, for example through involvement in science parks and in relation to attracting firms and a well-educated work force. We can see a difference between the Nordic and most European cases. The municipal level does not hold such a strong position in relation to economic development in most countries outside the Nordic countries, and therefore has not explicitly come across as important in the knowledge dynamics.

The emerging importance of the regional level
The regional level has gained importance with regard to regional development and the knowledge economy both in the Nordic countries and in the rest of Europe. In the Nordic countries the regional level has increased its importance for regional development significantly, a fairly recent change that is still not settled. The Nordic trend is in line with that of most European regions where the regional level has gained a stronger role in regional development and growth strategies. As discussed in Chapter 13, several processes lie behind this shift towards a greater role for regions, which can be labelled Europeanisation of policies for regional development.

[173] Halkier *et al.* (2010), s. 34.

An emerging trend? Provincial big cities and global villages

In comparison with a majority of regions, particularly in western and central Europe, most Nordic regions have considerably smaller populations, and apart from Denmark, struggle with fairly large distances between major urban settlements and have large sparsely populated areas.[174] The Nordic–European comparisons have shown an interesting similarity between knowledge dynamics in well-connected populous regions and less accessible, more remote regions with small populations in the Nordic countries. We have seen that the small size and remoteness of some of the REKENE case studies provide no barrier to multiscalar territorial and firm-level knowledge dynamics. This is in line with the increased recognition that few firms are able to create or source all of the knowledge required to produce goods and services within their 'home' regions.[175] The interesting contribution from REKENE is that our case studies show that the strategy of reaching out for extraregional knowledge sources is utilised in these smaller and more peripheral regions. In fact, in the only metropolitan case study in REKENE, that of the medtech knowledge dynamics in the Stockholm region, it is clear that a greater amount of intraregional knowledge interactions is possible because of the critical mass of actors and knowledge in that region. Extraregional knowledge interactions are still evident in this case, but with our heading 'provincial big cities and metropolitan villages' we have sought to draw attention to the perhaps somewhat unexpected situation of the extra regional knowledge interactions of the smaller and more remote regions. The compositions of case studies in REKENE and EURODITE, with insufficient case studies of more remote and less populous regions across Europe and metropolitan regions within the Nordic countries, does not allow more than tentative conclusions at this stage. These signs of 'provincial big cities and metropolitan villages' would need further research to draw more certain conclusions.

15.3 Changing regional trajectories to the knowledge economy

In this section, we recall the starting point of the REKENE and EURODITE projects as discussed in Chapter 1. An important starting point was the Lisbon Agenda, stating that 'Europe should become the most competitive and dynamic knowledge-based economy in the world'.[176] In the Lisbon Agenda, the path to this goal is by preparing the transition to a knowledge-based economy and society through better policies for the information society, R&D and also structural reforms to promote competitiveness and innovation.[177] REKENE and EURODITE aimed to contribute to this objective by performing detailed research on knowledge dynamics, delivering scientific knowledge and input to policymaking in the field. By the end of the projects, the Lisbon Agenda had been replaced by the new Europe 2020 strategy. This, in turn, states that smart growth in the development of an economy based on knowledge and innovation is of high priority to the EU because it is seen as a driver of future economic growth.[178]

As discussed above, the REKENE and EURODITE projects have contributed with new knowledge and insights into how knowledge dynamics actually take place, and what role regional and extraregional actors and interactions play in these processes. Furthermore, the projects have contributed more knowledge about policy strategies and instruments on various scales that are already in place to promote and stimulate knowledge interactions.

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[174] Damsgaard *et al.* (2008).

[175] James *et al.* (2010a)

[176] The Lisbon European Council 23 and 24 March 2000.

[177] The Lisbon European Council 23 and 24 March 2000.

[178] European Commission (2010) p. 9.

As indicated in Chapter 1, regional trajectories to the knowledge economy can be seen as paths or roads towards a knowledge-based economy that regions take. These paths are developed and changed over time through a number of different processes, such as investments made by firms and public bodies, changes in the global economy and to some extent by political decisions and choices regarding priorities and programmes. The multitude of interrelated knowledge interactions that exist in any region form parts of these paths or trajectories. As discussed in Section 2.2.1, the concept of path dependency indicates that the economic geography heritage of a region sets a framework for the actions taken today leading to future developments. Path dependency can be utilised in a positive manner to develop strategies where existing regional strengths are harnessed for regional development. However, there is a risk of lock-in if key actors fail to observe the risks of clinging to the traditional strengths at the expense of being open to new opportunities that can change the direction of the path through combining traditional strengths and capabilities with something new.

The REKENE case studies provide examples of how the risk of lock-ins in relation to path dependency has been avoided. In the case studies we have seen how actors utilise established strengths of the regions in a flexible and innovative way by combining these in a cross-sectoral manner. New knowledge and new products are developed, utilising a combination of cumulative knowledge in these regional strengths with composite knowledge through combining with knowledge in different fields and areas of expertise. In Värmland and Oulu South, for example, traditional strengths within the paper and pulp and machinery industries are combined with ICT knowledge to develop new knowledge and products.

We can also conclude that the perception of knowledge has so far been very strongly related to knowledge connected with the development of high-tech sectors such as biotechnology and ICT.[179] However, the approach and empirical findings of the EURODITE and REKENE projects reveals that different types of knowledge and skills are of importance for the development of a product, both goods and services. In policy terms in relation to the knowledge economy agenda, there has been a strong focus on analytical and synthetic knowledge. In policy practice this has implied an emphasis on the role of HEIs and high-tech sectors such as ICT and biotechnology, and infrastructure such as incubators and science parks, often under the heading of 'triple helix'.

By applying a gender perspective in the empirical case studies, it has also been revealed that the existing perception of knowledge has implied that women have been rather absent in sectors that have been considered important in the knowledge economy. This absence may be related to the rather gender-segregated education system and labour market in Nordic and other European countries, in terms of both sectors and positions.[180]

The findings of the EURODITE and REKENE projects show that knowledge dynamics, and thereby the knowledge economy, include important elements of other knowledge types than synthetic and analytical knowledge, namely symbolic knowledge. It is also acknowledged that the inter-connectedness among knowledge types, such as synthetic, analytical, symbolic, codified and tacit knowledge, and cumulative and composite knowledge processes, are important elements in the development of a specific product.

Thus, through our studies we can illustrate and further refine our understanding of path-dependencies and regional trajectories; and how different types of knowledge contribute to knowledge dynamics.

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[179] Halkier *et al.* (2010). p. 11.

[180] Högskoleverket (2008)

15.4 Policy considerations of the project

In the project we have generated knowledge about the characteristics of knowledge dynamics, and policies to support regional development in the knowledge economy. Furthermore, the work with policy tools and the interactive researcher–practitioner work in the project have provided additional knowledge in relation to policy considerations. Questions that we ask based on these findings include: How can policy actors assist the cross-sectoral, multiscalar nature of, and the multiplicity of actors involved in, knowledge dynamics and interactions? To what degree is management of such processes desirable and possible? In this section we briefly review policy considerations based on the project.

Examples of progressive ways of conducting policy have been presented in the case studies in the EURODITE and REKENE projects and also in the development of the REKENE policy tool kit. For instance, we have seen policy support in terms of brokering, funding and sometimes the management of platforms, clusters and network organisations. However, what is the way forward? Can platform organisations continue to move further towards cross-sectoral, perhaps cross-cluster initiatives? How can the trend towards increasing multiscalar knowledge interactions be further supported by policy initiatives? How can multi-actor interactions evolve further from various aspects of the triple helix thinking to those including users, consumers and civil society?

The REKENE and EURODITE projects have delivered findings that may be considered when policies aiming at knowledge dynamics supporting regional development are to be elaborated. The results provide insights in relation to the role of the regional level, because of its relation to such factors as economic development, focus on proximity, clusters and regional innovation systems (see Section 2.2). In relation to policymaking—this links to the paradigm shift from the old to the new regional development policy that is discussed in Section 13.1. These new policies focus on competitiveness, innovation and entrepreneurship and include policies to support regional growth in all types of regions.

Below are some themes that appear highly relevant to the development of policies ranging from strategies to more direct measures.

Perception of knowledge and knowledge types

From the findings, we can see that symbolic knowledge may have been underestimated in the knowledge economy and innovation discourses. So far, many of the policy instruments have focused on research, scientific knowledge and engineering, and consequently on analytical and synthetic knowledge. In the REKENE and EURODITE case studies, we can see that symbolic knowledge is important not only in sectors that are high in symbolic knowledge in the first place, such as new media, but also, for example, in cases related to ICT and food and drink. A broader perception and application of the knowledge concepts may also imply that sectors that at the moment are dominated by women may become visible in discussions of a knowledge-based economy. A broader perception of knowledge may also imply a broader definition of innovation, including innovative ways of selling or marketing, or new industrial design. (See also Section 2.2.)

The dynamics of knowledge dynamics

By studying knowledge dynamics we can conclude that the development, generation and transfer of knowledge are processes that are constantly changing in terms of interactions and combinations of knowledge fields. In a region, several knowledge dynamics prevail at the same time involving different sectors, businesses and other actors. The constant change of knowledge dynamics indicates that it is important to keep networks open, in terms of actors, geography and the issues at stake. This may also suggest that the 'triple helix' approach, comprising the notion that it is important to unite actors from the public, higher education and business sectors to develop an innovation system needs to be further elaborated. Already we

see that the term 'quadruple helix' has emerged, referring to the inclusion of civil society, including NGOs, in collaborations. An example has been seen in the shape of the Living Labs activities in the EURODITE case study of new media in Skåne, and the REKENE case study focusing on the NMM in Östergötland. For policymaking, continuous efforts to provide opportunities for brokering, such as funding of platforms and networks where different actors can meet and interact will also be important in the future.

Supporting knowledge dynamics—'one size does not fit all'
On the basis of the empirical findings, we can conclude that knowledge dynamics and interactions are very complex, constantly changing, and context-dependent. With regard to policy, we would consequently like to highlight that 'one size does not fit all' is a relevant statement when it comes to supporting knowledge dynamics. Instead, strategies and policy measures may need to be adapted to the specific situation at hand. However, the fact that working with knowledge dynamics at a regional level is a fairly recent and evolving policy field provides a golden opportunity for politicians and practitioners to show courage. Because there is no long and strong tradition of working with regional development in this manner, there is limited risk of being locked into traditional thinking such as 'this is how we have always done it'. There is potential for a more open relation to building on the regional strengths by combining with new sectors, knowledge types and geographies.

15.5 Future research and project issues

In this final section, we wish to indicate some issues that may be of relevance for further research and projects in relation to a greater understanding of knowledge dynamics.

Consumer–producer interaction and user-driven innovation
In the empirical case studies it has been shown that the exploration, examination and exploitation phases can take place at the same time. This confirms that innovation processes are not linear and should not be seen strictly as a value chain. We have also seen a development towards an increased interaction between the consumers and producers, for instance in the case of the visitors to the Holbaek brewery. This type of consumer–producer interaction brings knowledge about market demands and contributes to product development. In the innovation discourse, such interaction echoes the concept of user-driven innovation. What role does this interaction play in the development of products?

Exploration of knowledge types
The intention of EURODITE and REKENE was to provide increased knowledge about the different knowledge types (analytical, synthetic and symbolic knowledge), within the knowledge dynamics studied. However, the projects have revealed methodological difficulties with studying these knowledge types. They are difficult to define clearly, and many knowledge interactions involve several knowledge types simultaneously. Therefore, it has not been possible to make systematic comparisons and conclusions to the extent intended. The indications that symbolic knowledge and mixed knowledge interactions are of greater importance than generally recognised leads us to suggest that further research into knowledge types is required. We argue that it would be valuable to achieve further knowledge regarding the relation between knowledge types and knowledge anchoring. What are the connections between channels and knowledge types?

Policy tools—knowledge dynamics within the policy field
As stressed above regarding policy implications, the findings of the EURODITE and REKENE projects clearly indicate that, indeed, 'one size does not fit all' for policies that aim

to support regional development in the knowledge economy. By studying relevant policies in this field and by working with the policy tools we have revealed that there is a knowledge dynamic in the field of policies. Practitioners and policymakers need to be involved in knowledge interactions about policies. On the basis of the empirical findings, more policy initiatives may be developed to encourage multiscalar interaction.

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Rasmanis, Gundars, MD, Chief physician, Department of Cardiology, Karolinska University Hospital Huddinge, Karolinska Institute, Stockholm, Sweden, interviewed: September 22, 2008 in Stockholm.

Appendix 1 List of abbreviations

AB	Aktiebolag – Ltd
C-BIC	Compare Business Innovation Centre
CTF	Service Research Centre
CTMH	Centre for Technology in Medicine and Health
HEI	Higher education institution
ICT	Information and communication technologies
ÍSOR	Iceland Geosurvey
KIBS	Knowledge-intensive business services
KTH	Royal Institute of Technology
NGO	Non-governmental organization
NMM	New Media Meeting
NOSP	Norrköping Science Park
STING	Stockholm Innovation and Growth
Tii	The Interactive Institute
R&D	Research and development
RES	School for Renewable Energy Science
TPA	The Packaging Arena
TPP	The Paper Province
UNGTP	United Nations University Geothermal Training Programme
VINNOVA	Swedish Governmental Agency for Innovation Systems
ÅTC	Åland Technology Centre

Appendix 2 EURODITE territorial knowledge dynamics case studies[181]

Case study region	Primary sector(s)	Authors
Antalya, Turkey	Tourism	Ali Dulupçu, M., Sezgin, A., Demirel, O., Cevher, E., Gökhan, O., Sungur, O., Çiftlikli, B. & Göçen, S.
Aquitaine, France	Photonics & Food and Drink	Carrincazeaux, C., Gaschet, F. & Becue, M.
Baden-Würtemberg, Germany	KIBS/Automotive	Strambach, S., Stockhorst, J. & Sandmüller, M.
Bavaria, Germany	Biotechnology & New Media	Kaiser, R., Liecke, M. & Kripp, M.
Bornholm, Denmark	Food and Drink	Manniche, J., Topsø Larsen, K. & Petersen, T.
Bratislava, Slovakia	ICT	Pastor, R., Rehak, S. & Suranova, J.
Centro, Portugal	Biotechnology	Vale, M., Carvalho, L. & Silva, S.
North Jutland, Denmark	Tourism	Halkier, H. & Berg Schmidt, P.
North Rhine Westphalia, Germany	Tourism	Butzin, A. & Widmaier, B.
North-west Switzerland, Switzerland	New Media/Tourism	Jeannerat, H., Kebir, L. & Crevoisier, O.
Skåne, Sweden	New Media/Tourism	Dahlström, M., Östberg, S., Dymén, C., Hedin, S., Henriksson, S. & Smed Olsen, L.
Slovenia	ICT	Stanovnik, P. & Murovec, N.
South-east Lower Saxony, Germany	Automotive	Blöcker, A. & Jürgens, U.
Västra Götaland, Sweden	Automotive	Larsson, A.
Venice, Italy	Nanotechnology	Finotto, V.
Wageningen, the Netherlands	Biotechnology	Vissers, G.
West Midlands, the United Kingdom	Automotive & New Media	MacNeill, S., James, L., Collinge, C. & Staines, A.

[181] Not all 22 case studies were used in the analysis.

Appendix 3 REKENE case studies

Primary sector	*Secondary sector (if appropriate)*	*Regional case study*	*Title of territorial knowledge dynamics report*	*Title of firm-level knowledge dynamics report*	*Author(s)*	*Email*
KIBS		Akureyri, Iceland	Geothermal harnessing for electricity production in Iceland and the Akureyri region, N-Iceland	Development of geothermal drilling technology for electricity production. The case of Iceland drilling	Hjalti Jóhannesson	hjalti@unak.is
KIBS	ICT & New Media	Åland, Finland	A small island region riding the waves in computer and technical services	Crossbreeding entertainment at sea and the digital gaming world—the case of licensed gaming operators	Katarina Fellman	katarina.fellman@asub.ax
New Media		East Sweden, Sweden	New media, east Sweden	New media meeting	Josefina Syssner	josefina.syssner@isv.liu.se
ICT		Oulu South, Finland	Creating ICT-based innovation in traditional machinery	PC-free control system of forest harvester with remote control possibilities	Harri Jokela Eija-Riitta Niinikoski Ari Saine	harri.jokela@oulu.fi eija-riitta.niinikoski@oulu.fi
ICT		Värmland, Sweden	ICT in SERVItech: the case of Värmland	Serving food in 21st century—from restaurants to the kitchens: the case of Matglädje	Samuel Petros Sebhatu	samuel.sebhatu@kau.se
KIBS	ICT	Stockholm, Sweden	ICT in KIBS—Composite knowledge for development of medtech	Intersection and knowledge dynamics of medtech and KIBS—the case of Zenicor ECG	Lukas Smas Brita Hermelin	lukas.smas@humangeo.su.se brita.hermelin@humangeo.su.se
Food and Drink		Zealand, Denmark	From standardized mass production to experience economy and new micromode of production	Small producers—local based	Lene Ekholm Petersen Henrik Toft Jensen	ekholm@ruc.dk htj@ruc.dk

Appendix 4 REKENE policy tool kit: tasks and tools

Appendix 4 is a summary of the content of the REKENE policy tool kit. Please see Section 14.3 for more information about the structure of the REKENE tool kit. The tool kit is a work in progress, but this summary reflects the contents at present. In addition to this report, a more detailed description of the tools and task will be published in an electronic Appendix.

Category 0: Making regions attractive—precondition for knowledge dynamics

Tools for this purpose may be:

- Planning for broad spectrum quality of life for whole families, whole society planning
- Place-branding, achievement of critical mass in economic activity
- Connectedness, amenities, culture
- Good transportation infrastructure and good public transport

Category 1: Public support systems and support of small and medium-sized businesses

Task 1.1 Put practical knowledge of bureaucracy into the hands of SMBs to encourage trust in public support and address the desire for secrecy. Tools for this task include:

- Municipal business agents or pathfinders
- Business incubators organised as part of the local society
- A system of financial support for consultancy
- Small business development boards
- Good confidentiality agreements
- Success stories
- Public agencies as users or the market for new endeavours

Task 1.2 Help small and medium sized enterprises use others' knowledge, also cross-sectoral knowledge, from big to small businesses—Raise the level of knowledge and innovation capacity in SMEs. Tools for this task include:

- Knowledge platforms
- Mentors or coaching
- Small pro-business interventions
- Made-to-order courses
- The creation of hubs, networks, and microclusters
- Members of boards of directors from different sectors
- Arenas/places/rooms/facilities for SMBs to meet with researchers and each other

Task 1.3 Provide business support for small companies with new ideas and unlock innovations or knowledge held by large companies. Tools for this task include:

- Pilots, representatives who inform and educate business support institutions
- Courses and gateways, one-stop offices
- Growth houses
- Idea councils
- Reward systems

Task 1.4 Enable synergetic alliances of large and small companies (across distance). Tools for this task include:

- Innovation platforms
- Cluster initiatives
- Large companies supporting spin-offs
- Road shows, ambulatory business fairs

Task 1.5 Marketing initiatives. Tools for this task include:

- Pre-incubators, start-up financing

- Cultural guides
- Mapping exercise showing who is well connected in which country
- Support to enable new businesses to be seen in the 'right' places

Category 2: Linking research, higher education and business and promoting knowledge transfer among them

Task 2.1 Transfer knowledge from higher education to businesses. Tools for this task include:

- University employees with their own companies
- Selling of knowledge to private businesses
- Innovation initiators
- Tailor-made educational offerings
- Applied research requests
- Science parks, university incubators
- Opportunity to have different functions/jobs simultaneously

Task 2.2 Transfer knowledge from businesses to education. Tools for this task include:

- Industrial doctorate students
- Open university incubators
- Knowledge pilots

Task 2.3 Encourage co-production of knowledge: research and businesses. Tools for this task include:

- Innovation consortia
- Support of clusters
- Regional research strategies
- Regional growth agreements
- Business co-operation with academic merit
- Building of research infrastructure at HEIs

Task 2.4 Encourage entrepreneurial skills and culture. Tools for this task include:

- Mandatory entrepreneurship education
- Entrepreneurship contests, science fairs and interactive museums
- General programmes for the promotion of entrepreneurship

Category 3: Education and development of human capital: competence development

Task 3.1 Make education sensitive to the needs of businesses and secure a well-educated 'suitable' workforce. Tools for this task include:

- Students involved in real cases relevant to local business
- Internship/practicum placements and revitalisation of apprenticeships
- Low-threshold re-education for adults
- Advisory boards at universities with representatives from business

Task 3.2 Encourage youth and both women and men to be interested in science and technology education—gender initiatives. Tools for this task include:

- Female-only classes in science/technology
- Dissolve gender cultures
- Planning and time management
- Industry outreach programmes

Task 3.3 Develop or attract better or new users with competence in or to a region. Finding future knowledge/skill needs in the present. Tools for this task include:

- Foresight exercises or quality scenario building

- Competency development counselling
- Validation programmes of practical and foreign competences
- Agency to match competence in and across sectors
- Agency to track global developments and trends
- Business schools or courses for small businesses

Category 4: Networking
Task 4.1 Forge connections among people with necessary skills and inspiration, promoting value-adding person-to-person contacts. Tools for this task include:

- Meeting places/communities
- Matchmaking events
- Creation of connections, networks
- Network for women entrepreneurs
- Trust-building broker activities

Task 4.2 Encourage communication and understanding among different sectors/fields. Translation of information—building trust, bridging sectors. Tools for this task include:

- Good arenas for cross-sectoral projects
- Practice scenarios for students in cross-sectoral projects
- Funding for development projects earmarked for cross-sectoral activity

Category 5: Innovation and knowledge: exploitation and funding
Task 5.1 Attract public funding for research and development and create access to risk capital in general. Tools for this task include:

- Regional professorship consortia
- Targeted support of cross-sectoral research and design
- Flexible seed money tools
- 50/50 public co-funding
- E-risk capital
- Local risk funds for start-up capital
- Active business coaching
- Early phase seed money
- Capital access funnel

Task 5.2 Open up access to innovation to new stakeholders and harness grass-root competencies 'from basement to factory'. Tools for this task include:

- Commercialising passionate project
- Open house for innovative or underdeveloped ideas
- Support user-involvement in innovation
- Innovation house calls
- Tracking and mapping grassroots activities

Task 5.3 Generate support to bridge the gap between users and technology development. Promote and support 'soft' innovation and 'non-patentable' innovation. Tools for this task include:

- Technology needs inventories/needs-based procurement
- ICT resource centres
- Technology brokerage
- Innovation agents

norden

Nordic Innovation Centre

Nordic Innovation Centre

Nordic Innovation Centre (NICe) is an institution under the Nordic Council of Ministers facilitating sustainable growth in the Nordic economies.

Our mission is to stimulate innovation, remove barriers and build relations through Nordic cooperation. We encourage innovation in all sectors, build transnational relationships, and contribute to a borderless Nordic business region.

We work with private and public stakeholders to create and coordinate initiatives which help Nordic businesses become more innovative and competitive.

Nordic Innovation Centre is located in Oslo, but has projects and partners in all the Nordic countries.

For more information: www.nordicinnovation.net

Cover image: The Shaidon Effect & Dom Dugliga at the festival New Media Meeting. Photo: Johan Furuholm.

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