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Innovation Networks in Different Industrial Settings: From Flexible to Smart Specialization

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Abstract

The key research objective of this paper is to analyse industrial specialisation by developing innovative networks linked to the region. Institutional and entrepreneurial innovation systems, smart specialisation and a network based research framework for entrepreneurship are used as conceptual foundations in the paper. Based on theoretical elaborations our analyses illustrate how certain interventions have stimulated regional development and innovation in two specific Scandinavian regions. Our results highlight that both regions have gone from interventions fostering flexible specialization, with the motive of staying resilient and competitive over time, to an approach based on smart specialization with a focus on one or a limited number of strong industries.

Keywords: *innovative networks, part dependency, regional innovation, smart specialisation*

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1. Introduction

A growing interest in the region as a base for economic organization and political intervention has been eminent in recent decades of research within economic geography and regional development. Many studies have documented how rapid technological change and increased capital mobility have influenced the competitiveness and attractiveness of regions (see for instance Amin & Thrift, 1995; Tödtling, 2012). Renewal through innovation has been a suggested remedy for coping with changing demands. Many studies, not least in regional development, have moreover postulated that innovation is a necessity for keeping organizations and regions resilient to fluctuations in markets and to increased competition. To build networks for the purpose of developing new innovative products, services and/or organisational solutions/processes is, in a time when open innovation, outsourcing and innovation systems are honoured, an often occurring theme in research. The configuration of such innovative strategic networks is normally understood as conscious management initiatives based on enlightened individuals employing functional strategies. In this study we argue, however, that innovative configurations to a significant degree are path-dependent and result in innovation systems that are very different depending on what sector of industry and business that is in focus. It may e.g. be suggested that patterns and modes for innovative collaboration in traditional basic industries as compared to more recently founded hi-tech industries will probably be quite different. This assumption also represents the first research challenge for this study.

A second research challenge is to discuss the consequences of such an assumption. A highly popular concept in today's European policies is to support and stimulate regions to develop a smart specialization strategy, meaning specializing in one or a few strong regional industries or knowledge bases (cf. Foray et al., 2011; McCann & Ortega-Argiles, 2011; Foray, 2015). Smart specialisation strategies have been diffusing at a rapid pace among European regions in recent years. The smart specialisation concept is however still a relatively novel approach and there are aspects of it that deserve more attention and research. While the concept of smart specialization speaks in favour of developing and exploiting a regional focus, voices are also raised in favour of regional policies that strive for diversification in order to prevent the risk of regional lock-in effects (cf. Essletzbichler, 2007; Bishop, 2009). Employing diversification rather than a strong focus promotes organizational/regional resilience and counteracts the risk of regional lock-in effects, but also includes the risk of becoming "stuck in the middle" without any real possibilities to develop a regional and company-based competitive advantage. Moreover, it should be noted that there is no "ideal model" for innovation policy as innovation activities differ strongly between e.g. central, peripheral or older industrial areas (Tödtling & Trippl, 2005; Asheim, Boschma & Cooke, 2011). The literature on smart specialisation in rural and peripheral regions is gradually emerging. Issues of specific interest include e.g. the potential and possibility of a smart specialisation approach to overcome the urban bias of past innovation policies

(da Rosa Pires et al., 2014, p.1). Moreover, there are good examples of successful initiatives in rural and peripheral areas which make use of natural resources - which often play a crucial role in such areas - in an integrated way (da Rosa Pires et al., 2014, p.9-10).

The key research objective of this paper is to analyse industrial specialisation by developing innovative regional networks linked to the region. In order to analyse regional innovative networks and networking, the paper introduces and discusses institutional and entrepreneurial innovation systems (Cooke & Leydesdorff, 2006), the concept of smart specialisation (see e.g. Foray, 2015), and analytical frameworks used in network-based research in entrepreneurship (Hoang & Antoncic, 2003) as main theoretical approaches. Our paper addresses the challenges for an innovative regional development in optimizing the level of regional specialization by developing innovative networks linked to the region. Based on an explorative approach we especially question how a focus on specialization influences resilience and lock-in effects in regions. We also question which consequences such a strategy implies regarding modes for and support to innovative networking.

Our research approach is explorative and focuses on how regions focus on a shifting form of industrial specialization. The empirical material is based on two very specific regions in the Nordic countries of Sweden and Finland. The case study regions of Luleå in Sweden and Oulu in Finland were selected for several reasons. Firstly, these non-metropolitan regions in the North have an industrial structure and historical development with certain similarities but also significant differences. Moreover, the authors have studied the industrial and regional development of the case study regions over a long time period of time. Our research is based on repeated interviews conducted over a 25 year time-period with policy makers, entrepreneurs and academics in the studied regions. This is in line with proposals advocating longitudinal research based on “multi-method and qualitative research designs” (Hoang & Antoncic, 2003, p. 167) when attempting to further deepen our understanding of the dynamics in regional innovation and competitiveness.

The paper is structured in three main parts. The literature review introduces the key theoretical concepts and sets the scene for the empirical work. The empirical part presents the two case study regions of Luleå and Oulu, and compares their industrial and regional development over time. The final discussion includes an analysis of the implications for theory and practice.

2. Exploring key concepts

Managing path dependency and innovative collaboration

Michael Hannan and John Freeman – often referred to as fathers of the population ecology approach – have suggested that organisational development could be regarded as a result of a struggle for survival, where the organisations we see around us are the survivors of past processes of organisational founding and dissolution (Hannan & Freeman, 1989). With its roots in Darwinistic thinking, evolution then becomes

a process driven by natural selection where organisations with specific resources and expertise which make them well adapted to their environment develop and prosper, while generalist organisations without any organisational specialities normally face much tougher survival conditions (Hannan & Freeman, 1977). This kind of basic thinking – developed further by Nelson and Winter (1982) – has had a significant impact on research addressing organisational innovation (see e.g. Tushman & Andersson, 1986; Gersick, 1991; Romanelli & Tushman, 1994; Metcalfe, 1998) and to some extent in studies on regional development (St-Jean, LeBel & Audet, 2010).

Recognizing the relevance of evolutionary processes is also a prominent characteristic of research related to innovation and innovation networks and systems, e.g. research on regional innovation systems (e.g. Asheim, Boschma & Cooke, 2011), sectoral innovation systems (e.g. Malerba, 2005), technological innovation systems (e.g. Carlsson & Stankiewicz, 1991) or development blocks (Dahmén, 1950, 1984). To understand the development of an innovation system as an evolutionary endeavour means that the evolutionary process in itself is in focus. To design research that addresses the evolutionary processes in play when innovation systems emerge and develop is however a challenge that still occupies researchers in the field, e.g. referring to the importance and role of path dependency in these kinds of evolutionary processes and the emergence of different kinds of innovative systems and constellations.

The fact that collaborative network structures may take different forms is not any new nor revolutionary insight, and was a theme already in Annalee Saxenian's classic study on culture and competition in Silicon Valley and Route 128 (Saxenian, 1994). While the industrial cluster in the Boston area was characterized by vertical integration where information exchange between independent and self-reliant partnering organizations was closed and non-transparent, similar clusters in the Bay Area was by Saxenian depicted as porous networks collaborating on the basis of specialized expertise, and where intended and unintended knowledge spill-overs were common. In a more recent study, Phil Cooke and Loet Leydesdorff (2006) advocated the idea that innovative network configurations in the US and other Anglo-American economies are different from innovative networks in countries such as the Nordic countries and Germany. The former were characterized as entrepreneurial regional innovation systems (ERIS) and the latter as institutional regional innovation systems (IRIS). ERIS are characterized as an entrepreneurial innovation system which due to its lack of well-developed and established institutional systems relies on individual actors dressed as entrepreneurs, venture capitalists/business angels, researchers, incubators and demanding pioneering customers for developing innovations primarily on the basis of analytical and research-based knowledge. The latter variant – the institutional innovation system – is developing and exploiting synthetic, engineering-based knowledge and builds on a close collaboration between structures for production, knowledge development, and institutional frameworks.

There hence seems to be evidence that network configurations may

differ depending on geography and location; an understanding further underlined by Michael Porter's cluster concept and Richard Florida's concept of "the creative class" and its preferences for specific hot spots (Porter 1998; Florida, 2005). It may however also be suggested that patterns and modes for innovative collaboration in traditional basic industries, as compared to more recently founded hi-tech industries, are different regarding hierarchy, network centrality, confidentiality and openness (Mort & Weerawardena, 2006; Heidenreich, 2009). In traditional industries collaboration may hence be expected to be characterised by high density and strict hierarchy where the top of the hierarchy also shows a high degree of network centrality. In such settings there are strong links between partners securing confidentiality and long-term relations. Decision-making in these industries is based on the need for planning and control; "causation" in the wordings of Saras Sarasvathy, 2001. In more recent and high-tech oriented industrial configurations geared towards innovation, on the other hand, relations are typically not as dense and hierarchies are not that pronounced. These settings sometimes include several rudimentary partners possessing similar resources and expertise and are often characterised by weak and only occasionally salient partners. Decision-making is founded on the logic of taking action based on available or accessible resources: "effectuation" (Sarasvathy, 2001).

As a consequence of these basic differences, the innovative systems configured by actor networks are very different. While collaborative configurations aiming for innovation in more traditional basic industries normally reveal similarities with institutional regional innovation systems or IRIS (Cooke & Leydesdorff, 2006), corresponding collaborative configurations in modern high-tech industries such as ICT and biotech best are understood as entrepreneurial innovation systems or ERIS (ibid.). As elaborated by Ylinenpää (2008), these two models of innovation systems are very different regarding e.g. type of innovation processes occurring, time perspectives, organisational structures, and decision logics. IRIS-based systems rely on planned and long-term innovation processes where institutional actors operate in well-defined organisational structures where decision-making is based on risk-minimising and causation (Sarasvathy, 2001). ERIS-based systems, on the other hand, are characterised by their action-based innovation processes where "learning-by-doing" among participating and sometimes loosely coupled individual actors form an emerging innovation process based on "effectuation" (ibid.) where available or accessible resources are the point of departure for concrete action.

In an overview of network-based research in entrepreneurship, Hoang and Antoncic (2003) distinguish between three essential components of networks: (1) the content of the relationships; (2) the governance of these relationships; and (3) the structure or pattern that emerges from the crosscutting ties. In the construct of *content* they include those relationships that offer actors access to resources held by other actors (e.g. physical or immaterial resources such as information, advice or image/reputation). By *governance* mechanisms they understand means of

coordinating or leading network collaboration in terms of trust, contracts, power relations and hierarchy. Their third construct (*network structure*) emanates from network theory and includes different measures related to network positioning, size and structure (centrality, structural holes; interfaces/bridges etcetera). We will in this paper make use of these constructs to discuss differences and similarities between different types of collaborative network structures. In the following theoretically deduced framework we adopt the perspective that innovative networks in different lines of industries may be characterised by their network content, governance mechanisms and network structure, and that these characteristics may be summarized as an orientation towards either an ERIS or an IRIS mode of network collaboration following the distinction made by Cooke and Leydesdorff (2006).

As summarised in the framework in Table 1, the two different types of innovative configurations thus emerging may be expected to expose very different characteristics. These characteristics may be understood to result in different strengths and weaknesses and to be exposed to very different kinds of opportunities and threats. Innovative collaboration in more traditional and mature industries may hence be expected to reveal specific strengths when it comes to seek new innovative solutions related to efficiency (process innovations) - the classic message in Utterback and Abernathy (1975) - but to run a higher risk of being trapped into rigid and non-innovative partnerships. Innovative networks in new industries may on the other hand be expected to be more characterised by dynamic collaboration aiming for innovative products and services (effectiveness), but run the risk of opportunistic behaviour and unintended knowledge spill-overs (Kuang-Chieh, 2008).

Table 1: Framework for analysing innovative networks in different settings (developed on the basis of Hoang and Antoncic, 2003)

	Dominating mode in traditional industries	Dominating mode in new industries
Examples	Exploitation of natural resources, tourism	Hi-tech industries in ICT, bio-tech etc. Media businesses
Network content (Hoang & Antoncic, 2003)	Process innovations in focus, where access to suppliers of components and services at arm-length distance is critical. Closed innovation systems with absorptive capacity directed towards established partners integrated in the value chain. Limited knowledge spill-over outside the partnership.	Product and service innovations in focus where access to complementary resources/ competences regardless of location is critical. Open innovation systems where absorptive capacity is directed externally. External knowledge spill-over common.
Governance mechanisms (Hoang & Antoncic, 2003)	Planned research program based on the need for overview, control and risk-minimizing, and on long-term relations building on trust and contract forming stable local (mechanistic) configurations. Decision-making through causation – planning for and controlling the future.	More ad-hoc based processes based on experimental learning and on short-term win-win relations forming dynamic and organic porous network configurations. Decision-making through effectuation – actions based on available or accessible resources.
Network structure (Hoang & Antoncic, 2003)	Institutions (companies and organisations) important. Relation to academic partners based on long-term and institutional collaboration (research programs).	Individuals acting on behalf of institutions important. Relation to academic partners based on collaboration with individual researchers on more short-term basis (research projects).
Overall characteristics (Cooke & Leydesdorff, 2006)	An orientation towards an IRIS mode of network collaboration.	An orientation towards an ERIS mode of network collaboration.

Smart specialisation

Smart specialisation is the European Union's jobs and growth strategy, which was launched in 2010 to create the conditions for smart, sustainable and inclusive growth (EC, 2010). Where former innovation strategies were focusing more on national or sectoral levels, and thus limiting the possibilities of many regions to fully participate in the innovation programmes and activities, the current smart specialisation approach to regional innovation policy is based on a new "understanding of the role played by innovation in economic development and in particular its relationship with geography" (McCann & Ortega-Argilés, 2013, p.187). The concept of smart specialisation was first developed to address the gap in R&D investment between Europe and other global competitors, especially USA and Japan (Foray & Van Ark, 2007). Despite its sectoral origins, the concept was able to accommodate the place-based approach as advocated in the Barca Report (Barca, 2009). The smart specialisation approach has been being promoted by the EU as the basis for the EU structural funds programme period 2014-2020. Moreover, a smart specialisation strategy is even a requirement for the EU member states and their regions to receive structural funds in the programme period 2014-2020. Following the Organisation for Economic Co-operation and Development (OECD) (2013, p. 17) we define smart specialization as an:

industrial and innovation framework for regional economies that aims to illustrate how public policies, framework conditions, but especially R&D and innovation investment policies can influence economic, scientific and technological specialisation of a region and consequently its productivity, competitiveness and economic growth path. [...] taking into account regional specificities and inter-regional aspects, and thus a possible way to help advanced OECD economies – as well as emerging economies- restart economic growth by leveraging innovation led/knowledge- based investments in regions.

Smart specialization assumes that regions cannot do everything in science, technology and innovation. As such, regions need to promote what should make their knowledge base unique and superior. To ensure distinctive and original areas of specializations regions need to identify and focus on a few domains. A focus on a few domains also creates potential for scale, scope and knowledge spillovers, which in turn is necessary for driving competitive development of the region.

The complexity in a transformation process into a smart specialization strategy lies in many aspects, not least the discovery of the right domains of future specialization but also in fixing the many coordination failures which can hinder emerging domains from becoming real.

A key concept on smart specialization involves 'an entrepreneurial discovery process' that reveals what a country or region excel in terms of Research and Innovation (R&I) (Foray et al., 2009). Following Foray et al. (2011) the entrepreneurial process stimulates an emergency of new knowledge vis-à-vis regional specialization and as such stimulating the development of the regional economy. In doing so, smart specialization

also enables synergies (scale and scope economies and knowledge spill-over effects) among existing and established regional industries. In the following section of this paper we will use empirical illustrations from two Nordic regions as a test-bed for addressing the relevance of the suggested framework.

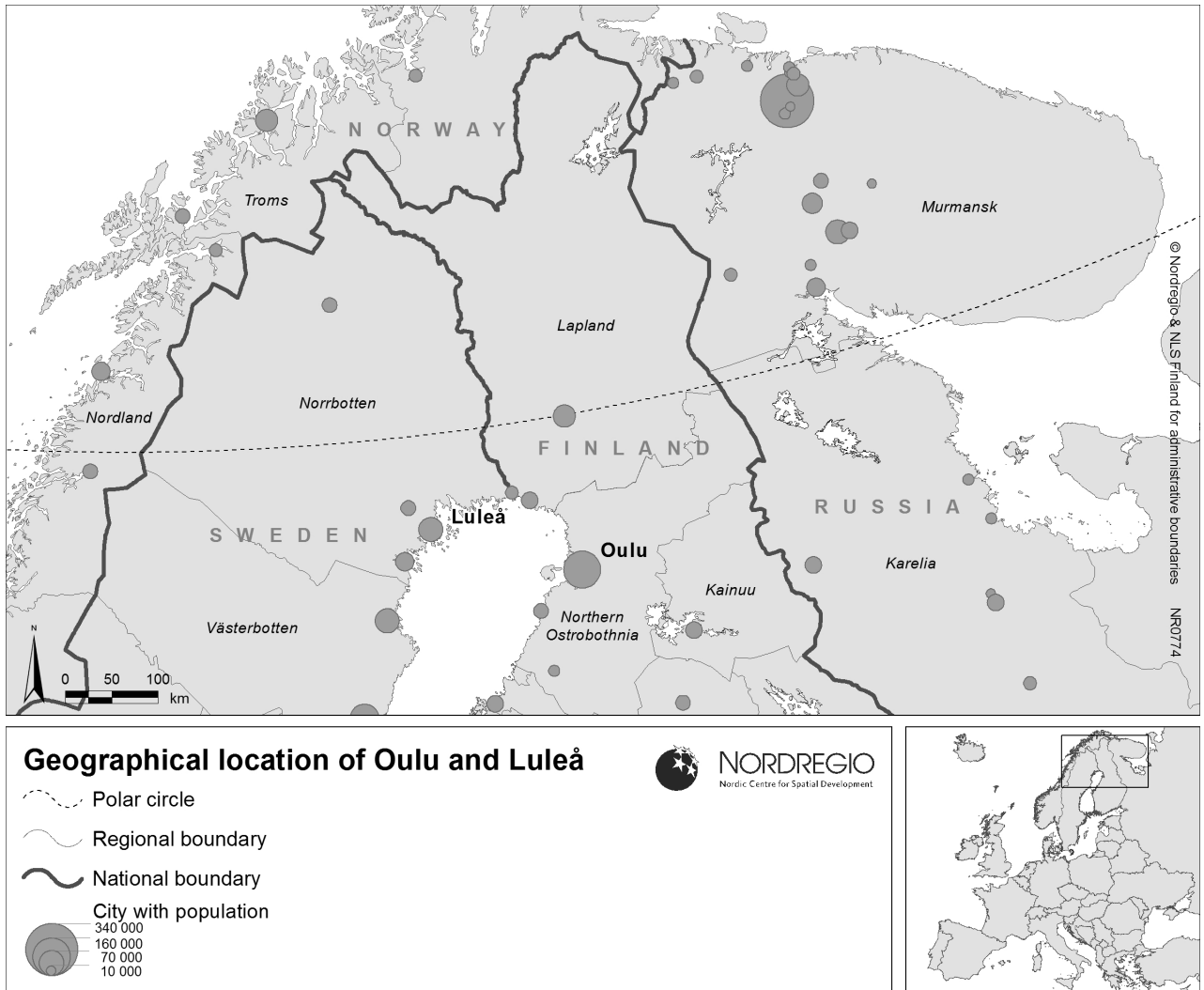
3. Our empirical test-bed: two Nordic sister regions

Luleå and Oulu, the locomotive cities of the northernmost parts of Sweden and Finland, respectively, are both located at the Gulf of Bothnia in Northern Europe, Luleå at the west coast and Oulu at the east coast of the gulf. Both cities have their historical roots in Sweden's imperial era in the 17th century and the mercantilist economic policy dominating this period. Luleå was granted the privileges of being a city (i.e. a monopoly to manage trade and thereby serve as a node for the state's tax-collection) in 1605, and Oulu was granted a similar position in 1621.

In Luleå, a more significant process of growth started during late 19th century as a result of the growth of a saw-mill industry, rail transport and the out-shipment of iron ore. A more substantial growth did not however emerge in Luleå until the 1950's, when an ironworks was located in the city and firms in mechanical engineering emerged. Luleå University of Technology was established in 1971, with a marked orientation towards the need for research and future employees in the region's historically important, but now mature, industries. Luleå University of Technology has today two faculties and about 16,000 students. Between 1970 and 1997 the number of inhabitants in the Luleå region (Norrbotten) increased with 3% and with 21% in the city of Luleå. Between 1998 and 2006 the figures for the region went down with 4% and for the city up with 3%. In recent years, Luleå has experienced a favourable development especially due to the boom in world market demand for iron ore and other minerals.

In Oulu, a more significant growth started during the second half of the 18th century due to the city's importance as a trade centre for tar and wood-products. Growth during the post-war period emanated from industries processing natural resources, from private and public services and from the establishment of the first domestic university outside the nation's capital in 1958. University of Oulu was already from the start assigned an important role in the development of culture, business and industry in the whole of northern Finland, and today has five faculties and 16,000 students. Between 1970 and 1997 the number of inhabitants in Oulu region increased by 20 per cent (and in the city of Oulu by 60%), Between 1998 and 2006 Oulu region continued to grow (+ 6% in the region and +14% in the city) . The population growth has continued in Oulu in the latest years, partly due to mergers with the neighbouring municipalities, too.

During the 1970's both Luleå and Oulu regions, as well as other regions in the industrialised world, faced a structural transformation from large-scale production, often based on natural resources, to global com-



petition and ‘flexible specialisation’ (Piore & Sabel, 1984) based more on specific competencies and capabilities than on existing supplies of raw materials (Greenwood et al., 1991). Location patterns and ways of co-operating and communicating across firms changed due to continuous development of information technology. New ‘engines’ or ‘locomotives’ for creating growth and development emerged, implicating new actors and new drivers for regional development. Ylinenpää and Lundgren (1998) identified the evolution of hi-tech sectors in the two regions as one key factor behind demographic differences, and concluded that while hi-tech firms in the Oulu region almost doubled their employment from 4,590 to 8,141 between 1987 and 1996, an already marginal hi-tech employment in Luleå region decreased to a mere 700 employees in 1996. During 1997-2005, however, both Oulu and Luleå experienced a significant growth in hi-tech sectors, especially in ICT-related industries (Teräs, 2008). In Oulu, rapid development of the hi-tech sector in 1958-2001 was followed by a stabilization phase in 2002-2006. According to Teräs (2008), there has not been any significant slowdown period in Oulu hi-tech cluster in 1958-2006. In Luleå, the hi-tech sector developed in much slower pace compared to Oulu. The hi-tech sector experienced a significant growth period from 1997 until the year 2001, peaking to 3,800 jobs in 2001. This upturn was followed by a slowdown

Figure 1: Geographical location of our illustrative case study regions. Source: Nordregio

caused by turbulence in the ICT sector. The downturn however affected the Luleå region much harder. According to Nordin (2008), 40% of Luleå-based ICT companies went bankrupt around the millennium. In the years 2004-2006, the Luleå hi-tech sector recovered. The number of people working in the ICT sector in Norrbotten was in 2006 2,855 persons, of which 1,818 were located in the city of Luleå.

Here empirical evidence from our case study regions may illustrate some of the messages communicated by population ecologists. When Nokia Corporation in 1960 established a cable factory in Oulu they in fact introduced the first elements of a new technology regime into a region which used to be dominated by basic industry and mechanical engineering. Through a close collaboration with the university and the research institute VTT and with important support from local and regional policy, a new line of industry requiring new competences and new markets started to emerge and soon developed into Finland's hot spot for hi-tech development and production of mobile phones and wireless communication systems. On a significantly smaller scale a similar development was also visible in the Swedish region, where e.g. the death of the outdated mining sector often was proclaimed and positive expectations related to the further development of a regional industry based on electronics and information technology were frequently expressed.

The new industries in Oulu and its region also prospered and developed for many years, leading to characteristics such as "the Silicon Valley of the North" (Hyry, 2005). While IT industry in Luleå and northern Sweden was significantly damaged by the dot-com crisis around the millennium shift, the ICT-based industry in Oulu managed to preserve a leading position in spite of increasing global competition (Teräs & Ylinenpää, 2012). During the period 2008-2012, the previously obvious role of the Nokia Company as a locomotive of the high technology cluster had more or less eroded as Nokia had outsourced much of its R&D and production work to other countries. As an example, in 2010 the Japanese company Renesas Electronics acquired 460 Nokia engineers in Oulu specialized in R&D on wireless modems (Kauppalehti, 2010). In early 2011, Nokia employed slightly less than 2,000 people and Nokia Siemens Networks 2,200 people in the Oulu region (Kaleva, 2011), while the Mobile Phone unit has continued job cuts and outsourcing. The Oulu region however still hosts a strong concentration of accumulated expertise especially in the ICT sector, although its present status differs considerably compared with the 1990s. The previous cornerstones of the Oulu hi-tech cluster – the research community and strong ICT industry – are still in place but currently at least partly in search for new opportunities to be explored. The diversification of the region's expertise into other sectors such as the environmental sector, biotechnology, wellness technology, and content production and media has so far not been able to compensate for previous losses. The Green ICT sector, combining the expertise gained through former ICT & telecommunication jobs with the new opportunities opened in the environmental sector, is a candidate for restarting a positive development in the Oulu region. Moreover, the "renaissance" of the mining industry in North Finland in the 2000's has

provided the high tech industry in the Oulu region with new, advanced needs, e.g. in the form of new ICT solutions and multidisciplinary research needs. Finally, a promising emerging, research-driven sector of printed electronics is developing rapidly in the Oulu region attracting domestic and foreign industrial actors.

From the viewpoint of innovative networks, the longitudinal analysis reveals that Oulu has experienced a development in which traditional, relatively closed innovation systems governed by traditional industry have gradually paved the way for two different types of innovative networks. On the one hand, the multinational network represented by Nokia and its partners strengthened its grip over a long time period, resulting in diminishing local decision-making power and lower levels of intra-regional cooperation. On the other hand, however, the specific culture that previously constituted the so called “Oulu Phenomenon” which emerged on the basis of collaboration between Nokia and its smaller partners and a trustful cooperation between different sectors of society (public-private-partnership), is still viable. The innovation system in Oulu therefore has elements of both an institutional regional innovation system (IRIS) as well of a more entrepreneurial regional innovation system (ERIS) with a preference for the former. The regional innovation system is thus rooted in institutions such as universities, universities of applied sciences, and government-owned research centers (e.g. VTT).

The Luleå hi-tech cluster does not have any major locomotive companies such as Nokia in Oulu. The companies can instead be divided into four major categories: units of nationally or internationally operating ICT companies, government-owned companies, niche companies which already experienced rapid development, and new spin-off companies for instance hosted in the science park’s business incubator. Two successful spin-offs from university-based research during recent years were the ICT-based companies Marratech and Nordnav. Marratech was however acquired by American Google in 2007, and after a short period relocated from Luleå to other parts of the Google imperia. The Luleå-based spin-off company Nordnav was in 2007 facing a similar destiny after being acquired by the British multinational Cambridge Silicon Radio. These examples illustrate both commercial success and the vulnerability involved in new industries operating in ERIS-like innovative constellations. A third example of such ERIS-like innovative configurations is depicted by Ylinenpää (2012), who describes and analyses a small ICT-based company with seven employees and how it operates in close collaboration with two researchers (who serve as an out-sourced R&D unit and a resource for business intelligence and environmental scanning respectively), and different types of actors offering venture capital spanning from local institutions to international venture capitalists and business angels. This innovation system resembles obvious similarities with Cooke’s and Leydesdorff’s (2004) ERIS-mode of innovative collaboration. This contrasts to the substantial collaboration and innovative networking that is established between actors such as the mining company LKAB and the Luleå University of Technology LTU. Here different centres for research collaboration have been founded (such as the Hjalmar

Lundbohm Research Center, the Agricola Research Center, the Center of Advanced Mining and Metallurgy CAMM, Swedish Blasting Research Center SWEBREC, ProcessIT Innovations and the Faste Laboratory); all manifesting typical characteristics of an IRIS-like innovative constellation. Funding is granted from industry and research foundations on a long-term basis, and R&D operations are performed based on a detailed multi-year plans where process innovations are in focus. Individuals building up these innovative configurations are best described as agents for the organisations they represent rather than as the individual actors dominating in ERIS-like innovation systems.

Turning then to the degree of regional specialization in our two case study regions, both Northern Finland and Northern Sweden share as already indicated a historic tradition of specialization on the exploitation of natural resources as a base for the regional economy. After the establishment of a university in Oulu in 1959 and (later) the national research institute VTT, a new era based on modern knowledge-intensive technologies started. The unfavourable development of raw material prices accelerated the shift from natural resources to knowledge-based economy in the 1990s. The stagnation of the Oulu ICT cluster in the 2000's together with a more favourable development of the raw material prices resulted in yet another shift in the regional specialization - this time back to mining industries. The increased environmental thinking together with the advanced needs of the mining industry are currently producing the Sustainable Industry era in North Finland with a lot of high tech expertise directed towards clean-tech solutions respecting a vulnerable Arctic environment.

In the Swedish region the shift to a specialization in hi-tech industries has been far less visible. The university (established in 1971) has as compared to its sister university in Oulu still a much more pronounced orientation towards traditional basic industries. Under the heading "From hard rock to heavy metal", the University states that "prominent scientists work together from traditional mining research topics ore geology, geophysics, rock engineering, geotechnical engineering, mineral processing, process metallurgy and applied geology with researchers in fields such as chemistry, industrial production environment, operations and maintenance engineering, fluid mechanics, geotechnical engineering, economics and statistics." As already noted, however, also new fields of expertise have been developed over the years, for example in ICT and distance-spanning technologies, electronics and green technologies. These new areas of expertise have contributed to the emergence of a new but – when compared to the Oulu region – a significantly smaller hi-tech sector.

Two examples of specialization initiatives taken in the Swedish region during recent years however deserve attention. Instead of making a choice between established basic industries and new hi-tech industries, the region launched an innovation system initiative named ProcessIT Innovation. This initiative was based on the idea that the traditional basic industry should strengthen its competitiveness with the help of smart ICT-based process solutions developed by LTUs researchers and the regional ICT industry. It soon got a ten year support from VINNOVA – the

Swedish innovation agency – as a national excellence centre (Johansson & Ylinenpää, 2012). What is interesting in this empirical anecdote is that the region develops “smart specialization” by developing an interface between the old and the new – thus exploiting “related variety” as suggested by for example Asheim, Boschma and Cooke (2011). Another empirical anecdote illustrating this is the establishment of Facebook and its servers for big data in Luleå – the first establishment for Facebook outside the U.S. Even if “Big Data” and the storing of enormous amounts of data on servers in Luleå seems to be far away from the region’s tradition from steel works and paper and pulp industries, Ylinenpää (2013) revealed that the region’s capability to deliver reliable and renewable energy to the Facebook’s server halls was one of the determining factors behind Facebook’s decision to locate its first European establishment to Sweden and to Luleå. Again; a regional capability to deliver safe and reliable electric power generated by the region’s hydro-power stations so important for the regional process industry also proved to serve as order-winning criteria for attracting new entrants to the region such as Facebook. By exploiting “related variety” (Asheim, Boschma & Cooke, 2011) referring to regional knowledge bases a region may thus achieve spill-over effects that initiates “economic renewal, new growth paths and regional growth” (ibid., p. 896).

4. Conclusion: Implications for theory and practice

In this paper we have described and discussed interventions to stimulate regional development and innovation in two specific regions. Especially, our results highlight that both regions have gone from interventions to foster flexible specialization, with the motive of staying resilient and competitive over time, to approach a smart specialization, with the motive of building competitiveness from a focus on one or a limited number of strong industries within the region. As illustrated by our empirical data, both our study regions have undergone periods of developing innovative clusters and systems related to both traditional and new industries. By following these regions during a longer period we may also note how development trajectories and priorities have shifted over the years:

- The Finnish region serves as an example of a region that during decades has developed into a European hot-spot for high technology but also a region that today experiences tough times due to globalization of the economy, with a need to redirect the accumulated know how of the ICT cluster to new applications and to utilize the natural resources in North Finland in a sustainable way.
- The Swedish region lags behind its sister region in Finland regarding development of new industries and innovations in these sectors, but is also a region that today can be described as a hot-spot for development based on natural resources such as iron ore and other minerals as well as energy. The Swedish region also demonstrates interesting initiatives to develop “smart specialization” based on integration of

“the old” and “the new”.

From normative books in management we have learned that a generic strategy based on focus pays off better than a diversification strategy involving the risk of getting “stuck in the middle” (Porter, 1980). We have also learned that developing core competences in a more knowledge-based economy is a gateway to success (Hamel & Prahalad, 1990). Built on this logic, the dominating understanding in regional development policy and EU rhetoric’s today is that regions should develop their own smart specialisation strategy. For regions outside our big metropolitan areas, such as the two regions used as empirical illustrations in this paper, this normally implies targeting one specific sector or branch of business/industry. Developing a regional specialisation based on only one specific focus (e.g. natural resources or a local competence) however also comes with a cost: the cost of being exposed to volatile markets where global competition or market needs are radically changing the “rules of the game”, or where innovation and new materials may jeopardize existing market logics. This volatility may corner a region into structural lock-in situations and is clearly illustrated by our Finnish case, but is also instrumental for understanding the dynamic development that northern Sweden today is undergoing. The combination of expertise and know how related to the sustainable utilisation of natural resources and the know how and expertise related to latest new technology solutions seems to open promising and fruitful avenues towards smart specialisation in both North Sweden and in North Finland.

But is then diversification the answer? According to Bishop (2009), development of a specialized cluster expected to generate local and regional growth is not always a good and functional medicine. Instead especially new service-based companies and innovations develop better on a soil constituted by many different competences and actors (Essletzbichler, 2007). A regional smart specialisation built on two or more existing (or emerging) sectors may therefore represent a truly “smart” specialisation since this allows for tapping into the development potential of more than one sector and (not least) allows for exploiting the development potential existing in the interface between two (or more) sectors of industry and business (cf. McCann & Ortega, 2011). This also reduces the inherent risk of ‘picking the winner’ a priori; a documented high-risk strategy since new regional specialities and clusters normally emanate from spontaneous processes rather than from orchestrated policy interventions (see e.g. Lambooy & Boschma, 2001). Critical is to recognize that a region’s opportunities to diversify into new industries and new knowledge bases is affected by the degree of related variety where “new industries are deeply rooted in related activities that are present in the region, and which set in motion a process of regional branching” (Asheim, Boschma & Cooke, 2011, p. 895). Thereby a specific region may also achieve a form of system resilience that improves the region’s ability to cope with change and new demands, and at the same time counteracts the risk of regional lock-in effects into one specific and often cyclic and potentially outdated regional structure.

In our paper we have been focusing on some of these regional charac-

teristics which may mitigate the potential costs of smart specialization. We denote that the insight in the “rules of the game” for how to mitigate potential costs is very different in new and traditional industries. The characteristics depicted in Table 1 may hopefully serve as a kind of road-map for stakeholders interesting in exploring and exploiting the innovative potential in both traditional and new branches of business and industry.

The suggested framework for analysing innovative networks in different settings also demonstrates some challenges. Foray et al. (2009) argued that the source for economic development and regional growth comes from the interplay between new and old sectors and how these are merged. However, our framework makes it clear that the mechanisms for change and development are quite different between new and traditional industries. This increases the complexity of planned interventions over spontaneous development of smart specialisation.

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