

Higher education institutions as drivers of
regional development in the
Nordic countries

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Preface

This study is the result of the project “Regional universities and university colleges, their regional impact on innovation, attractiveness and economic performance” commissioned by the Nordic Senior Officials’ Committee for Regional Policy, the Nordic Council of Ministers.

The study is prepared as an input to the conference “Regional universities and university colleges as drivers for local and regional development in the Nordic countries” organised by the Nordic Senior Officials’ Committee for Regional Policy of the Nordic Council of Ministers, the Ministry of Industry, Energy and Tourism and the Regional Institute of Iceland in cooperation with Nordregio in connection with the Icelandic Presidency 2009 for the Nordic Council of Ministers. Key questions for the conference are: If universities and university colleges are to serve as regional drivers, what pre-conditions must be met? What is the future of regional universities and university colleges concerning function and organisation?

The main target groups of the study are representatives of higher education institutions, policy-makers and practitioners working with regional development on the national, regional and local level in the Nordic countries and the research community.

The following persons have significantly contributed to the content of this working paper:

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Johanna Roto and Jose Sterling, Nordregio, worked on the maps presented in the report.

In addition to this working paper there is also an electronic working paper including more extensive descriptions of the case studies undertaken in the context of this project. This report can be down loaded from www.nordregio.se

Executive summary

The overarching question explored in this study is how universities and university colleges can work as instruments of regional development. Higher education institutions have been allotted an important role in the development of the knowledge-based economy, which is an important objective of the EUs Lisbon strategy. This role implies both the provision of education and the conduction of research. Higher education institutions have also been assigned a third task in all Nordic countries implying cooperation with the surrounding society.

This evolving definition of higher education makes comparisons over time and across Nordic countries difficult. In a mapping exercise displaying the development of higher education institutions over the last 100 years a clear development towards regionalisation, implying the geographical diffusion of higher education institutions, can be seen particularly from the 1960s onwards in all Nordic countries. The concentration of higher education institutions and students however remain predominantly in the metropolitan areas. The share of the population (above 25 y-o age) with a tertiary education and the R&D intensity are also higher in the metropolitan areas and where a higher education institution has been present since before 1960s.

The direct effects a university may have on regional development and the surrounding business environment are hard to prove by quantitative means alone. Instead, this aspect is displayed by illustrating how universities work as instruments of regional development through specific initiatives, through education, research and cooperation with the surrounding society. The case studies cover Aalborg University in Denmark, Oulu Southern Institute in Finland, the School for Renewable Energy Science (RES) in Akureyri, Iceland, the University of Agder in Norway and Dalarna and Jönköping Universities in Sweden. The case studies illustrate how these universities participate in specific initiatives aiming to develop the regional knowledge-based economy. In the context of the case studies three approaches to knowledge sharing between a higher education institution and the business community (Reglab 2006) are highlighted: education and lifelong learning, business formation and entrepreneurship activities, and research and development collaboration.

Most of the higher education institutions covered in the case studies were established during the expansion era for higher education from the early 1960s, with the exception of the RES in Iceland which has only recently opened. The specific initiative covered is, moreover, often based on previous cooperation. The focus of the collaboration projects is, primarily, on technology

development and small and medium-sized enterprises. Most of the collaboration projects are also based on some kind of triple helix approach, implying the bringing together of private and public actors with higher education institutions. Furthermore, the importance of networks, stretching from the local and regional to the national and international level is further illustrated. Public actors remain important financiers of such collaboration projects though most initiatives demand matched funding. The financing situation also helps to connect these initiatives to the every day politics of regional development strategies.

Good practices

From the case studies it can be concluded that higher education institutions have a role to play concerning regional development. By *offering education* to the workforce that matches the needs of both private and public employers in the region their regional impact may be enhanced. However, this offering must be dynamic since needs are constantly changing. Other such examples include *project or problem based learning and student outplacement* as a part of the education, and offers of *entrepreneurship programmes and up skilling and life-long learning* modules.

Secondly, higher education institution can provide the public and private sector in the region with research which contributes to the development of a knowledge-based economy by emphasizing *applied and need/user driven research*. This is however a two-way process where private companies and public sector institutions have to approach the university in order to highlight those problems they need help in solving. In this process a higher education institute may also work as a broker for other domestic and foreign higher education institutions which may have the required competence. In respect of research approaches additional good practices include: inclusion of regional aspects relating to the higher education institutions' particular areas of competence and strength in the research strategies of the university colleges, establishment of *facilities*, as laboratories, connected to companies in the region for research projects and employment of *industrial PhDs*.

Finally, higher education institutions can be used to promote *entrepreneurship*, by offering entrepreneurship programmes and establishing *science parks*, including incubators etc., where new companies can be developed. Science parks are a useful tool as regards education, research and collaboration with the surrounding society. A broad partnership contributes to the task of connecting the university with the regional business environment and thus more effectively rooting the university in the regional context. In addition, the outplacement of students in smaller and medium-sized enterprises may either see

students recognising these firms as potential future employers or help to encourage them to start up their own businesses.

In respect of cooperation with the surrounding society the following good practices can be further highlighted:

- *Regional representation*, private and public, on the board of the higher education institution.
- A higher education institution may function as a platform for building networks which can be used for branding the region and making the region more attractive to external investors.
- A *facilitator or a “hub”* enables cooperation between companies, public actors and higher education institutions and works as a knowledge broker uniting the different “worlds” of higher education institutions and private companies. Having process leaders who divide their time between the project and companies, research institutes, and public actors is one way of enhancing interaction.

Knowledge gaps

The enhanced role gained for distance education over the last decade should be further investigated to discern what potential impact this has on regional development and the development of a knowledge-based economy. It does of course provide greater possibilities for life-long learning, but making education “place-independent” may also influence the effects a higher education institution has on the regional surrounding. In addition, the potential effects of current consolidation processes among higher education institutions towards a two-tier system, Master’s and PhD level institutions versus institutions that merely provide programmes at the undergraduate level, due to the Bologna process and its connection with regional development should be further elaborated.

As regards the issue of research, more knowledge is needed on how to develop collaboration with the regional surrounding that goes beyond the traditional focus on technology development with a move towards social, service and organisational development in the private and public sector now needed. In the Nordic countries, graduates of higher education institutions also make up a significant portion of all employees in the public sector. As such then the potential for higher education institutions to develop knowledge-intensive private and public social services is an interesting issue in need of further exploration.

Finally, the challenge remains to measure the direct effects universities have on regional development and the causal relation between the two. More knowledge is needed here so that the establishment of universities does not

simply end up being a “symbolic” policy in the promotion of regional development. Here a better understanding is needed of the organisation of different knowledge fields within the higher education institution and the expenses incurred within the institution which may have an effect on the regional development of the area concerned.

Policy implications

In the regions a jointly developed *strategy* should be considered in respect of how universities should best contribute to regional development through the creation of networks of universities, private companies and regional and local authorities with a view to creating a framework for single cooperation projects, as seen in the case studies reproduced in the context of this report. Here regionally-based public actors can provide strategic development and including the development of the higher education institutions in regional strategies and linking business life development with education and R&D. The role of public actors is also to facilitate these interactions by providing appropriate arenas and funding. However, the interactions between universities, companies and public actors constitute complex systems which are often difficult to steer since they involves actors at different levels (local, regional, national and international) with differing main tasks and objectives. This calls for a definition of clear objectives in respect of the initiatives in order to harmonise the interests of the various stakeholders.

The development of social capital is essential here. Fireballs and visionary individuals from different sectors, i.e. companies, higher education institutions, and public actors, play an important role in developing collaborative ventures and networks. Here one of the main challenges is to go from being dependent on individuals to the establishment, management and embedding of systematic links into networks. The development of flexible and dynamic organisations and networks should be encouraged here and while they should, not become pre-defined and static they should, nevertheless, be robust enough to take the time that is needed to react to new challenges.

At different policy-making levels some general issues also need to be considered in order to more effectively use higher education institutions as instruments of regional development:

- Firstly, a *definition of what the cooperation task with the surrounding society* is needed. Education and research policies and regional development policy are often managed by different ministries. If the *regional* dimension of higher education is to be made more explicit, better coordination between ministries is needed.

- Secondly, the *incentive structures* for researchers working in higher education institutions may be further developed to promote cooperation with the surrounding society including private sector companies.
- Thirdly, the funding situation in respect of fulfilling the task of cooperation with the surrounding society and with the business community in particular is not very robust. Here the development from small scale and short term projects to *long-term structures* may be considered.
- Finally, *more knowledge* is needed concerning the direct effects universities potentially have on regional development, in order to avoid the promotion of merely 'symbolic' policy. More knowledge is also needed as regards the issue of whether the pooling and centralisation of higher education institutions represents the best way forward for the Nordic countries. The findings contained in this study suggest that such an approach may indeed have negative consequences in respect of the move towards a *regional* knowledge-based economy.

1. Introduction

Towards a knowledge-based economy

How can universities and university colleges work instruments of regional development? This question is to be further investigated in the following study. The question can be connected with the fact that we have over the last decade seen increasing emphasis on the development of a knowledge-based economy in order to boost competitiveness on world markets. Higher education institutions have been acknowledged as major players in this process.

A key document promoting the development of a knowledge-based economy is the EU Lisbon Strategy adopted in 2000. This strategy was developed in order to address the problem of low productivity and the stagnation of economic growth in the EU member states compared with the EU's major competitors. The Lisbon Strategy was adopted to support the transition to a knowledge-based economy and society. This was to be achieved by developing better policies in respect of the information society and R&D. Furthermore, the process of structural reform for competitiveness and innovation was to be stepped up and the development of the internal market completed (EC 2000b). To develop a more innovative and entrepreneurial European Union, development potential was defined as being found in the small and medium-sized enterprises (EC 2000a).

In order to establish a knowledge-based economy increased individual competence levels and more research are required. Access to skilled people and research are issues of particular importance for small and medium-sized enterprises in order to ensure their ability to become globally competitive and thus to enable them to grow. In the mid-term evaluation of the Lisbon strategy three new concepts were mentioned as being important for the establishment of the knowledge-based economy and innovation: knowledge, R&D and universities. (The High Level Group 2004) In order to stimulate regional innovation strategies and the development of regional innovation systems; high-technology small and medium-sized enterprises, universities and the necessary business and financial support should be brought together in *innovation poles*. (EC 2005).

Consequently, there is a strong political belief in the notion that higher education institutions have an important role to play in further developing the knowledge-based economy. This is also illustrated by the fact that several studies in Denmark (Reglab 2006; Øster 2009), for instance mainly related to the implementation of the Globalisation strategy, and also in Sweden (ITPS 2004),

have investigated and discussed the role of universities as regional drivers. The central role of regions in research policy in the Nordic countries is also well illustrated by the decision in Norway to regionalise parts of the research funding structure. However, notwithstanding this increased interest, the direct effects that universities may have had on regional development are difficult to measure or prove (ITPS 2004).

Higher education institutions and regional development

The difficulty in measuring the effects of a university may relate to its organisation. The two major tasks of universities are to provide education and research. In addition to these two tasks a third task, which in general terms stipulates cooperation with the surrounding society, has been added in all the Nordic countries. In an OECD report (2007) the tasks have been termed *knowledge transfer* (through education and human resources development), *knowledge creation* (through research and technology transfer) and *cultural and community development*. All these tasks are of importance in order to ensure development towards a knowledge-based economy in the regions. One of the main challenges in respect of this increased level of cooperation with the surrounding society is that it questions the fundament of the academic ideal of being independent in order to maintain an impartial stance (ITPS 2004:51).

The importance universities and university colleges have concerning economic, social and cultural development is stressed by OECD (2007). In order for regions to be integrated into and competitive in the globalising knowledge economy, knowledge-intensive goods and services have to be produced. Here access to new technologies, knowledge and skills are considered essential. Higher education institutions are stated as being key sources in the provision of the needed knowledge.

In an overview of several studies however it is concluded that resources that are directly or indirectly allocated to universities do not have any major influence on the specialisation of companies or the international orientation of a region. The relationship between expenses for education and research and knowledge-intensive businesses is non-existent in regions with less than one million inhabitants (ITPS 2004). This statement is of great interest for Nordic regions, since it is in the main the capital regions and some other metropolitan regions that have more than 1 million inhabitants.

A disadvantage with university colleges in regions with a smaller number of inhabitants and at a distance from metropolitan areas may thus be that they lack the critical mass to be competitive and that the level of scientific performance may also be lower. In the World University ranking of JIU (Institute of Higher Education Shanghai)¹ it is evident that the Nordic universities of global or European importance are located to capitals or other major *metropoles*. This may strengthen the discussion emphasising the importance of having elite universities designated, for instance, as centres of excellence. This approach may be of particular relevance for small countries such as the Nordic countries thus better enabling them to allocate resources and remain internationally competitive.

In the OECD report (2007) there is however a fear that a centralisation of university research and education may imply a concentration of higher education institutions in already advanced regions. We may also assume that there are Nordic universities or university colleges outside the metropolitan areas where performance is at least of regional or national and to some extent even international standard. That there is some kind of impact of such universities is displayed in a Nordic comparison made between regional centres that have a university or university colleges and those without one. In general terms it seems that universities may be important drivers pushing forward regional development, since a regional centre with a university is better off in respect of occupational and demographic development than a regional centre that lacks such a facility. However, the causality of this has not been proven (Hanell & Neubauer 2006).

Focus of the study

Despite the challenge to prove the effects of higher education institutions the overarching question for the study is to discuss how universities and university colleges can work as an active instrument in regional development policy in the Nordic countries. This will be done by trying to identify conditions or measures that need to be at hand in order to allow universities and university colleges to function as major drivers of regional development. A significant point of departure for the study is that the functioning regional anchoring of a university demands that the university is well integrated in knowledge networks that produce and transfer knowledge in relation to companies. Furthermore, the university should contribute to the education of the workforce and thus to a general level of competence development and an increasing measure of “regional capacity” on the aggregated level, which is essential for

the development of companies while also influencing the localisation of new companies in the region. In the study we use the terms higher education institution, university and university college more or less synonymously, with the meaning that this is an institution of higher education and research, which grants academic degrees in a variety of subjects providing both undergraduate and postgraduate education.

Methods and materials

The findings of this study are based on quantitative and qualitative methods and data reproduction aiming to display how the various tasks of a higher education institution, namely education, research and collaboration with the surrounding society can be related to regional development and the development of a knowledge-based economy. Firstly, a comparative descriptive and statistical overview of Nordic higher education institutions was undertaken. This task included a general profiling of universities and university colleges concerning their individual historical development. Regarding education the number of students and the educational level in Nordic regions is displayed. Concerning the research task a map displaying research and development expenditure is presented. It is a somewhat more problematic task to statistically describe the collaboration process with the surrounding society.

Here, the focus has been on looking at high-tech manufacturing and R&D intensity in the Nordic regions. Secondly, collaboration with the surrounding society has more thoroughly been addressed by providing some illustrations of how universities and university colleges participate in collaborations with their surrounding business environments. This aspect has been explored more thoroughly by the production of six case studies². The case studies cover the Aalborg University in Denmark, Oulu Southern Institute in Finland, the School for Renewable Energy Science (RES) in Akureyri, Iceland, the University of Agder in Norway and Dalarna University and Jönköping University in Sweden. The case studies attempt to illustrate how the universities participate in a specific initiative aiming at the further development of the regional knowledge-based economy in some way or another. The case studies offer examples of three approaches found in the current practice of knowledge sharing between higher education institutions and the business community (Reglab 2006), education and lifelong learning, business formation and entrepreneurial activities, and research and development collaboration. The case studies are intended to function as

¹This result is gained by using the measurement of the qualities of universities globally by the institute of Higher Education of Sanghai Jiao Tong University that is one of the most cited works in this field. The measurement considers some 2000 universities on all five continents and is based on five groups of criteria:

- Alumni of an institution winning Nobel Prizes and field medals (10%)
- Staff of an institution winning Nobel Prizes and Field Medals (20%)
- Highly cited researchers in 21 broad subject categories (20%)
- Articles published in Nature and Science (20%)
- Articles in Science Citation Index-expanded, Social Science Citation Index, and Arts & Humanities Citation Index (20%)
- Academic performance with respect to the size of an institution (10%) (Hanell & Neubauer 2006).

²More extensive descriptions of the case studies can be found in the electronic working paper that can be down loaded from www.nordregio.se

examples of how higher education institutions can be of use in regional development in general and for the local and regional business environment in particular. The case studies are based on interviews with key stakeholders and on traditional document analyses.

Disposition of the working paper

This working paper is comprised of four chapters. Immediately following this brief introductory chapter is chapter 2 which includes some descriptive statistics in respect of the education and research undertaken at universities and university colleges. Furthermore, a

history of the development of universities and university colleges in the Nordic countries over the last 100 years is reproduced. Chapter 3 contains a description and synthesis of the six case studies. The case studies function as examples of the various roles universities or university colleges have in specific collaboration projects including other public actors and the business community. Based on the content of chapters 2 and 3 some observations and reflections concerning the emerging policy implications are discussed in chapter 4. Here the preconditions needed for the use of universities as instruments for regional development are set out.

2. Overview of Nordic higher education institutions

The main task of this study is to elaborate on the role universities may have for future regional development. The following chapter includes some descriptive statistics concerning the number of higher education institutions, the number of students, educational level and R&D expenditure in the Nordic regions. To begin with however we will undertake a brief historical description of the development of universities and university colleges in the Nordic countries over the last 100 century.

Historical development of higher education institutions in the Nordic countries

The ranking of Nordic universities of global or European importance is generally connected to the age of the institution in question. A brief historical overview of the territorial evolution of Nordic higher education institutions illustrates how the international status of higher education institutions can be correlated by the age or the academic profile or specialisation of particular institutions of higher education. In the context of this overview it also becomes evident that it is often not particularly easy to define what a higher education institution is since this definition has widened considerably over the last 100 years.

Between 1900 and 1960: spreading out to new metropolitan areas

By the beginning of the 1900s, tertiary education in the Nordic countries could be characterised as an example of Humboldt in the city. Universities were almost exclusively to be found in the capital region of the various countries (the Universities of Lund and Uppsala being the main exceptions here), and were broad institutions that focussed on academic prowess. Interactions between universities and the business community were almost exclusively catered for by specialised single-faculty institutions (universities of technology, schools of economics and business administration). Often, these more specialised higher education institutions were privately owned institutions or foundations, with national uptake areas (see figure 1).

Between 1900 and 1960, higher education institutions began to spread out to new Nordic metropolitan areas. In Denmark, Aarhus University was established in 1928, whereas the precursor of what was later to become the University of Southern Denmark was established in Odense in 1905. In Iceland, the University of Iceland was founded in 1911. A more extensive expansion of tertiary education took place in Finland where, in chronological order, major cities such as Åbo/Turku, Tampere and Oulu

saw the establishment of new universities (in Åbo, it was actually more a re-establishment of Åbo Academy, which had relocated to Helsinki in the 19th century).

In Norway, a set of single-faculty higher education institutions were established in Trondheim, Oslo and Bergen prior to the establishment of a second Norwegian university in Bergen in 1946. In Sweden, advanced research education (doctorates) also took place at specialised higher education institutions such as *Karolinska Institutet* and the Royal Institute of Technology. Additional specialised higher education institutions were founded, still mostly in the greater Stockholm area. In the Nordic countries, developing the system of tertiary education still meant creating and locating higher education institutions to major cities at the top tiers of the urban hierarchies.

Between 1960 and 1990: the Nordic welfare states take HEIs to non-metropolitan regions

Between the 1950s and 1970s economic growth and the emergence of welfare states were seen across the Nordic countries. The expansion of tertiary education to new parts of the population – and to new locations – became an essential foundation of these new welfare societies. The volume of students in tertiary education increased significantly. This meant not only that established universities had to set up branches in new regions; but also that entirely new higher education institutions had to be established at new locations. In addition, a range of municipal and private higher education institutions were nationalised, so that tertiary education increasingly came under state control.

In Denmark, new reformed universities were established in Roskilde and Aalborg. A fully fledged college was established in the Faroe Islands, while in Iceland, the University of Akureyri was established in 1988. In Finland, the regionalisation of tertiary education was further boosted by the setting up of new universities in Vaasa, Kuopio, Joensuu and Rovaniemi. The number of single-faculty, specialised higher education institutions increased with the establishment of Universities of Technology in both Tampere and Lappeenranta.

In Norway, new universities were established in Trondheim and Tromsø towards the end of the 1960s. During the 1970s and 1980s, a new set of higher education institutions – specialised regional public colleges - were established in selected regional centres that did not currently host universities to boost regional education capacities (see figure 2).

Sweden opted for a different strategy by first out-locating some of the activities of the then existing universities to Örebro, Växjö, Karlstad and Linköping while establishing an entirely new university in Umeå in 1965. In Luleå a university of technology was established in the early 1970s. In 1977 the Swedish university college reform process ensured that all counties were to host a higher education institution³ – in some locations by providing the decentralised university outpost full independence as separate institution in its own right. This period of significant expansion concluded with the establishment of Blekinge University of Technology in 1989.

Between 1990 and 2009: institutional reforms in tertiary education, the consolidation process continues

The regional institutional reform in tertiary education signalled in Sweden in 1977 was repeated elsewhere in the 1990s and early 2000s. In Norway, state university colleges were institutionalised as a new higher education institution category following the 1994 reform of tertiary education. By this, 98 specialised public colleges and independent higher education institutions were merged into 26 new larger units – mostly with regional uptake areas.

In Finland, the 1990s saw the advent of a new set of higher education institutions with the introduction of polytechnics. Their main task was defined as to train professionals in response to labour market needs, and to conduct R&D that specifically promotes regional development. The first polytechnics began to operate on a trial basis in the early 1990s, and were fully functional by 2000. The polytechnics complement the traditional universities in Finland by having a stronger focus on applied research (see figure 2).

The wave of institutional consolidations in Nordic tertiary education has most recently taken place in Denmark. In 2007, not only was the Danish higher education governance system reformed, but the higher education institution and research sector was completely restructured. The outcome was the creation of a two-tier university system. Effective from January 1st 2007, 13 government research institutions (GRIs) and 12 universities merged into eight universities and three GRIs. This has created a set of eight long-cycle higher education institutions (research universities). At the same time, 22 centres for further educations were merged into eight new regional university colleges. These are medium-cycle higher education institutions with some – but modest – research linkages to the universities.

While the consolidation of higher education institutions

has been both systematic and thorough in Denmark, consolidation processes in tertiary education is currently continuing in Finland and Norway. In the new proposed University Bill of Finland, the process of institutional consolidation is also continuing. The Universities of Kuopio and Joensuu are set to merge to form a new Eastern Finland University (despite the *status quo* option preferred by an international team of experts, see Goddard *et al.* 2003). In addition the University of Turku and Turku School of Economics are also set to merge. The most radical change will, however, come in the capital region where a new foundation – the Aalto University – will be established by merging three higher education institutions with particularly strong business connections: Helsinki School of Economics, the University of Art and Design and Helsinki University of Technology.

In Norway, the University College of Tromsø and the University of Tromsø merged in 2008. Parallel to this, several of the state university colleges are set to restructure their activities in order to reduce their total number of campuses (see for instance University of Agder and Østfold University College). This will reduce the direct institutional higher education institution presence in several regions.

Higher education institutions in the Nordic countries

Despite the establishment and diffusion of higher education institutions over the last 40 years, the major higher education institutions are still concentrated to metropolitan areas in the Nordic countries. A map of *higher education institutions* (figure 3) shows the absolute locations of institutions offering education at ISCED (International Standard Classification of Education) levels 5 and 6 at the beginning of 2009. Several Nordic cities have more than one such higher education unit. Greater Stockholm and Greater Helsinki are the top locations for the Nordic higher education institutions in terms of the absolute number of higher education institutions hosted, with 19 and 15 units respectively. The other Nordic capital regions and major cities are among these concentrations of higher education units (see the appendix on the identification of the set of higher education institutions displayed).

Regarding *universities* the capital regions also outperform all other areas in respect of the number of universities. Greater Helsinki region has eight universities. This can be explained by the existence of various independent art universities.

As seen in the historical development of higher education institutions there are some differences concerning development patterns between the Nordic countries. Colleges can be found in Denmark and Finland.

³ A process that was only completed with the establishment of the University College of Gotland in 1998.

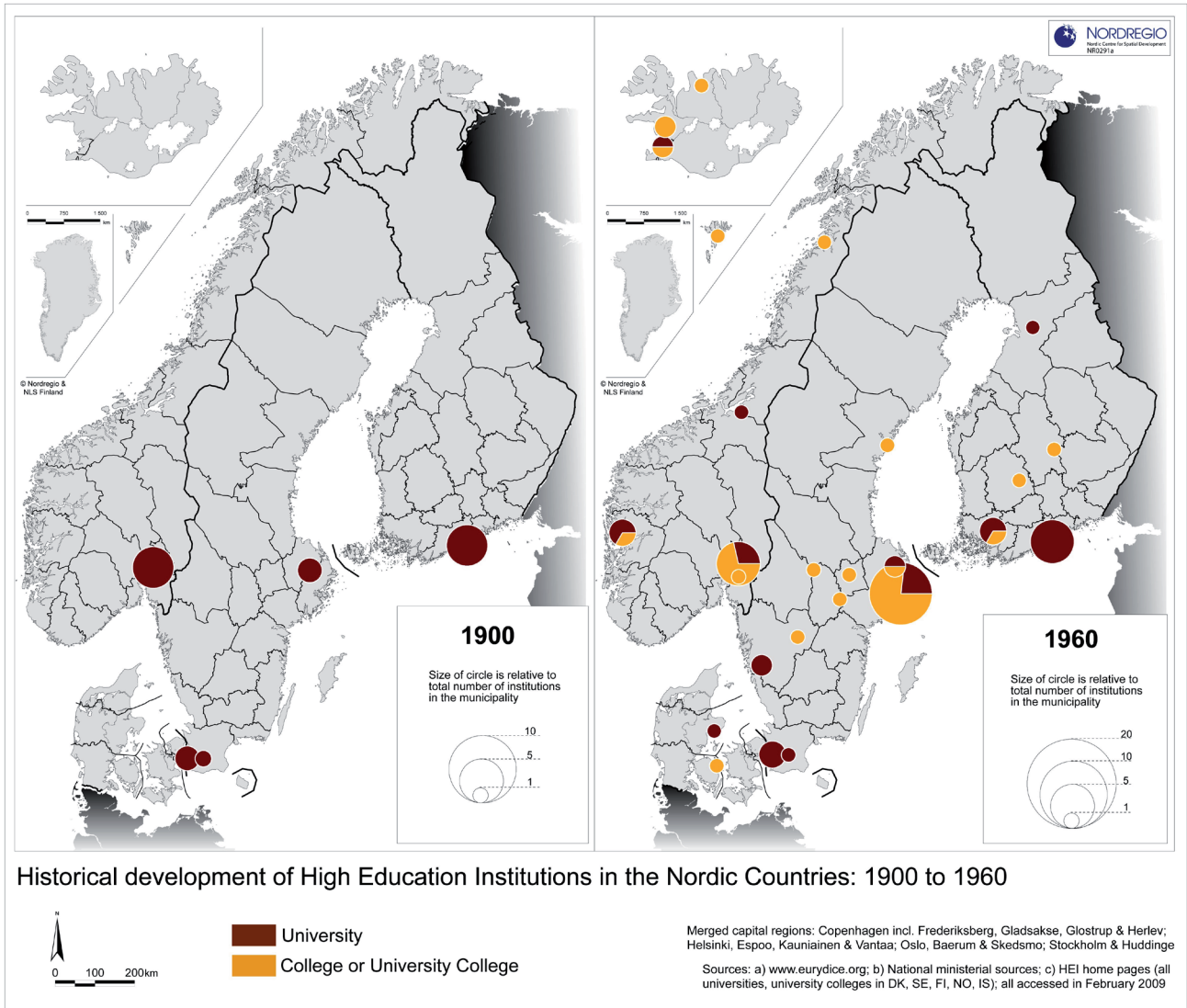


Figure 1: The historical development of Higher Education Institutions in the Nordic Countries: 1900 to 1960

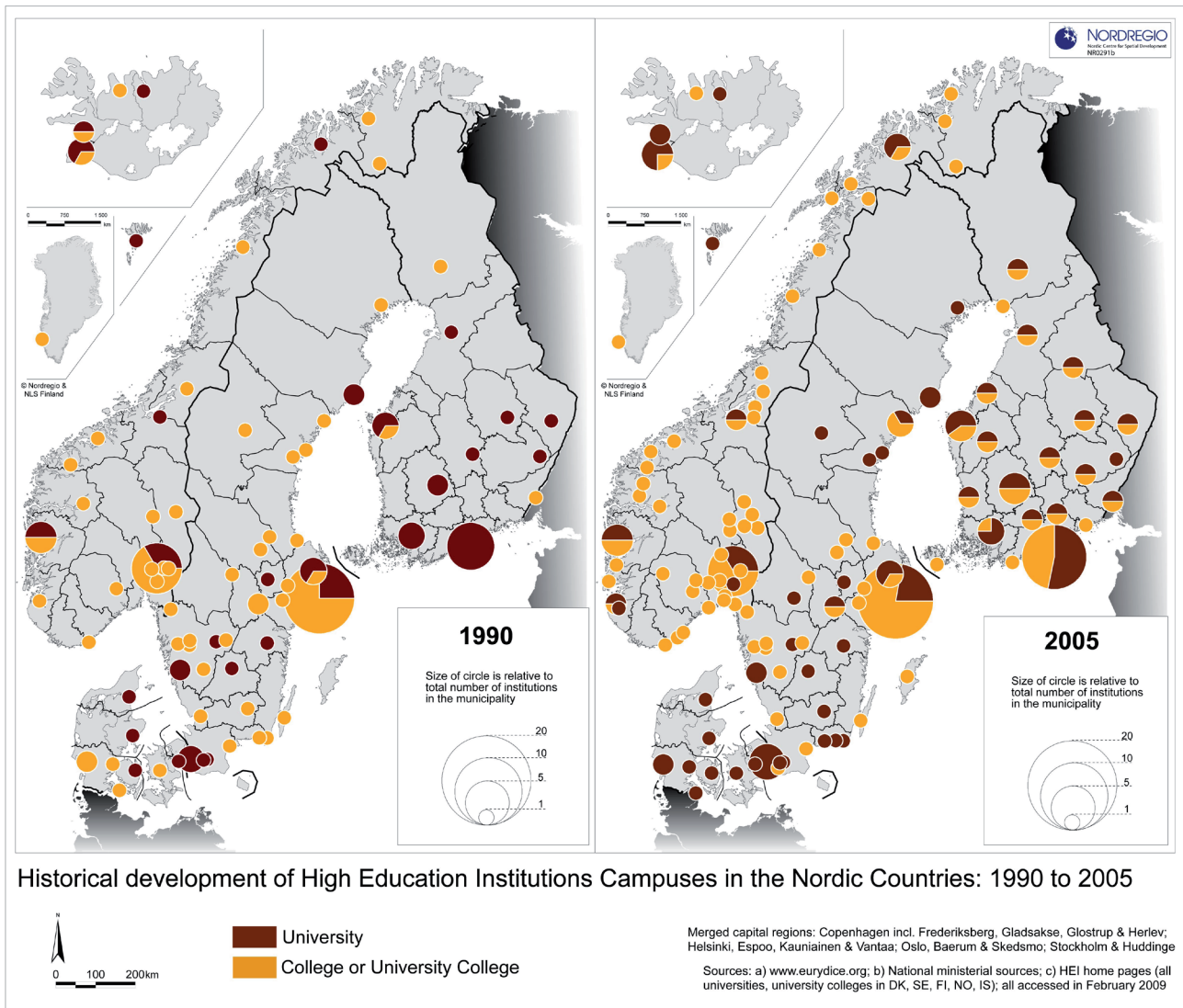


Figure 2: The historical development and location of Higher Education Institution's Campuses in the Nordic Countries: 1990 to 2005

In Denmark there are administratively 10 colleges⁴ - two colleges of engineering and eight “*professionshøjskoler*” - listed by the Ministry of Education. In Finland these colleges are located in every regional centre.

In Sweden, Denmark and Norway a distinction exists between *universities* and *university colleges* (see appendix). In Norway the university colleges are located around the country. About half are located in regional centres or other bigger cities while the other half are located in rather more regional institutional settings. It is also often the case that the administrative campus is in the regional centre, whereas the other higher education institution campuses are located in more peripheral locations. In Sweden a concentration of 15 university colleges is located in Greater Stockholm region. Otherwise the Swedish university colleges are located in the large and medium-sized cities in Southern- and Mid-Sweden. In Iceland the higher education institutes

are located in the cities of Reykjavík and Akureyri, but in contrast to other Nordic countries to a higher degree also in rural areas.

A specific phenomenon in Denmark and Finland is the existence of networks of higher education institutions. While the uptake areas of higher education institutions in Sweden and Norway tend to be functionally-speaking strongly regionalized, this may not be the case in Denmark⁵ and Finland (figure 4). There have been many mergers between Danish higher education institutions, in particular within the college sector of ‘*erhvervsakademiet*’ and the university college (“*professionshøjskoler*”) sector. In Finland, a special part of the university network is the so-called university consortiums, which are network universities that were established by two or more Finnish universities offering services provided by the departments of these universities. There are currently six (regional) university

⁴These colleges have in total over 160 campus sites. In terms of comparability all the campus areas/departments located in one municipality belonging to same institution have been summarized as one unit in the map.
⁵In Denmark the campus universities of Aalborg and South Denmark provide only a small part of the linkages. Seven out of ten Danish university colleges have campuses distributed around the region or even country, *Professionshøjskolen VIA University College* being the most widespread with 46 campuses/institutions located in 14 municipalities.

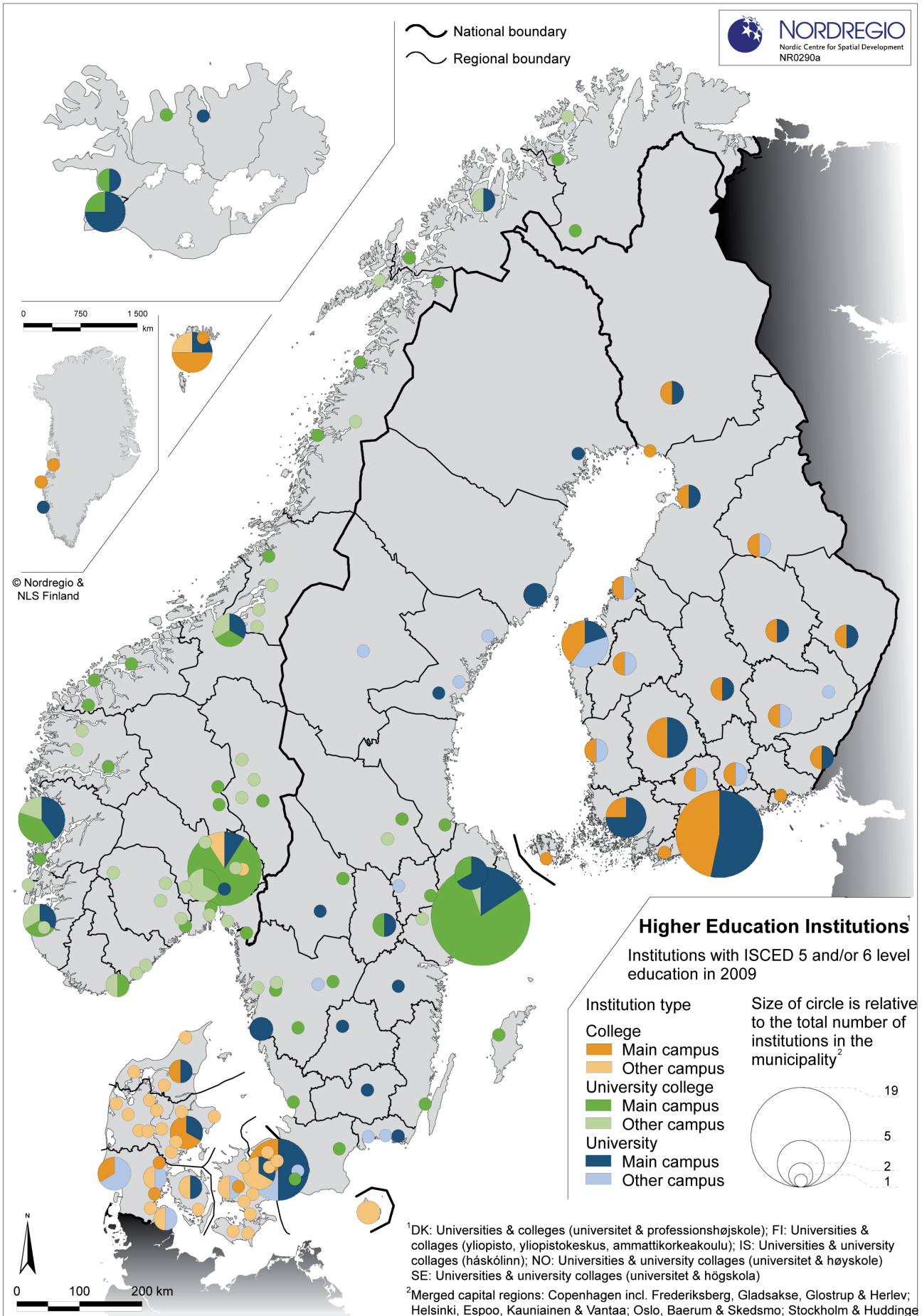


Figure 3: Higher Education Institutions

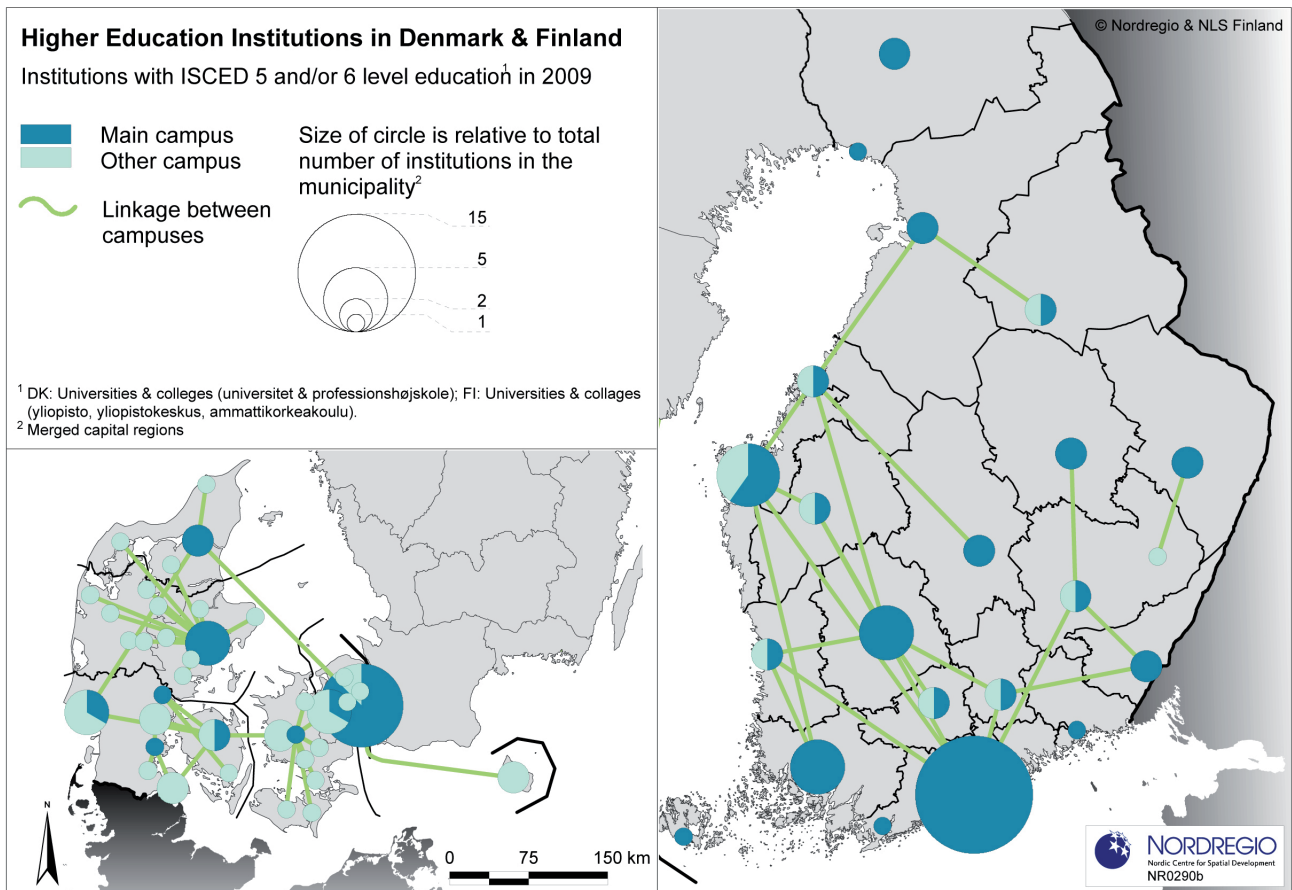


Figure 4: Higher Education Institutions in Denmark & Finland: intra-regional networks

consortia in Finland. They do not have a formal legal status, but are the result of Finnish regional development policy which aims at boosting the impact of higher education institutions as regional development tools. Set up between 2001 and 2003, the Finnish university consortia combine the activities of several different universities in regionally networked campuses.

Higher education institutions and education

HEI students in the Nordic countries

Regarding the total number of students in Nordic higher education institutions (figure 5) a definite concentration to the metropolitan areas can be seen. The total number of students is almost one million. The number of students per municipality however varies from 18 students in Swedish Filipstad to over 100 000 in Greater Helsinki. The average size is around 10 000 students. One third of the students at higher education institutions are studying in the capital regions and over half of these students are studying in the three main cities per country⁶. All the municipalities which have less than 1 000 students are located in the autonomous regions or in the northernmost part of the countries concerned.

There is also a gender dimension here. On average 57.7 percent of the students at higher education institutions are female (figure 6)⁷. Norwegian Harstad and Kautokeino together with Akureyri (Iceland) are the municipalities with, in relative terms, the most female students (all over 75 percent). All ten municipalities which have more male than female students have either a technical university or a (university) college focusing on maritime or forestry studies. Filipstad with its Gammelkroppa skogsskola (forestry school) is the most male dominated higher education institution municipality with a female student share of just 16.7 percent.

In figure 6 the total number of students, and the gender balance, have been split between universities and other higher education institutions. The total number of university students is around 600 000. The number per municipality varies from 124 students in Tórshavn (the Faroe Islands) to over 60 000 in Greater Helsinki. The average size is around 15 000 students. In this comparison 55.7 percent of the university students are female. The female share is highest in the rather peripheral universities and especially in Akureyri (Iceland) and Rovaniemi (Finland), both having over 70 percent female students. The highest share of male students can be found in cities with a technical university and especially in Lappeenranta

⁶Denmark: Greater Copenhagen, Århus & Aalborg; Finland: Greater Helsinki, Tampere & Turku; Iceland: Reykjavik & Akureyri; Norway: Greater Oslo, Trondheim & Bergen; Sweden: Greater Stockholm, Gothenburg & Lund.

⁷In Denmark only the data for universities is shown.

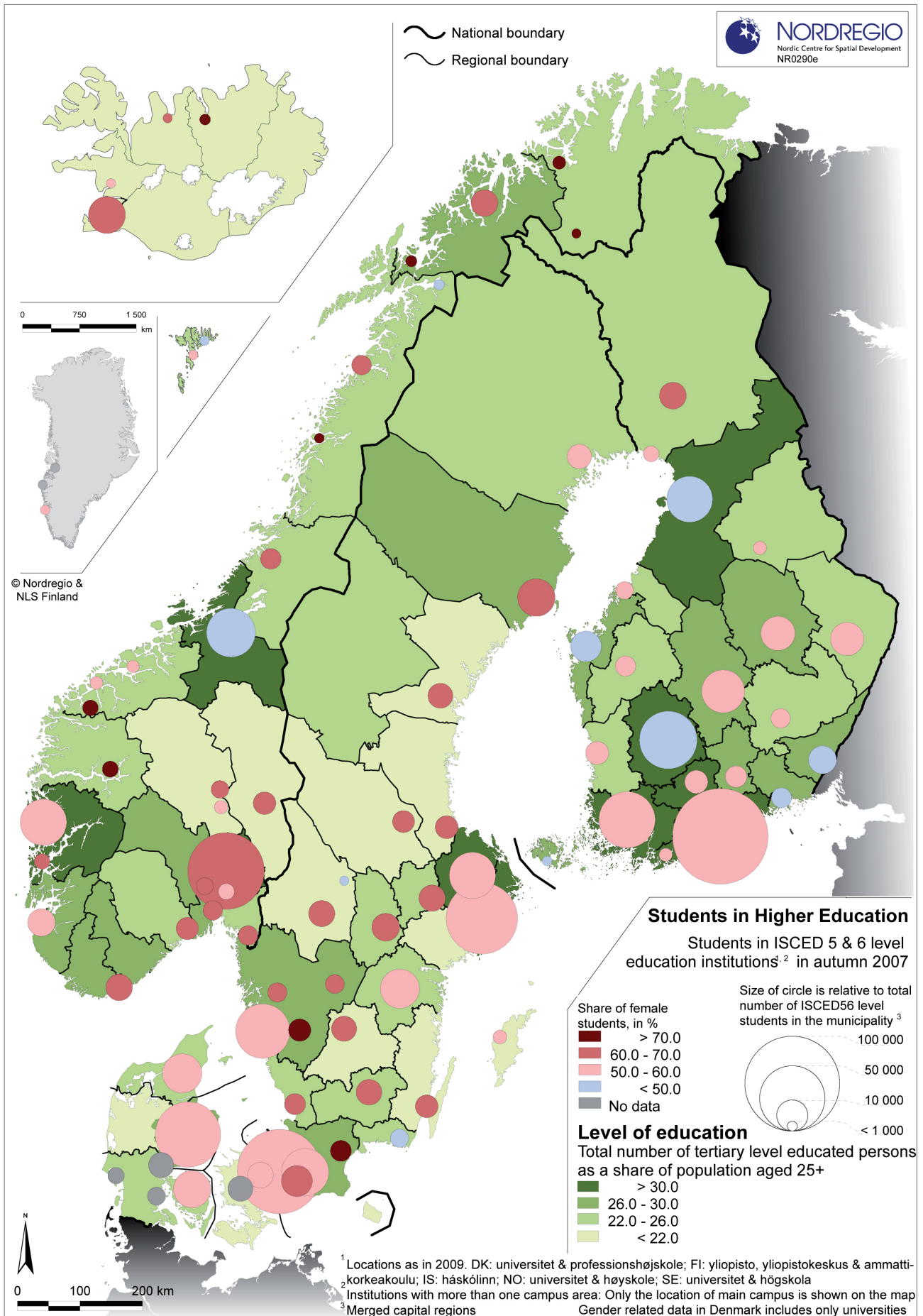


Figure 5: Students in Higher Education

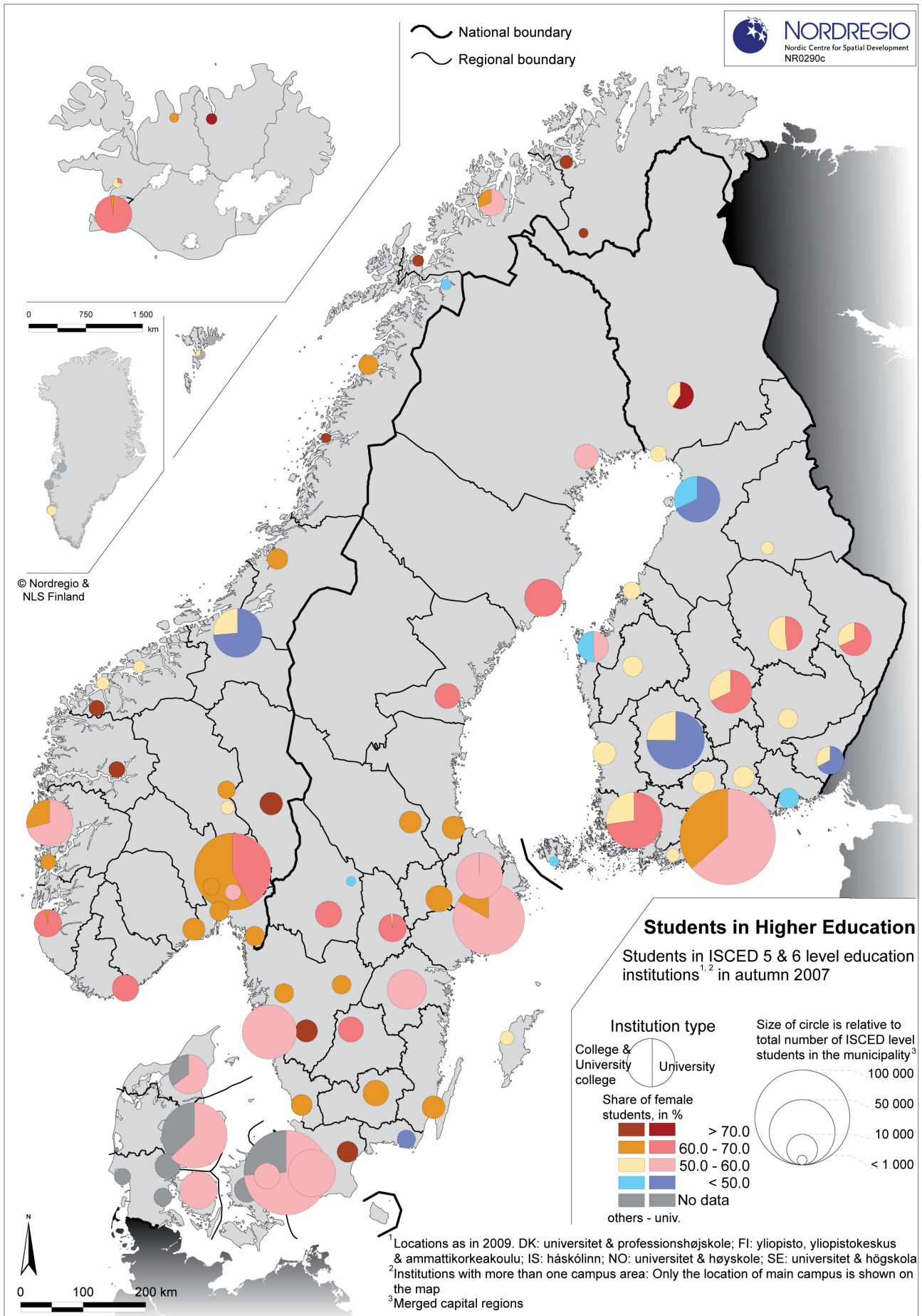


Figure 6: Students in Higher Education

(Finland) with 70.7 percent male students.

Around 400 000 people study at the university colleges and other colleges. The total number of students per municipality varies from 18 in Filipstad (Sweden) to over 37 000 in Greater Oslo. The average size is around 5 000 students. Around 63 percent of the university college and other college students are female. In the capital regions the share is 61.1 percent. The female share is highest in Tórshavn (the Faroe Islands) with over 80 percent female students and in northernmost Norway (Harstad and Kautokeino). The highest share of male students can be found in cities with forestry and maritime education, like Filipstad (Sweden), Narvik (Norway) and Mariehamn (Finland).

Educational level in the Nordic countries

The educational level also varies substantially between the Nordic regions. A discernable overall pattern here is that the share of the population (above 25 y-o age) with a tertiary education tends to be higher in capital and secondary city regions and where a higher education institution has been present since before the 1960s expansion (figure 5). On average 28.3 percent of the Nordic population has a higher education (ISCED 5 or 6). Uusimaa (Finland) and Oslo together with Akershus (Norway) are the only Nordic regions with over 40 percent of highly educated persons. The lowest education level can be found in the Icelandic countryside, island regions and in Mid-Sweden (for instance the counties of Gävleborg and Dalarna).

Higher education institutions and research R & D expenditure

In the EU context the Barcelona objective, established as a measure to be used in the implementation of the Lisbon strategy, is that at least 3 percent of GDP shall be spent on research and development (R&D) in the member states. In general the R&D intensity is rather high in the Nordic countries. Focusing on the regional administrative level marked differences however occur in expenditure levels (figure 7). The objective is fulfilled by only 14 out of 70 Nordic regions⁸ including Iceland, the Faroes and Greenland. Except in capital regions high R&D expenditures were⁹ undertaken in major Nordic metropolises and some important regional centres. However, roughly one third of this total Nordic R&D expenditure is distributed to the five Nordic capitals alone. Adding the large Swedish R&D hubs of Västra Götaland and Skåne to this group leaves somewhat more than half of the total Nordic expenditure to be distributed to all other regions. Despite this fact, the regions spending most intensively on R&D in relative terms

are not the capitals but the regional centres hosting a major university such as Uppsala in Sweden. Furthermore, almost all regions scoring above 2 percent have had a university or university college since before 1960.

Higher education institutions and their influence on the surrounding labour market

Concerning the effects higher education institutions have on businesses and employment in the region it has already been noted in the introduction to this study that such effects have been hard to prove. In a report (Reglab 2006) investigating the role of universities in Denmark it is however stated that the best role to assign to universities is the attraction and retention of knowledge-intensive companies. It is also noted here that strong universities with well developed cooperation agreements with the business sector function as magnets for private companies. Many of the entrepreneurs that have been educated at the university tend to remain in the place where they were educated to develop their company.

Furthermore, universities remain an important partner in the process of the spreading of knowledge to already existing companies. Moreover, universities are an important source of employment for highly educated people. It is however noted in a report from ITPS (2004:20) that the major labour market effects in Sweden could only be seen in the three metropolitan areas. Looking at the county level, the highest percentage of employed people in higher education institutions measured as the share of the working population was 4.95 percent for county of Uppsala and 3.76 percent in the county of Västerbotten. In all the other counties the percentage was less than 2 percent.

Since the 1960s, higher education institution development has been presented as a regional policy tool which may boost regional development in non-metropolitan areas. Systematic evidence to some extent supports this basic argument. Andersson, Quigley and Wilhelmsson (2004) investigated the effects of higher education institutions' decentralization (i.e. education) policies in Sweden on regional worker productivity and outputs 1985-1998, relying on panel data from Sweden's 285 municipalities. The scale of higher education institutions' impact was measured by a) the size of the student body and b) by the number of university-based researchers. They found that the impact of higher education institution R&D personnel was the most significant, since it takes some time before registered students graduate and are thus able to contribute to productivity gains by entering the labour force. However, they also found significant

⁸Denmark: 7 R&D regions. Here expenditures by administrative region are not available. Norway: Oslo and Akershus constitute one region.

⁹When comparing the volume of regional R&D expenditures (in Euro) across *Norden* one has not only to bear in mind the different purchasing power rates for knowledge intensive services between countries but also between regions. The major part of this expenditure finances labour costs, namely the wages of the researchers. Wage levels, however, clearly differ across Nordic borders. Consequently the same nominal amount of R&D expenditure may finance different volumes of R&D in different countries and regions in terms of worked hours.

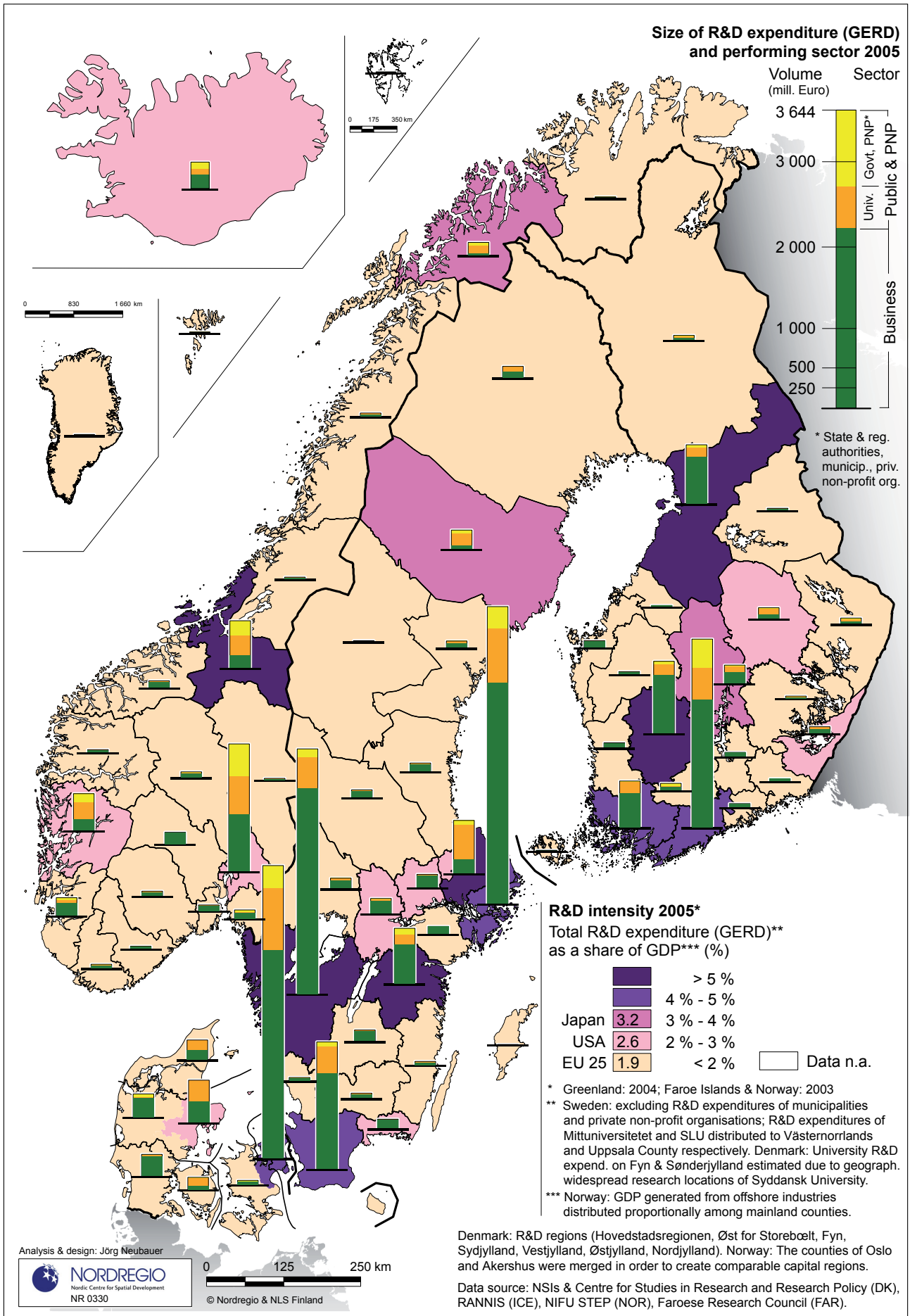


Figure 7: R&D expenditure and performing sector 2005

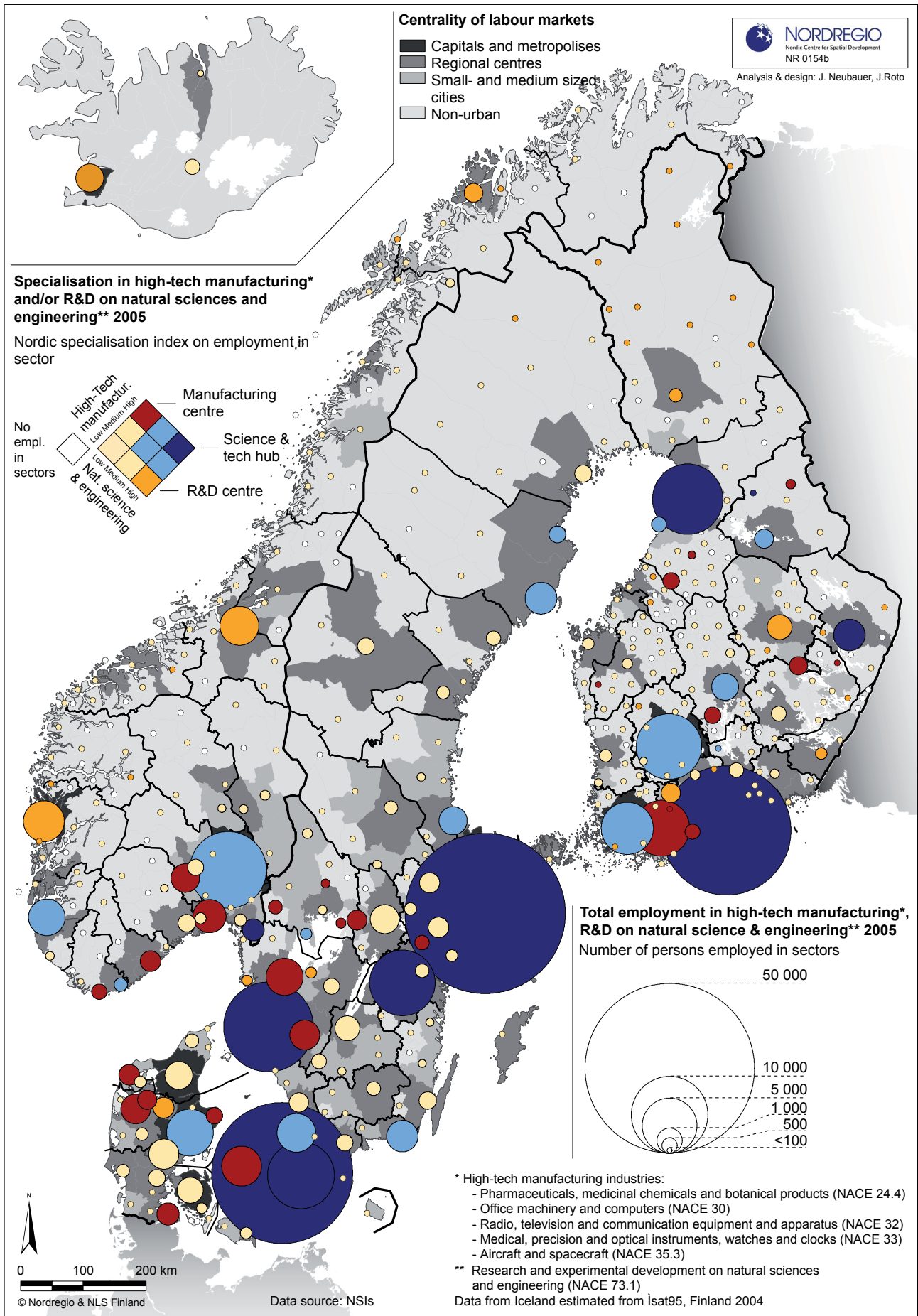


Figure 8: Specialisation in high-tech manufacturing and/or research and experimental development in natural science and engineering in Nordic labour markets 2005

effects on average worker productivity in the higher education institution's local communities, suggesting that the Swedish higher education institution decentralization policy has been economically important - productivity gains were for instance larger in regions in which 'new' colleges and universities have been set up, than in regions with old universities. This effect was particularly important in regions where the new institutions represent upgrades of more technical/vocational institutions than extensions of the traditional regional colleges.

In a recent study it has also been argued that higher education institutions might function as 'anchor tenants' in less developed regions. Using Twente University as a case in point, a young technological university in the Eastern Netherlands, Benneworth and Hospers (2007) have explored whether and how a higher education institution can provide a 'stability point' in a region which is attempting to strengthen its innovation system and attract external investment in knowledge capital. In such a case a higher education institution can become a temporary venue for 'local buzz', building networks that might both become attractive for external investors and promote regional innovation systems.

In figure 8, employment in high-tech manufacturing and research and development in natural science and engineering in the Nordic countries is displayed. The map does not however display whether there is a link between these two branches. High-tech manufacturing and R&D activities tend to concentrate in areas which have a university with a technologically-based education. In the map the centrality of local labour markets has been added displaying the following categories: capitals & metropolises, regional centres, small and medium-sized cities and non-urban labour markets.

Labour markets with both a specialisation in production and research are characteristic of the capitals and other major metropolises. An average specialisation in production but strong R&D production or vice versa is characteristic of major metropolises. Specialisation in high-tech production but low R&D activity is found in regional centres close to capitals or the major metropolises. In some Nordic countries there are also some examples of specialisation in R&D in some "peripheral" regional centres. All these centres have a university, i.e. Rovaniemi, Kuopio and Tromsö. Labour markets with neither high employment in high-tech manufacturing or research and development in natural sciences are evident in regional centres, small and medium-sized cities and non-urban labour markets located at a distance from major metropolises.

The finding that high-tech manufacturing and R & D activities tend to concentrate in areas which have a university with technologically-based education is to some extent confirmed in a study by Nilsson et al (2004) based on nine Nordic case studies examining the role of higher education

institutions in Nordic regional innovation systems. The regional impact of higher education institutions was found to be largely determined by a) the size of the institution (in terms of employees and students) as well as the size (population) of the region. The character of the regional impact was dependent on whether the higher education institutions possessed a technological faculty or not.

However, the regional economic restructuring capacity was boosted by the production of new, qualified candidates in various technology fields, rather than by the R&D in technology and natural sciences actually being performed at the higher education institutions. The key to higher education institutions having a significant regional impact was thus that the institution in question was able to offer courses and professional education in potentially high-growth technological fields. In the 1990s such areas were ICT, electronics and telecommunications.

However, it must be noted that private technology knowledge intensive activities are a rather limited approach. In the Nordic countries, the public sector is an important employer of higher education institution graduates, and growth in public sector jobs might be correlated with the presence of regional higher education institutions. In a Swedish evaluation (*Statskontoret* 1989) access to a university was stated as essential in order to get an agency to work, especially after the relocation of authorities from Stockholm beginning in the early 1970s. It was also noted that this relocation has stimulated the development of regional universities. This observation was recently confirmed in a report produced by the now defunct *Glesbyggsverket* (2005).

Summing up the findings of the Nordic overview

Since the 1960s, higher education institution has been presented as a regional policy tool which may, potentially, help boost regional development in non-metropolitan areas. Despite an ongoing regionalisation process in respect of higher education institutions in the Nordic countries a concentration of higher education institutions to the major metropolitan areas remains. The same pattern can be seen concerning number of students.

Concerning education levels and the R&D intensity these tend to be higher in metropolitan areas and in regions with an "old" university, meaning one that was present in the region since before 1960. This may also point to the fact that a definitive "time-lag" exists before changes can be seen. In this overview it also becomes clear that it is not easy to find a coherent definition of what a higher education institution is since the definition has been continuously and significantly widened over the last 100 years and, moreover, continues to differ even between the Nordic countries themselves. This also implies a difficulty in measuring the effects of higher education institutions

since they differ so much in organisation and character.

Concerning what impact higher education institutions may have on labour markets and on the local business life great uncertainties remain. High-tech manufacturing and R&D activities tend to concentrate in areas which have a university with a technologically-based education. Evidence pointing to the fact that an increase in worker productivity may be related to the establishment of higher education institutions has also emerged. A higher education institution may also function as a platform for the building of networks which may make the region more attractive to external investors and promote the establishment of

regional innovation systems. But education and research is not only offered to fulfil the needs of the private sector. Access to a university is essential also for the public sector.

To summarise then the overview provided in this chapter verifies the fact that there is a challenge to prove the causal relationship concerning the effects a university may have. Consequently, there is a need to apply a qualitative approach to better investigate this relationship. This will be done in the next chapter where the interaction between higher education and the surrounding business life is highlighted in the context of six case studies.

3. Interactions between universities and the surrounding business environment

In the following chapter we will look at interactions between some universities and their surrounding business life environments. The findings from the case studies undertaken are then briefly presented. The intention of the presentation is to provide an input into the debate over how higher education institutions can be used as instruments in the promotion of regional development, in general, and the enhancement of the knowledge base in companies through research and education in particular. The focus in this chapter is also mainly on the interaction between higher education institutions and the private regional business life environment. The main reason for this is that this sector can be developed thus creating growth in a region. The size of public sector is rather pre defined by national, regional and local policy. This is not however to say that the public sector and the actors within it lack importance in the interactions between the higher education institution and their surroundings.

As a point of departure for the presentation and analysis of the various case studies we have used a model developed to enable universities to work as regional drivers. Reglab (2006) notes that there is no “short cut” to the process of transmitting the specific knowledge held by the universities into regional growth. A number of initiatives using different channels are however required to produce efficient knowledge sharing with the business community. The case studies fit three so-called “knowledge bridges” defined to promote an interaction between the university and business sectors thus contributing to regional development. The knowledge bridges are as follows: 1 Education and lifelong learning, 2 Business formation and entrepreneurial activities, and 3 Research and development collaboration. The presentation of the case studies is structured in accordance with these knowledge-bridges. It must also be stressed that each case fits several knowledge bridges, implying that a specific initiative fulfils several functions.

Education and lifelong learning

The aspect of education and lifelong learning in the main refers to the first task of higher education, namely the education of the workforce. The case study that fits this knowledge bridge is the School for Renewable Energy Science, Iceland. This school is an example of how unique conditions can be used to establish a rather “innovative” higher education institution in a rather peripheral Nordic region.

School for Renewable Energy Science in Akureyri

The main academic goal of the School for Renewable Energy Science (RES) is to “offer excellent education programmes in renewable energy science and technologies, as well as to strengthen future cooperation between leading Icelandic and international academic and research institutions in the utilisation of renewable energies” (RES <http://www.res.is/>). The motivation for the cooperation was to make use of current knowledge and the setting in Iceland to create a specialized education opportunity in the field of renewable energy and to create jobs in this field.

The establishment of RES is thus strongly connected to the physical geological conditions at hand in the region. Akureyri is about one hour’s drive west of the most active volcanic belt that runs diagonally SW-NE across Iceland. These unique geological conditions have significant relevance for RES since there is potential for increased geothermal harnessing in the area. There are also many geothermal utilities for domestic heating and hydro power stations in the area. Moreover, the fact that Iceland has the highest use of renewable energy per capita in the world has influenced the establishment of RES.

The RES was constructed on the back of the idea to create a business model which would be self sustaining within 3-5 years and would stimulate research in the renewable energy sector and other businesses in the region. Thus far however no significant impact on the business environment can be discerned although this is understandable given the short time involved. The establishment of the RES was in line with the objectives of the Akureyri Region Growth Agreement (ARGA) which began in 2004 and lasted until 2007. The growth agreement was vital to the establishment of the programme providing the initial funding. Consequently, a strong connection to a specific policy instrument undoubtedly helped in the establishment of the programme. In addition, the establishment of the company *Bekkingarvörður* in 2005 and the foundations of the North Iceland Innovation Centre made it possible to foster the idea for RES. Later *Bekkingarvörður* established the company *Orkuvörður* to operate RES.

The establishment of RES is strongly connected with the actions of specific individuals. One such person was the Dean of the faculty of Natural Resource Sciences at the University of Akureyri, now Rector of RES. He supplied the scientific input and organized the curriculum for the RES programme. Other pivotal persons here include the

Rector of the University of Akureyri, the Chairman of the ARGA and the Facilitator of ARGAs education and research cluster. The importance of individual actors is also highlighted by the good will the Minister of Industry (also Member of Parliament for the constituency where RES is located) showed towards the initiative. Without this support, RES would not have materialized. To summarise the RES was initiated at just the right time; when many things were favourable relating to available funding and growth policies.

Iceland: Higher education in the field of renewable energy

RES—the School for Renewable Energy Science - a graduate school for Master's students in renewable energy science, was founded in 2007 and located to Akureyri. Akureyri has 17 500 inhabitants and belongs to the Akureyri region around the fjord Eyjafjörður which has a central location in Northern Iceland. The establishment of the University of Akureyri (UNAK) in 1987 precipitated major changes in the local economy. The university was established just at the time when the traditional manufacturing sector was entering a period of terminal decline. Study for a Master's degree at RES involves an intensive one year programme. Each year some 30-40 students from across the globe are enrolled.

The RES provides an example of how higher education institutions have been organised as private companies. RES is a limited liability company. This business form was chosen to make it easier for the school to seek share capital and other forms of funding. The partners are Akureyri municipality, Gift Investment, KEA Ltd. (a cooperative), Landsbanki (a bank), *Landsvirkjun* (the national power company), *Norðurorka* (Akureyri municipal power company), RARIK (a state owned power company) and *Deikingarvörður* (a holding company. The University of Akureyri is also one of its owners). RES also has agreements with the power company *Landsvirkjun* and with other companies in respect of financial support, e.g. in the form of teaching at RES. The University of Iceland is also in the process of becoming one of its owners and RES will therefore also be present in the capital region.

The private organisation of the school however bring its own challenges in respect of the funding issue. During the preparatory set-up phase funding came from the ARGA and the Ministry of Industry. Now, financing of the collaboration is undertaken through its owners and an EFTA fund enabling students from Eastern Europe to attend. One issue which has caused persistent problems is the global credit crunch with its particularly drastic effects on the Icelandic economy. The crisis has hit some of the owners of RES quite badly especially the financial institutes

and has thus negatively impacted on their capacity to act as active supporters. The parliament directly supported RES with 25 million ISK in 2008 as extra funding. However the board of directors has not succeeded in getting long time government funding for RES such as other private universities are entitled to. Long term funding is vital for its development but thus far the lack of support from the Ministry of Education has been evident. Here there may also be a conflict of interest, and competition between universities in Iceland is high. The previous Minister of Education mentioned that RES would better be located in Reykjavík as a part of the University of Reykjavík, the largest private university in Iceland. An initiative like RES is valued as an important strand of 'added value' to the development of both the energy- and higher education sectors. Therefore it is not a surprise that there has been competition concerning the location of the school.

There is a strong *international dimension* included in the education offered at RES. RES extends beyond the boundaries of region and of Iceland itself as the school has cooperation agreements with many foreign universities and institutes and this forms an extensive network which is vital for such a small institute. The RES network, which to a large degree was built up during the preparatory phase, has proved to be a very valuable asset and a prerequisite for the offering of such specialized studies in a rather remote location. It appears that gaining access to this network has also been useful for other partners such as the universities, energy research institutes such as Iceland Geosurvey (ÍSOR) and the Icelandic power companies. The depth of internationalisation is also illustrated by the number of foreign teachers and the students associated with the programme. Specific renewable energy science modules may also be located in different parts of the world according to natural conditions or the knowledge level available.

The students make their final Master's theses projects at RES¹² and this knowledge can often be of use for University of Akureyri, the University of Iceland and the companies/institutes that these students work with during their final project placements. However, since most of the students ultimately leave, there is a risk that their influence remains rather limited and a brain drain takes place.

There is a *mismatch* between RES and the supply of competence to the local labour market. This was something that was however anticipated from the onset and therefore a network of professors from all over the world was organized to lecture at RES. In addition, there is also a mismatch between the local labour market and those who obtain their degrees from RES. Most students return to their home countries and work there. The spin-off effects

¹²Formally with joint master's diplomas from UNAK and UI.

for the local economy, particularly in respect of tourism (edu-tourism) around RES are however considerable due to the high number of professors teaching there for short periods.

Due to its recent start up and its, as yet, rather insecure future it remains to be seen what further impact the school may have on the regional surrounding. According to the Rector of the University of Akureyri, RES has opened up a *new perspective* for the university in the field of regional development as there is now a new institute operating in tandem with the University of Akureyri. This offer opportunities for foreign connections and can be considered as a good example of the maxim “think globally act locally”. Access to a good education is also considered to be the best type of regional development one can think of. A clear lesson to be learned from the RES experience then is to build on local strengths in knowledge and other fields.

To summarise then, RES links the Akureyri region, including the university and the local and regional companies, to international networks. RES may also strengthen the University of Akureyri in a more international direction. In addition it may also work as a bridge between local companies and the university. The placement of students for their Master’s thesis may for instance work as a direct input to the development of the regional business environment. RES has not thus far however been an economically self-sustaining business model and remains dependent on national funding. Also the significant level of dependence on individuals makes it vulnerable to unforeseen change. The present mismatch between graduated students and the local and regional labour market implies a significant challenge to ensure that RES has a future influence on regional business development.

Examples of education and lifelong learning from the other case studies

Two broader and more developed examples of education and life-long learning are represented by the cases of Aalborg University and Dalarna University.

Denmark: Aalborg University and the ICT sector in North Jutland

Aalborg University has since it was established in 1973 been an active player in regional development. The engagement varies between different actors and *fora* as well as changing structural circumstances in the region. Their involvement in regional development and ICT cooperation in Northern Jutland stretches from engagement in the science park NOVI to their relationship with the interest organisation NoRCOM and the ICT Forum. Furthermore, the establishment of Centres for Tele Infrastructure (CTIF) worldwide already implies an internationalisation of the network. The international reputation of NoRCOM as a

unique cluster of wireless telecommunications companies in the region has undoubtedly been important for regional development. With the establishment of the ICT Forum in 2005 as a part of a nationwide network of IT *Fora*, a more politically oriented organisation was established. For instance, the municipality of Aalborg was involved and provided co-funding. ICT Forum was a broader network than NoRCOM and includes a wider range of IT companies in the region. ICT Forum did not however have a specific relationship with one particular department at Aalborg University, as was the case with NoRCOM which cooperated with the Department of Electronic Systems. In 2009, the ICT Forum merged with NoRCOM and *ictnorcom* was established.

Another network of importance for the ICT sector is the partnership *BrainsBusiness*. In 2007 an ICT partnership was established as a part of the regional Growth Forum’s business development strategy, thus involving the public authorities. In 2009 the partnership was renamed *BrainsBusiness*. The difference between Aalborg University’s previous engagement in regional development and its current involvement is that in the context of the *BrainsBusiness* partnership Aalborg University’s regional development role has become more formalised, and thus the University also has an influence on the development of regional policies. *BrainsBusiness* manages funds from the regional Growth Forum which they distribute to project applicants in the ICT sector. In connection with this, all parties to the partnership: Aalborg University, the region, the municipality and ICT NoRCOM select which projects will receive funding, and in this way they influence the development of the ICT sector in the region.

In the case study looking at how *Aalborg University* has cooperated with the ICT sector in North Jutland the educational aspects of great importance. The establishment of the University was considered a basic precondition for the attraction to and maintenance of people in the region. For instance, the University’s Department of Electronic Systems matched a need for electronic engineers in the local wireless telecommunications companies from 1979 when the first Master’s degree students in engineering were educated at Aalborg University. According to the varying market conditions, the demand for electronic engineers has varied over the years. Meanwhile a study carried out in 2007 showed that a majority of electronic engineers employed in the wireless telecommunications companies in Aalborg have been educated at Aalborg University (Reinau 2007). This would indicate that a large number of electronic engineers stay in the region after they finish their education. Also in connection with the current financial crisis implying the relocation of wireless companies, initiatives have been taken in the context of the *BrainsBusiness* initiative to offer further education to unemployed engineers in the region. Previously in times of crisis or changing market conditions, for instance

during the late 1990s, Aalborg University has been engaged in similar competence upgrading initiatives with local companies in order to help better adapt the workforce to changing market demands.

Another element of education is the Centre for Tele Infrastructure (CTIF), which is an international research and education centre concentrating on wireless technologies. Here the interest organisation NoRCOM was a key actor in initiating this project at Aalborg University. CTIF has set up divisions around the world and attracted international students and researchers to the University. The education policies at Aalborg University have also been influenced by NoRCOM. It is however yet to be seen whether *ictnorcom* will have a similar cooperation agreement with the University and to what extent education will be influenced through the *BrainsBusiness* partnership.

Aalborg is an example of how an industrial cluster and a university can develop side by side as interrelated demand and supply systems. The Aalborg 'complex' has so far been able to adapt to new challenges, for instance fluctuations in the world market and in technological development. This ability to adapt to new situations has been followed by the formation of new networks and new approaches to organisation. The recent economic crisis demonstrates how the 'complex' tries to redirect an over production of engineers into new fields of learning with the overall objective to maintain competences in the region while at the same time developing new business opportunities

Even if the focus of the Triple Steelix project, where *Dalarna University* is a partner, is on research and development it nevertheless includes elements that can be connected to the educational role of higher education institutions. At Dalarna University a number of Master's theses have been produced as a result of Triple Steelix funded projects. Here Triple Steelix can offer payment to students for performing the work. This creates an incentive for students to develop a Master's thesis in cooperation with smaller companies which could not otherwise offer financial compensation of their own. That Dalarna University through Triple Steelix provides the students with the contact with smaller and medium sized enterprises in the region is essential, since this is a way for the students to discover these businesses as potential future employers. Besides giving the students an opportunity to develop their competences in respect of the private sector Triple Steelix also offers the smaller and medium-sized enterprises an opportunity to develop research and development and hopefully also their competitiveness by having Master's students undertaking project work.

Business formation and entrepreneurship activities

Entrepreneurship activities concern both the role of commercialising findings and also the role of educating students in entrepreneurship. These activities can mainly

be related to the third task of higher education institutions. The most explicit example here is the case study of Jönköping University and the Science Park Jönköping.

Sweden: Science Park Jönköping and Jönköping University

Jönköping County is constituted by 13 municipalities and while it is a region with strong entrepreneurial traditions it remains rather weak in respect of higher education provision. Jönköping University was established as a state university college in 1977 through the reformation of the higher education system in Sweden. In 1994 it became a foundation. One argument for this decision was that more independence was considered to be important for a more consistent engagement and collaboration with society and in respect of profiling the University.

Jönköping University is one of three private universities in Sweden (teaching to the PhD-level). The University is organised into four schools; Jönköping International Business School (JIBS), the School of Education and Communication, the School of Engineering, and the School of Health Sciences. These are all subsidiaries of the parent company which also consists of a firm for university services. Education, research, internationalization, entrepreneurship and collaboration with society are the five profile areas of the university. The JIBS offer their students both traditional entrepreneurship courses and facilities for students who want to start their own business.

Science Park Jönköping and Jönköping University

Jönköping University has been closely involved in the development of the Science Park Jönköping AB and its Business Lab, Business Incubator, and Business Growth units as well as in seeking funding from businesses. The Science Park in Jönköping was inaugurated in 2002. But this platform for business development actually began in 1999 in the context of a specific project and was subsequently established as a firm named *Creative Center Science Park Jönköping City AB* in 2000. Briefly, *Science Park Jönköping* can be described as an incubator for knowledge intensive businesses. Since 2007 it has been owned by Jönköping University and the Municipality of Jönköping through a joint non-profit organisation.

The *Business lab* is a test site for new ideas from students and researchers as well as from the surrounding business environment. Fruitful ideas elaborated in the Business lab can then be developed into firms through the *Business Incubator*, although the incubator cannot house all new firms. The Business Growth unit contains established firms originating both from the university and beyond. The science park has an extensive network of formal collaborative partners such as i.e. banks, law firms etc. There are also a range of different financiers involved, for instance state and regional agencies (VINNOVA, Innovationsbron, Swedish Agency for Economic and

Regional Growth and the Regional Council of Jönköping County), private partners (Företagarna and VSM Group) and international agencies, i.e. EU.

Another interesting development originating from *Jönköping Science Park* is the *Science Park System* in the Jönköping region. The Science Park System includes an ambition to *diffuse and extend the reach of the Science Park* in Jönköping region and began to be developed in the mid 2000s. The Science Park System is organised as a non-profit association with the overarching aim of enhancing business development and commerce in the Jönköping region and in Sweden more generally by supporting knowledge intensive businesses and products and growth-oriented companies. All municipalities in the Jönköping region are part of the organization as well as Jönköping University, Jönköping County Council, Chambers of Commerce in Jönköping, the Swedish Federation of Business Owners and the Confederation of Swedish Enterprise.

The overarching objective of the Science Park System association is to contribute to regional innovation and to be a motor and platform for developing synergies between business, organizations and individuals. Another aim is to create possibilities for business establishments through the staging of creative meetings and processes between the University and businesses.

The Science Park System consists of different nodes located in various municipalities. The development and structure of the nodes differs between the municipalities. In 2007 there were 11 nodes in 10 municipalities. A node should include a meeting place with physical facilities such as offices and conference rooms, business services such as financial and marketing support, as well as knowledge i.e. providing linkages to research and higher education.

In order that it be further developed and expanded, the Science Park system has been prioritized in the regional development plan. The work began slowly but has now become more established and is now seen as an important element in dealing with the current economic downturn that occurred in the wake of the financial crisis which became manifest during the autumn of 2008.

Jönköping Science Park is today one of the nodes in the Science Park System. The Science Park functions much as an incubator and a platform for starting firms as well as a meeting place for students, researchers, firms and institutions. It currently has around 90 companies and also acts as a basic source of know-how for existing enterprises. Activities that take place in connection with the Science Park include events, i.e. seminars, business development and the promotion of new investments. The knowledge primarily produced by the Science Park focuses in the main on the commercialisation of products. There are also experimental forms of knowledge development, i.e. such as in the *Business Lab* where business ideas are tested. The Business Lab is very closely connected to the

specialisation of Jönköping University on entrepreneurship and is often mentioned as a tool students can use for starting up a business during their studies. Each year about 50 enterprises are started by students and researchers of Jönköping University.

In connection with the Science Park Jönköping there is also the *Jönköping Business Development AB* (JBD). This organisation was established in 2007, when the holding company *SPJ Development AB* established in 2005 and owned by the University and the Science Park was renamed. *Jönköping Business Development AB* is an investment company and a regional “seed money” company, now jointly owned by *Jönköping Science Park AB*, Jönköping University, the *Sixth AP-fond*, the Federation of Swedish Farmers (LRF) and a number of other private investors. The objective of the firm is to contribute to the development of newly founded firms in the region of Jönköping by providing financial support, experiences and access to various networks.

Due to its private organisational structure Jönköping University is a rather unusual Nordic university. The specific focus on entrepreneurship, concerning for instance the training of students offers a distinct profile. The very broad partnership behind the science park and the science park system contributes to connecting the University and the regional business environment and the University with the regional context in general. But the rather complex organisation and the many involved stakeholders can often generate difficulties in addressing the shifting needs and interests of the involved stakeholders while it is also suggestive of a perceived lack of ability to adapt to changing conditions since the risk is that out-dated or moribund organisations and networks are maintained for bureaucratic rather than productive reasons.

Examples of business formation and entrepreneurship activities from the other case studies

Business formation and entrepreneurship activities can also be found in the case study of *Aalborg University* and the ICT sector in North Jutland. Here the role of *individuals* is particularly important. People from the Departments of Business Studies and Electronic Systems at Aalborg University played key roles both in establishing the science park NOVI in 1988 and the cluster and interest organisation NoRCOM at the end of the 1980s. Their personal relationships, particularly with actors in the private sector, and their professional commitment to strengthening the profile of the emerging wireless telecommunications cluster was essential in the development of the wireless technology cluster in the region. During the 1990s a *development hub* for international companies in the field of wireless telecommunications started to emerge in Aalborg with NOVI as its centre. This has undoubtedly had an impact on the regional business environment where the University can be viewed as an important supplier of competences. The establishment of the NoRCOM further

strengthened the international profile of an upcoming cluster in Aalborg. International telecommunications companies increasingly set up divisions in Aalborg, thereby generating employment in the region.

The Aalborg case also highlights the fact that science parks play a role as a bridge between universities and the wider business environment. Here it is also a visualiser of a knowledge driven clusters. It is also seen that networks and organisations linking research and business are quite complex constituting highly dynamic systems with multiple centres of power.

Research and development collaboration

The knowledge bridge ‘research and development collaboration’ relates to the role of having collaboration projects concerning research between higher education institutions and private companies but also other public actors. Here many of the case studies can be placed. The most refined cases are those of *Dalarna University* and the Vinnväxt project Triple Steelix, *University of Agder* and VRI in Agder and the *Oulu Southern Institute* and ELME Studio.

Sweden: Dalarna University and the Vinnväxt project Triple Steelix

Dalarna University was founded in 1977 and has about 15 000 individual students; of whom around 6 000 are full-time. It also has around 400 teachers and researchers. The University College has three academies; Health and society, Humanities and media and Industry and Society. The University has two main campuses, one in Borlänge and the other in Falun. Dalarna University is one of many participants in the VINNOVA (Swedish Governmental Agency for Innovation Systems) financed *Vinnväxt* (Regional growth through dynamic innovation systems) project Triple Steelix (System for innovation in relation to advanced steel products and applications).

The Vinnväxt programme aims at promoting growth and international competitiveness within growth areas through the problem-oriented research and development of innovation systems in functional regions. The Triple Steelix project, which was acknowledged as a Vinnväxt winner in 2004, covers the functional region of the industrial area of Bergslagen. This area covers parts of three counties, where mining and the metallurgic industries have been important since the Middle Ages.

The financing of Triple Steelix is complex. VINNOVA has disbursed to Triple Steelix 60 million SEK over a ten year period. The project initiators (municipalities, regional authorities, private enterprises and educational institutes) invest at least the same amount of money. The co-financing from other actors, such as small and medium-sized companies, becomes greater and greater each year.

There is also a connection here with regional development strategies. Triple Steelix was linked to the regional growth programme of Region Dalarna and can also be connected to the objectives mentioned in the follow-up strategy *Dalastategin*, such as in the promotion of investments in research and development. But Triple Steelix is not explicitly mentioned in that strategy or in the action plan. Instead, more general modes of work for developing innovation systems and cooperation between companies are instead stressed.

Dalarna University and the Vinnväxt project Triple Steelix

The Triple Steelix project aims to develop the steel branch in the industrial region of Bergslagen making it world leader in the field. This is to be achieved by developing new advanced technical solutions to increase the value of steel production. Mainly *small and medium-sized companies* are supported by creating accessibility to the broad knowledge-base of steel and steel processing contained within the region and by bringing research to the enterprises where there previously had been limited contact. Through growth of small and medium-sized companies, a more differentiated industry within the steel branch is to be created, implying a more attractive environment for the workforce.

The project includes an explicit *triple helix approach*, including the participation of actors from the business community, research organisations, politics and public administration. The project owner is the private actor, *Jernkontoret* (the Swedish Steel Producers’ Association). The set up which includes having process leaders divide their time between Triple Steelix and various other enterprises, research institutes, municipalities and county administrative boards, is considered to be of great importance in attempting to discover real research needs among the companies while also ensuring both the flow of information between and spillover effects from the various projects concerned.

The emphasis on the *functional region* in the Vinnväxt programme highlights that Dalarna University is only one of three university colleges in the Triple Steelix “geography”. The point of departure is also that Triple Steelix is working with and through the university colleges in the functional region. If the competence needed in a specific project not is available here, the search continues outside the region. But Dalarna University is active in the collaboration, for instance being a project partner, having participants in regularly meetings concerning the general development of the project, and having representatives in the steering and research groups. Furthermore, a person is employed half time at Dalarna University and half time at Triple Steelix to work proactively exploring the needs of companies and developing these into projects.

In 2009 Triple Steelix has around 30 projects running. Mainly “*need-motivated*” research is undertaken while the

driving force for new knowledge is that a company has a problem that needs to be solved. The projects are thus defined by the target groups. Cooperation within the context of Triple Steelix ensures that larger enterprises' R&D divisions become available or are utilized by the smaller enterprises. For the six larger process industries in the region this provides access to important competence-based resources while seeing them become participants in the regional innovation system.

Triple Steelix has contributed to the notion that there is now a "cluster" with a lot of competence regarding steel production in the industrial region of Bergslagen. If Triple Steelix had not been established it is likely that business would still have been conducted on the basis of short distance customer relations. A very different company structure would exist, with many struggling and most with a lower competence level. It is also likely that the companies concerned would have been bought up by larger international concerns lowering the level of regional responsibility.

For Dalarna University, the creation of Triple Steelix has meant that around 10 PhD students have been employed by companies in the regions and that a research school on processing has been established. The Triple Steelix experiment also suggests that cooperation with companies has become more structured and that more university teachers and researchers cooperate with companies. Triple Steelix is also considered to be an important tool in ensuring that bright ideas do not 'fall between two stools' since it unites many stakeholders in the steel industry. Furthermore, Dalarna University has through its interaction in this area further developed its reputation. Companies tend not to differentiate between Triple Steelix and Dalarna University, and thus the University gets the credit even if the students are actually financed by Triple Steelix.

A significant challenge to this cosy picture of cooperation is however remains the fact that various not necessarily coterminous incentives exist in the rather different worlds of research and business. In the academic world, needs driven research in cooperation with small and medium-sized enterprises is not rewarded. This needs to be packaged in special projects for innovations systems, such as Triple Steelix. However, Dalarna University actively tries to encourage collaboration between companies and staff employed at the University by having so called "*samverkeanspriser*" for companies, teachers and researchers. Another weakness of Triple Steelix may however be that the strict focus on the steel industry implies that other important industries in the region such as carpentry and sawmills are excluded. The results obtained from Triple Steelix projects are likely also to be interesting in these industries too.

To summarise then, the Triple Steelix project is a top down initiative, but anchored to and managed by an existing private business organisation. Triple Steelix illustrates that

a hub is important in uniting and promoting synergies between the different triple helix actors. Thus far the project has given a "cluster" of steel industries, both smaller and larger, an identity and managed to facilitate the transfer of research and development to small and medium-sized enterprises. But it remains to be seen whether the end goal of having a more differentiated industry within the steel branch in the function region will be attained.

Norway: VRI in Agder

Agder covers the two southernmost Norwegian counties, Aust- and Vest-Agder, consisting of 30 municipalities. The University of Agder was established in 2007, when Agder University College was accredited university status. The University of Agder has a proud history as a higher education institution. Agder Regional College was established as a regional higher education institute in 1969. In 1975 Agder Regional College became a permanent college and was transformed into Agder University College in 1994, when six state colleges located in Kristiansand, Grimstad and Arendal merged into one institution. From 2010, the University's activities will be consolidated to Kristiansand (main campus) and Grimstad. The University of Agder has five faculties (health and sport; humanities and education; fine arts; engineering and science; economics and social sciences).

VRI is a national 10-year programme (2007-2017) founded by the Norwegian Research Council (NRC). The programme is co-funded by the NRC, regional authorities and participating enterprises (mostly in-kind). VRI is based on previous practices established in a regional business development initiatives co-financed by national regional policy and industrial policy agencies, i.e. Business development in university colleges, Value creation 2010 and Competence brokering business development scheme.

VRI Agder is one of nine VRI projects currently in operation, and was officially established in 2007. The objective of VRI-Agder is to improve the level of regional collaboration between industry, higher education institutions, labour market organisations and public sector institutions. The VRI projects are, to a large extent, an experimental programme, testing and assessing tools to stimulate regional innovation capacities. It is also a complex initiative, involving a range of different institutional and organizational actors with very different objectives, organizational forms and working methods.

VRI in Agder

In the case study of VRI in Agder some interesting examples in respect of the organisation of research and development projects can be found. Three industrial fields have been identified: 1 Information and communications industry; 2 Oil/gas and processing industry and 3 Cultural and experience-based industries. The VRI Agder project is organised as a regional VRI team. Each of the three industrial fields is headed by a Process Manager (located at one of the higher education institution or in the industry

itself), and a Joint Coordinator. The three industrial fields have very different local and regional structural characteristics, and this has implications for how the VRI approach is implemented. The regional ICT industry is made up of mainly small and medium-sized enterprises, whereas the oil/gas and processing industry is regionally dominated by large, highly innovative and export-oriented enterprises. Two major industrial networks are collaborating with VRI; the NODE (Norwegian Offshore and Drilling Engineering) cluster and the Eyde industrial network for industrial processing enterprises. Compared with these well-established regional industrial *milieus*, the cultural and experience-based enterprises remain something of a Cinderella concern in the economic field, dominated by micro-enterprises.

The focus areas of VRI Agder are related to the *regional development* plans of both Aust-Agder and Vest-Agder counties, which aim at the creation of learning regions. This has significantly improved the legitimacy of this experimental regional innovation endeavour. The VRI initiative is also supported by the objectives of the strategic development plan of the University of Agder.

One of the most interesting activities in respect of VRI Agder is the creation of a measure for *individual placement* where VRI supported exchange arrangement schemes enable higher education institution researchers (typically from Agder University or Agder Research Institute) to be placed in a private company for a short period of time in order to participate in product development processes thus stimulating collaboration between higher education institutions and industry. Similarly, an employee of a private enterprise is invited to participate in research projects managed by the University or by a research institute. The tools employed to boost innovation and value creation in such cross-sectoral interactions include knowledge brokering, (student) exchange arrangements, trail research and various forms of pilot studies.

In the ICT field, these activities have thus far contributed to improving the level of collaboration between local *small and medium-sized enterprises* and the University of Agder. In oil and gas, significant effort has been put into initiating and performing collaboration projects with the University, Agder research Institute and industry associations (Teknova). By drawing on the NODE network, the higher education institutions have been able to meet and interact with enterprises in a range of different cooperation activities. In the field of oil and gas, the NODE industry network and the higher education institutions have developed the mechatronics technology field and initiated vocational University of Agder courses in mechatronics, aimed at industry practitioners. The development of mechatronics competencies is deemed an essential element of knowledge development in oil and gas companies which aim to expand into the larger energy sector.

Culture and experience-based economic activities still remain somewhat underdeveloped as a regional industrial endeavour. It has proved difficult to identify the role of the University in this field, as there is no evident institutional knowledge base at the University of Agder on which to draw. Here, the lead higher education institution in terms of participation is the Agder Research Institute.

The main challenges observed thus far relates to how to match knowledge originating in the different sectors (higher education institutions and private enterprise). An important discussion accompanying this basic challenge is whether the knowledge shared and diffused should come to the benefit of firms in well-established industries (oil/gas), or whether particular observation should – or could – be paid to enterprises operating in emerging or less established knowledge fields (mechatronics).

The VRI-Agder is a new long term top down initiative addressing three very different sectors with very different needs and perspectives in the region of Agder. As in the Triple Steelix case knowledge brokering is the main activity. Cooperation with existing business networks, only available for two of the three industrial fields, is likely to be an important indicator of the long term degree of success.

Oulu Southern Institute and ELME Studio

Another attempt at research and development collaboration is highlighted in the Finnish case study of the ELME studio in the Oulu South region.

Finland: Oulu Southern Institute and the ELME Studio

Oulu South region consists of 14 small municipalities and cities which form three sub regions (Nivala-Haapajärvi, Ylivieska and Haapavesi-Siikalatva). The name 'Oulu South region' has been in use since 1995. Oulu South region is industrialised countryside with a rather low level of higher education. Most of the enterprises are small or medium-sized, but internationally oriented. A range of educational and R&D institutions are available in the region. The Central Ostrobothnia University of Applied Sciences has more than 1 000 students and a R&D unit called CENTRIA. The School of Health and Social Care of the Oulu University of Applied Sciences have a unit of 200 students.

Oulu Southern Institute is a regional unit of the University of Oulu (established in 1958) and organises academic studies and carries out research. Its purpose is to promote and organize academic research, education and regional development in the southern part of Oulu province, in order to foster the growth and development of industry and commerce. Oulu Southern Institute was established in 2000 and became permanent in 2004. The institute collaborates with the vocational education organizations and universities of applied sciences located in the region as well as other regional development organizations. The main

research fields of Oulu Southern Institute are technology education, underground physics/astro-particle physics, RF & microwave/wireless communication research, digital media/ digital holography and future production technologies/ sheet metal technology.

ELME Studio located in Nivala is a production laboratory of electronics' mechanics and metal, which started as a pilot project in 2001-2002. The operational environment is administrated by *Nivala Technology Village Ltd.* The core of the ELME Studio is collaboration in a so-called knowledge hub. ELME Studio is comprised of experts from various organisations helping enterprises in the metal and electronics' mechanics sector in the Oulu South area to become more competitive by offering business knowledge, research and product development. The main actors besides the technology village are Educational Municipal Federation of the Kalajokilaakso region KAM and its vocational college in Nivala, *Nihak Ltd.*, which is a municipally-based development company, the University of Oulu and its regional unit Oulu Southern Institute and the R&D unit of the Central Ostrobothnian University of Applied Sciences, CENTRIA.

The laboratory of ELME Studio uses a variety of high technology equipment for sheet metal industry and tool manufacturing. Its sheet metal expertise covers the whole product life cycle and the chain of order, delivery and maintenance. It also includes the planning and design, proto and pilot testing, and the production-technical knowledge needed for manufacturing. This creates a knowledge base for research and development in respect of sheet metal materials and production technologies.

The collaboration activities undertaken here relate to research, development, education and business development while ELME Studio is *funded by various sources*. Research, development, investment, educational and other projects have been and are mainly funded by European Structural Funds (ESF, ERDF), the Finnish Funding Agency for Technology and Innovation (TEKES), the Regional Centre Programme (AKO) and the Centre of Expertise Programme (OSKE). In most cases however matched funding is needed. Covering this part of the budget depends on the project at issue. Sometimes it is seen as seed funding covered by enterprises, Nivala-Haapajärvi sub-region, the city of Nivala, *Nivala Technology Village Ltd.*, *Nihak Ltd.*, and the Educational Municipal Federation of the Kalajokilaakso Region (KAM). Getting the funding from many different sources means a lot of administrative work and negotiations with the funding organisations.

The most significant result of the collaboration is the ELME Studio itself. Thus far collaboration has enabled a change from thin sheet metal production to medium heavy sheet metal. This development can be seen in the enterprises of the sector in the region while production levels and the enterprises themselves have succeeded in maintaining their global market share and position. The collaboration

has also facilitated the implementation, application and commercialisation of new technologies. The laboratory itself is also a precondition for having the ELME research group in the Oulu Southern Institute and the Professorship in sheet metal at the University of Oulu.

Collaboration has also enabled the further development of their product, production technologies, marketing etc. To the educational institutions collaboration has meant the possibility to renew equipment, to include new research results in the educational programmes and to educate a workforce in these modern technologies. New enterprises based on research initiatives and development projects have also been established. Notwithstanding the emergence of these collaborative organisations ELME Studio has initiated a new way of networking and access to the networks that each organisation has. The collaboration, in which Oulu Southern Institute's has been active, has promoted the regional engagement of the regional unit of the University of Oulu and its Department of Mechanical Engineering. Through this collaboration the University has come into closer contact with the regional business and industrial life as well as with the local policy decision-making structures. ELME Studio has also influenced the Oulu South Educational Network and the Oulu South Higher Education Strategy as well as the strategic work done in the sub region of Nivala-Haapajärvi and in the collaborative organisations.

The main challenge here is that such collaboration which necessarily requires funding from various sources demands a significant level of administration. In order to develop further however the ELME Studio collaboration initiative also needs to be developed to meet the needs of small and micro-sized companies. Here a process or mechanism needs to be developed to transfer knowledge, created in ELME Studio, in a form that even the micro-sized companies can make use of. It is also needed to foster the development of better communication between researchers and entrepreneurs. One possibility may be to find a technology-oriented editor to cooperate with the ELME Studio. In addition, updating training sessions planned more closely with all the collaboration partners may also prove to be a partial solution.

Above all, ELME Studio illustrates that a hub may be needed to generate synergies between higher education institutions and companies in the region, in respect of both research and education.

Examples of research and development collaboration from the other case studies

An interesting example of how to organise research and development collaboration can also be found in the case study about *Aalborg University* and the ICT sector in North Jutland. Here the influence of the interest organisation NoRCOM was a key actor in initiating the major project at Aalborg University, the Centre for Tele-Infrastructure

(CTIF). The CTIF is a research and education centre concentrating on wireless technologies. CTIF has set up divisions around the world and also attracted international researchers to Aalborg University. CTIF is expected to continue to grow, and thus one can assume that it is intended to also continue to strengthen the international profile of the wireless industry in Aalborg. North Jutland's Growth Forum has allocated a significant amount of funding to the Centre for Tele-Infrastructure, thereby demonstrating the region's support for international projects strengthening research and education in the field of wireless telecommunications. Another important actor influencing research at Aalborg University is the partnership *BrainsBusiness*. In the *BrainsBusiness* partnership Aalborg University has been an active player through, for instance, taking the lead in technological development projects in cooperation with regional ICT companies.

As noted previously the Aalborg case demonstrates how organisations and networking change over time. Lately, the University has gained a more formalised role through the *BrainsBusiness* partnership which suggests that it is now moving away from its previous role as bottom up networker and initiator.

Summing up the case study findings

The fact that all of the case studies discussed here are rather unique suggests that any attempt at comparison remains problematic. This point notwithstanding however a number of interesting findings can be made in respect of the knowledge bridges discussed above. In the context of the case studies it is also the case that a number of different strategies have been exemplified, i.e. build on existing strongholds (Triple Steelix, ELME Studio and Jönköping University); to build on an emerging stronghold (RES and VRI in Agder); use "unique" assets (RES and Triple Steelix), build on previous cooperation and initiatives (VRI in Agder, Triple Steelix and Aalborg University) and branding by cluster initiatives (Aalborg and Triple Steelix).

Regarding the knowledge bridge *Education and lifelong learning* the match between the education offered and the regional demand for labour is essential in order for it to have an impact on the regional business environment. The placement of, for instance, Master's students in small and medium-sized enterprises is a win-win scenario.

The examples displaying *Business formation and entrepreneurship activities* show that science parks function as physical and organisational markers of the interaction between research, business and education. In the case studies it also quickly becomes clear that what we are dealing with here are rather complex and dynamic organisations. Having a science park 'system' in the Jönköping region, including local, regional and national authorities, private actors, etc, is thus an attempt to diffuse the impact of higher

education more widely across a region which, historically, has a weak tradition of higher education provision and attainment. The question however emerges here whether this approach implies that there are too many stakeholders with often competing interests involved thus implying that there is a risk of sub-optimisation.

Some top down initiatives are displayed regarding *Research and development collaboration* aiming at facilitation and knowledge brokering. These can be successful if they are anchored in powerful business organisations. The sustainability of the collaboration depends on the ability to respond to changes from outside and changing needs in the regional business environment. The dynamics of, and pressure from the outside, and the ability to adapt to these new conditions is a two-way process which demands a change of networks and organisations. Such responses will often be visible as formations of new networks and in the appearance of new formal or informal ways of organisation. The long-term policy support given in both the Triple Steelix and VRI Agder cases suggests however that such changes can often be hampered.

Notwithstanding these general remarks in respect of differences and uniqueness a number of similarities do nevertheless emerge. Moreover, some of these findings can undoubtedly also be sharpened by further studies.

Temporal aspects

There are also a number of important *temporal differences* between the case studies, at least concerning the establishment of the higher education institutions studied. Oulu University was founded already in 1958. However, the regional unit the Oulu South Institute was created in 2000. Aalborg University opened in 1973. The Swedish university colleges in Jönköping and Dalarna were established in 1977. The newest institutions are the University of Agder (2007), and RES, Iceland which also commenced its activities in 2007.

However, the University of Agder has its origin in a regional higher education institution established in the late 1960s. All higher education institutions, except the Icelandic one (The University of Akureyri was established in 1998 and the RES in 2007), covered in the case studies are thus examples of the great expansion of institutions which began, across the Nordic area, in the early 1960s.

In many of the case studies there has been a *history of cooperation* and the investigated initiative has built on a previous cooperative relationship. This suggests that where hard won trust is established between actors from the business world and the higher education sector it is important to maintain it. Examples of rather long-term initiatives (Triple Steelix and VRI in Agder) particularly in respect of financing, also exist, suggesting that this may be essential in establishing a stable collaborative process that is robust enough to be invigorated and re-invigorated on a case by case basis.

Focus of R&D and education

In almost all of the case studies there is a strong focus on technology and natural sciences and on cooperation between higher education institutions and companies. There is also an emphasis on cooperation with *small and medium-sized enterprises*. A challenge in respect of many of the initiatives reported on here has been to ensure that the competence level is increased in small and medium-sized companies (for instance ELME Studio and Triple Steelix) which thus far have had little experience of research and education.

The strong focus on technology also implies a gender dimension since technology education is historically, and remains, male dominated (see figure 5 and 6). The focus on technology in collaboration projects is also acknowledged in other studies. Active collaboration between universities and external actors is already an established tradition within technical, science and medical research circles. The social sciences and humanities are however not as well developed in this regard (ITPS 2004:55, Øster 2009¹³). In Øster (2009), it is however stressed that increasing emphasis on the users in development processes will offer opportunities for other types of disciplines to collaborate more actively.

In the Jönköping case study it becomes clear that business schools can work as a foundation for *entrepreneurship education*. This education is also integrated into the science park which is partly owned by the University through the encouragement of students to develop and test ideas in the Business Lab.

If a local, regional, national or even international workforce is educated differ between the higher education institutions covered in the case studies. In the Aalborg case the education offered matched the competence that the companies belonging to the regional wireless cluster needed. But it may also be seen more or less as a coincidence that the first engineers graduated at the same time as demand was high in the local economy. NoRCOM has undoubtedly however influenced the education programmes of Aalborg University such they were adapted to the needs of the industry with many graduating engineers staying on in the region. An example which points in the opposite direction is the education of the RES students, where the aim is to attract international students the vast majority of whom will leave after finishing their studies.

No critical mass exists in the region which would allow it to use the potential offered by RES. The lack of absorptive capacity of a region, tracking its ability, or otherwise to absorb the student's knowledge, technology and innovations generated is a problem, since this ability is seen as being crucial in the regional 'internalisation' of the benefits produced by these higher education institutions

(ITPS 2004:56 referring to Florida Cohen 1999).

The education and life-long learning examples in the case studies have mainly focussed on relations with the private sector. It should however be stressed here that a large public sector employing people with higher education qualifications exists in the Nordic countries. The connection of higher education institutions to companies and also to some extent public employers is evident in education offered at Aalborg University, the University of Agder and Dalarna University, where such contact is encouraged through i.e. project work and placement schemes. These approaches serve as good practice examples of how cooperation with the surrounding society can be integrated in the other tasks.

In the mapping exercise of education and research in Nordic regions reproduced in chapter 2 significant regional differences were displayed. We can also assume however that significant differences exist within regions in respect of both education levels and R&D intensity. An interesting approach to ensuring that the impact of a university is diffused across the entire region is the establishment of the science park 'system' in Jönköping region. Notwithstanding anecdotal evidence however the specific effects of this remain as yet indeterminate. This may be connected to the fact that it remains a challenge to establish new "strongholds" where the regional absorptive capacity, for instance in respect of the industrial area of Cultural and experience-based industries in VRI Agder and RES in Iceland, is limited. If, however, these initiatives are based on a more profound assessment, i.e. a SWOT analysis, the risk of failure may be lessened.

Involved actors

Many of the case studies include some form of *triple helix* approach, specifically aiming to unite the three helices of public authorities, private actors and the research and education sector. The many initiatives discussed here usually strive to encourage this type of interaction., This approach is not however beyond criticism. Drawing from the comparison of two cases of universities established as regional boosters in the 1960s, namely, Tromsø and Joensuu, Arbo and Eskelinen (2003) focus on the realisation of the local and regional development potentials of such institutions.

This study notes that the conceptions of triple helices and regional innovation systems are constructions of imagined systems with pre-defined actors, institutions and relationships. The Joensuu and Tromsø cases thus amply illustrate that a neat and tidy single regional innovation system which can be easily understood and easily referenced simply does not exist. Instead, we have a multitude of networks, social structures, and mixes of

¹³Based on a survey with 25 universities in Canada, Denmark, Finland, Germany, the Netherlands and Sweden.

institutions and patterns of innovation. Furthermore, while it is also stressed that higher education institutions interact with sections of their regions it should also be remembered that they are also parts of the global networks of academic communities.

This finding suggests that there remains a firm demand for flexible and dynamic organisation, as in the Aalborg case. It is thus also important to avoid 'locked in' situations where organisations are maintained even if they do not fit new or emerging needs. The complex systems and collaboration initiatives are also calls for a definition of clear objectives, i.e. as in Triple Steelix, which harmonise the existing and developing cooperation between the various stakeholders.

The role of *networks*, mainly formalised, between universities and also between universities and other education institutions, providing both higher and lower level education, is rendered particularly visible in the Finnish case study concerning ELME Studio. A network approach is also visible in the Triple Steelix project, where it is stated that the inclusion of higher education institutions in projects is dependent on the competences needed in each specific project, not where it is located. Triple Steelix also works as a network for small and larger companies.

Aalborg University has participated in several flexible bottom-up networks which are able to develop and transform in accordance with the tides of economic and political change. It is clearly revealed here that networks and organisations linking research and business are complex and dynamic systems with many centres of power. In VRI in Agder however it remains to be seen whether this kind of development will be accomplished in top-down manner.

Each of the case studies highlights the importance of *internationalisation* and that the networks of the universities stretch beyond the region to other universities and companies in neighbouring or more distant regions in the same country and abroad. In the Aalborg case, the internationalisation of the Centre for Tele-Infrastructure, which also works as a tool for branding the region is one such example of this. Similarly, the establishment of the

RES network utilised an international approach and may be seen as a way of overcoming the lack of critical mass locally. It also helped to highlight the fact that *functional regions* become more important in optimising access to competence and businesses, such as for instance was highlighted in the Triple Steelix case and VRI in Agder.

In the Aalborg case and that of the RES in Iceland the fact that specific individual actors are important in making things happen is a significant conclusion. Dependence on a few individuals however implies a certain level of vulnerability as development may be hampered if such individuals disappear.

Organisation and the financing of initiatives

In the case studies all initiatives displayed are based on a formal organisation. Some however began life as rather informal activities. Some initiatives are constructed from the *bottom up* (NorCOM in Aalborg and Science Park Jönköping) while others are *top down* (such as the VRI project in Agder and Triple Steelix). Differences also emerge in respect of whether the initiative was *private* or *public*. In general however a mixture of these is the norm. The role of a strong private actor is highly visible in the case of the Triple Steelix project and in some of the projects connected with Aalborg University and Science Park Jönköping. Public initiatives can be seen in the Norwegian case featuring VRI in Agder, and in respect of ELME Studio in Finland

Policy initiatives, mainly national and regional, have played a role in all cases since the *financing* sources for the specific initiatives are almost always based on various public sources, though matched funding is often required. One advantage with matched funding is that it enables commitment in the projects, on the other hand however it renders a project vulnerable and dependent on the finding of that matched-funding. Due to the financing situation the connection to i.e. *regional development strategies* is more or less explicit. In order to attract the necessary financing, a project generally needs to fit a policy context. Here there is a risk however that this 'policy context' more or less predefines exactly what types of collaboration project will take place.

4. Observations and reflections

The overall aim of this study has been to explore how universities and university colleges can work as instruments of regional development policy. It must be stressed once again however that the direct effects of university activities on regional development remain difficult to prove. We have however found a number of examples of good practices from interactions between higher education institutions and the surrounding business environment in the context of the case studies which may indeed contribute to regional development.

Below we present some of these good practices which may be considered when discussing how universities can best be used to further regional development. These observations are presented in accordance with the stated higher education institution tasks of education, research, cooperation with the surrounding society and cultural and community development. It must however, be noted that the distinction between the tasks is not that clear cut in respect of their ultimate impact on regional development.

Collaboration with the surrounding society may also be seen as an integral part of the education and research tasks rather than as a separate task per se. This is also emphasised in an OECD report (2007). We also point to some of the knowledge gaps that need to be further explored in order to obtain a more systematic knowledge of how higher education institutions can work as drivers for regional development. Finally, we present some considerations in respect of the policy implications of using universities as regional drivers.

Good practice and knowledge gaps

Knowledge transfer through education and human resources development

Concerning the issue of how higher education institutions can best be used for regional development purposes the following good practices emerging from the case studies can be highlighted:

- *A match between the education offered and the regional labour force demand* (as in the Aalborg case) may contribute to enhancing the impact on regional development.
- *Project or problem-based learning and student outplacement* (as for instance at RES, Dalarna University, Jönköping University, Aalborg University and the University of Agder) connected to private and to some extent public employers in the region, is one way of including the surrounding (regional) society in the education task.

- *Entrepreneurship programmes* (as at Jönköping University) provide an example of how the educational task can best be developed to encourage firm formation in the regions.
- *Up-skilling and life-long learning approaches*, (highlighted in the case of Aalborg University), provide a way to ensure increased competence levels in the population which is also sensitive to the needs of regional employers.

Knowledge gaps

A development that has not been dealt with in the case studies but that we encountered during their preparation was the increased role played by *distance education* over the last decade. This aspect may be further investigated with a view to discerning what impact this may have had on regional development and the development of a knowledge-based economy. It undoubtedly provides possibilities for life-long learning, however, making education “place-independent” may also influence significantly impact the level of influence a higher education institution may have on its regional surrounding.

In addition, the potential effects of current consolidation processes among higher education institutions and the move towards a *two-tier system*, Master’s and PhD level institutions versus institutions providing programmes only at the undergraduate level, due to the Bologna process and its connection with regional development needs to be further elaborated.

Knowledge creation through research and technology transfer

As regards the good practices in respect of research approaches displayed in the context of the case studies the following can be stressed:

- Inclusion of regional aspects relating to the higher education institutions’ particular areas of *competence and strength* in the research strategies of the university colleges (as for instance in the ones of Dalarna University and Jönköping University).
- Emphasis on *applied and need/user driven research* connected to companies in the region (as in the cases of Triple Steelix, VRI in Agder and ELME Studio).
- Establishment of *facilities*, such as laboratories, connected to companies in the region for joint research projects (as the case of the ELME Studio).
- Employment of *industrial PhDs* in companies in the region (as for instance in Triple Steelix).

Knowledge gaps

In terms of research more knowledge is needed on how to develop modes of collaboration with the regional surrounding that go beyond the traditional focus on technology development encompassing social, service and organisational development in the private and public sector (see also OECD 2007). In the Nordic countries, graduates with a higher education make up a significant part of the public sector workforce. The potential for higher education institutions to develop knowledge-intensive private and public social services may be interesting to explore further.

Cooperation with the surrounding society and cultural and community development

Regarding the issue of cooperation with the surrounding society we highlight the following good practices:

- *Science parks* (in for instance Aalborg and Jönköping) are a tool for education, research and cooperation with the surrounding society. The existence of a *broad partnership* behind the science park contributes to connecting the university with the regional business environment and ‘roots’ the university in the regional context.
- In most of the universities covered in the case studies there was *regional representation* (private and/or public) on the board of the institution.
- *Collaboration with other higher education institutions* within the country and abroad, implies improved access to relevant knowledge (as for instance CTIF at Aalborg University, Triple Steelix and RES) of use to companies in the region.
- A higher education institution (such as for instance Aalborg University) may function as a *platform for building networks* which can be used for branding the region and making the region more attractive to external investors.
- A *facilitator or a “hub”* (as Triple Steelix and VRI in Agder) facilitates the cooperation between companies, public actors and higher education institutions and works as a knowledge broker between the different “worlds” of universities and private companies. Having process leaders that divide their time between the project and companies, research institutes, and public actors in the region is a way to enhance the interaction. A future challenge here is whether it will be possible to make this cooperation run without facilitation and extra public financing.

Knowledge gaps

The challenge however remains in respect of how to measure the direct effects universities have on regional development and the causal relation between the two. More knowledge is therefore needed here so the establishment of universities does not simply end up as a “symbolic” policy in the promotion of regional development and

the knowledge-based economy. More knowledge is also needed here concerning the question of whether the pooling of resources is appropriate. A better understanding of the way in which of different knowledge fields within the higher education institution are organised and what expenses incurred at the institution may have an effect on regional development, may counter this need. But this requires a more profound theoretical foundation and more differentiated data (See IIPS 2004:60).

Considerations in respect of the policy implications

To sum up it can be concluded from this study and the displayed “knowledge bridges” that higher education institutions can play a considerable role in respect of regional development.

- By offering educational opportunities to the workforce which match the needs of private and public employers in the region, the regional impact of the institution may be enforced. The offering needs however to be dynamic and responsive to changing needs.
- Secondly, knowledge creation and research at higher education institutions can provide the public and private sectors in the region with enhanced competence levels thus contributing to the development of a knowledge-based economy. This is however a two-way process where private companies and the public sector organisations need to effectively relay their needs to the university. In the context of this process a higher education institute may also work as a broker for other universities with the competences needed.
- Finally, there is also a connection to entrepreneurship in the region, by for instance offering entrepreneurship programmes and also by establishing science parks, including incubators etc., where new companies can be developed. Also the outplacement of students in smaller and medium-sized enterprises may contribute to them discovering these companies as future employers or to encouraging them to start up their own businesses.

As emphasised in Reglab (2006) there is no “quick fix” to the task of transforming the knowledge produced and disseminated at universities into regional growth. In Øster (2009) it is concluded that the universities themselves do not possess sufficient resources to develop the necessary infrastructure for the exchange of knowledge with other universities, companies or other private or public institutions on their own. Thus action needs to be taken by other private and public actors. Here a strategy dealing with how universities may better contribute to regional development needs to be developed by universities, companies, regional and local authorities jointly in order to create a framework for single projects. Here regional public actors can play a role ensuring that the university contributes to position

the region on the global market by, for instance, providing strategic development expertise based on assessments, including the development of the higher education institutions in regional strategies and linking business life development to education and R&D (see Reglab 2006).

The role of public actors is thus to *facilitate* interactions by providing arenas and funding. However, the interactions between higher education institutions, companies and public actors are complex systems which are difficult to steer since they involve actors at different levels (local, regional, national and international) with different tasks and objectives. This complex system needs clear objectives to be defined in order to harmonise the interests of the various stakeholders. In order to avoid 'locked in' situations where organisations are maintained even if they do not fit new needs, flexible and dynamic organisations must also be encouraged. Here, there is a balance to be struck since they need to be robust enough to take the time needed to react to new challenges.

In a report from ITPS (2004:52; 60-63) it is noted that the development of *social capital*, defined as social networks inside and between organisations and the values connected to them, is essential in order to be able to further develop the effects had by the universities in their regions. This social capital must be developed both within the university and in the regional context. Here, new incentives for cooperation are mentioned. One such example here could be political acceptance of the granting of greater autonomy to these higher education institutions nurturing their questioning and innovative role in order to further develop their function as a collaborative partner.

The social dimension is also visible in relation to the case studies undertaken, especially when it comes to highlighting the role of *fireballs and visionary individuals* from the different sectors, i.e. companies, higher education institutions, and public actors, have in developing new collaboration initiatives and networks. The successful initiatives displayed in the case studies were – and are – created more by accident than by design.

Here the challenge remains to go from being dependent on individuals to the systematic establishment, management and embedding of these links into concrete networks. The challenge here is to ensure that flexible

and dynamic networks are developed, so that they do not become pre-defined and static. In a study by Asplund & Nordman (1999:31) it is noted that relations built on private connections are the only relations of interest. Centralised organisations for external contacts tend to be highly overrated. "Firms with specific demands for certain knowledge directly confront the individual departments of concern, instead of using a mainstream entrance".

At different policy-making levels some general issues also need to be considered in order to more effectively use higher education institutions as an instrument of regional development:

- Firstly, a *definition of what the cooperation task with the surrounding society* is needed. Education and research policies and regional development policy are often managed by different ministries. If the *regional* dimension of higher education is to be made more explicit, better coordination between ministries is needed.
- Secondly, the *incentive structures* for researchers working in higher education institutions may be further developed to promote cooperation with the surrounding society including private sector companies.
- Thirdly, the funding situation in respect of fulfilling the task of cooperation with the surrounding society and with the business community in particular is not very robust. Here the development from small scale and short term projects to *long-term structures* may be considered.
- Finally, *more knowledge* is needed concerning the direct effects universities potentially have on regional development, in order to avoid the promotion of merely 'symbolic' policy. More knowledge is also needed as regards the issue of whether the pooling and centralisation of higher education institutions represents the best way forward for the Nordic countries. The findings contained in this study suggest that such an approach may indeed have negative consequences in respect of the move towards a *regional* knowledge-based economy.

Appendix: The classification of Nordic higher education institutions according to education levels

The descriptions drawn and regional analyses made in the context of this study incorporate higher education institutions that provide public and private long-cycle education. These incorporate most institutions that provide tertiary education according to the 1997 International Classification of Education (ISCED) at the ISCED 5 and ISCED 6 levels, although with some modifications: ISCED 5 is the first stage of tertiary education, and does not lead directly to an advanced research qualification. Education programmes at this level makes a distinction between theoretically based/research preparatory programmes (such as history, philosophy, mathematics etc.), and those that give access to professions with high skills requirements (such as medicine, dentistry, architecture etc.), and those programmes that are practical or occupationally specific. The first type of programmes are termed ISCED 5A, while the latter, and shorter type of educational programmes are termed ISCED 5B.

– in Finland the polytechnics, and in Denmark the new amalgamated University Colleges¹⁴. In www.eurydice.org, these institutions are termed providers of medium-cycle non-university education.

The *ISCED 5* level includes programmes which are not part of a doctorate. Typically they might lead to a Master's degree. In some countries, adult education programmes may be equivalent in content with some ISCED 5 programmes. The ISCED 6 level corresponds to education at the second stage of tertiary education, and leads to an advanced research education. The education programmes are based on advanced studies and original research, and not on course-work only. In the end, graduation requires the submission of a thesis or a dissertation of publishable quality that thus should represent a significant contribution to new knowledge-making. This requirement delimits the Nordic sample to what the OECD (2008) has defined as the following providers of tertiary education (Table 1).

Table 1: providers of tertiary education in Nordic countries (2008)

	Denmark	Finland	Iceland	Norway	Sweden
Public and state universities	8	20	5	12*	14
Private universities/colleges			3	1	3
Public and state university colleges	7			24	21
Academies of arts				2	
Polytechnics		26			
Minimum number of HEIs	15	46	8	39	38

*: including specialised university institutions (*vitenskaplige høyskoler*)
Source: complemented with data on Denmark from OECD (2008)

The current organisational structure of tertiary education in the Nordic countries (as of January 1st 2009) varies, and in some countries long stream (ISCED 5A) as well as short stream (ISCED 5B) programmes may be offered by the same higher education institutions. In others, such as Finland and Denmark, regionally significant ISCED 5B programmes such as nursing and teaching are offered by specialised institutions. In Sweden and Norway, these two short stream professions are offered by University Colleges. To provide comparable results across all Nordic countries, the maps include those ISCED 5B institutions that provide nursing and teaching programmes

The analysis does not include specialised ISCED 5B institutions which offer programmes that produce graduates to serve the public sector at the national level (military colleges or national police academies). In total, the number of current higher education institutions included in the descriptive status report as of 2009 can be set at 146 institutions. Most – but not all – provide education programmes up to the ISCED 6 level. Institutions providing programmes at the ISCED 5 in the Faroe Islands and Greenland have also been incorporated into the cartographic displays.

¹⁴Note the confusion of terminology: in Norway and Sweden, university colleges may provide education at the ISCED 5A, 5B and 6 levels. In Denmark, the newly established university colleges (the newly amalgamated regional *professionshøjskoler*) merely provide education at the ISCED 5B level.

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