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Quadruple Helix, Innovation and the Knowledge-Based Development: Lessons from Remote, Rural and Less-Favoured Regions

Jari Kolehmainen[1] · **Joe Irvine**[2] · **Linda Stewart**[2] · **Zoltan Karacsonyi**[3] · **Tünde Szabó**[3] · **Juha Alarinta**[1] · **Anders Norberg**[4]

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Abstract This paper addresses the dynamics of knowledge-based development of remote, rural and less-favoured regions. Many of the regional strategies and policies aimed at developing innovation emanate from policymakers in centrally located urban conurbations and are assumed to be universally applicable. An example is the classical "triple helix" model and its successors for economic development based around the idea of universities, business and public sector organisations all coming together to foster innovation and economic prosperity. In many remote, rural and less-favoured localities, there may not be a university or other knowledge-intensive institution present which makes a difference from the point of view of local development agendas. In many regions, also the business community may be scattered and insufficiently developed in terms of innovation. And furthermore, this kind of region may also have a weak public sector to enhance innovativeness. In such regions, social and community groups may often play the dominant entrepreneurial role. The community may also play a significant role in remote, rural and less-favoured regions where the basic elements of "triple helix" model are present. In this respect the concept of a "quadruple helix" is highly beneficial. This is the case, because innovation processes are becoming increasingly open to different stakeholders. In this paper, four illustrative cases of knowledge-based development processes and policies in remote, rural and less-favoured regions are analysed by using a "double-coin model of knowledge-based regional

✉ Juha Alarinta
juha.alarinta@uta.fi

[1] University Consortium of Seinäjoki, Seinäjoki, Finland

[2] University of the Highlands and Islands, Inverness, Scotland

[3] University of Debrecen, Debrecen, Hungary

[4] Umeå University, Campus Skellefteå, Skellefteå, Sweden

development" which places the quadruple helix model at the very heart of knowledge-based regional development.

Keywords Knowledge-based · Regional development · Higher education institutions · Triple helix · Quadruple helix · Double-coin model

Introduction

The role of higher education institutions (HEIs) in regional development processes is somewhat paradoxical: on the one hand, the role of HEIs may be emphasised supporting the improvement of regional competitiveness, economic growth and the creation of valuable knowledge-based economies, which are sustained by accessible, efficient and high value education and research. On the other hand, there are universities and other HEIs that are purely aiming at international or even global approaches to research and education, resulting in neglecting their own home base, namely the city or the region in which they are located. The regional and global views are not necessarily mutually exclusive, but even globally oriented universities and HEIs can have a huge impact on economic development and business innovation locally and regionally (see, e.g. Goddard and Vallance 2013).

EU, national and regional strategies and policies on innovation have been prioritised and innovation is now core to most EU economic and regional development funding programmes. The EU-wide and EU-led smart specialisation agenda is a good example of that trend. However, many of the strategies aimed at developing innovation emanate from policymakers in centrally located urban conurbations, based on specific policy models which are in many case assumed to be universally applicable. There are several earlier studies on knowledge-based development, innovation systems and innovation policies in rural and peripheral regions (e.g. Alarinta 1998; Wiig and Isaksen 1998; Doloreux 2003; Sotarauta and Kosonen 2004; Doloreux and Dionne 2008; Karlsen et al. 2011; Suutari and Rantanen 2011; Pelkonen and Nieminen 2015). It can be stated that all of these studies examine certain aspects of the specific nature of innovation and innovation policy in the context of rural, peripheral and less-favoured regions. However, it quickly becomes obvious that all regions are not alike in terms of innovation and innovation policy.

This paper aims to contribute to the academic debate on the knowledge-based development of rural, peripheral and less-favoured regions by introducing the "double-coin model of knowledge-based regional development" which places the quadruple helix model at the very heart of that process. The key question of this paper is, how can businesses, higher education institutions, governmental organisations and different community groups contribute to the economic growth and social development in regions with underperforming economies, turning peripheral or otherwise less-developed regions onto the path of sustainable knowledge-based development? Having feasible answers to that question and understanding the dynamics of knowledge-based regional development is increasingly important in Europe and beyond. From the European point of view, the "double-coin model of knowledge-based regional development" is related to the key ideas of the smart specialisation agenda mentioned above (see, e.g. McCann and Ortega-Argilés 2013; Foray 2015). For example, our

point of departure is that the knowledge-based regional development should not be seen as a set of traditional top-down policies, but as a complex, place-based, multi-actor discovery process.

The approach of the paper is practical and policy-oriented, as it is based on case studies from Finland, Hungary, Scotland and Sweden. The above-mentioned conceptual framework has been sketched, and empirical case studies have been mainly conducted within the UNICREDS project (UNICREDS 2010), which was an EU INTERREG IVC funded project made up of partners from remote, rural and less-favoured regions from across the EU including the UK, Nordic countries and central Europe. UNICREDS included various assessments, a survey and reviews of best practice. All of these measures produced a large number of case studies and a wealth of insightful data on how knowledge-based development and innovation take place in the case regions.

The paper is organised as follows: first, the concepts of triple helix and quadruple helix are introduced briefly and the "double-coin model of knowledge-based regional development" is established to set the scene for the case studies. Shared conceptual framework is illustrated by case studies from different angles. Respectively, they illustrate the key points of this article from different angles. The first, Finnish case is a summary of how a rural region has waded its way to the "knowledge economy" by adding new, knowledge-based layers to its natural strengths. The second, Swedish case deals with multi-institutional learning environments and suggests them to be a future solution that can also be applied beyond remote and sparsely populated communities. The third, Hungarian case illustrates the ways in which a research-intensive university has intensified its regional engagement in terms of innovation by involving civil society actors and potential innovation users in various ways. And finally, the fourth, Scottish case describes how one of Europe's most peripheral regions has achieved excellence in healthcare provision by intense collaboration among triple helix actors and by involving new actors in the development of health service provision.

Setting the Scene: Knowledge-Based Regional Development

From Triple Helix to Quadruple Helix

The knowledge-based or innovation-driven regional development calls for certain kinds of activity, actors and their collaborative practices. In this respect, the concept of triple helix is relevant and beneficial (see, e.g. Etzkowitz and Leydesdorff 1995, 2000; Etzkowitz 1998, 2002; Gunasekara 2006). The basic idea of this concept is to deepen the understanding concerning universities' and HEIs' role in innovation. It is based around the idea of universities, business and public sector organisations all coming together to foster innovation and economic prosperity (Etzkowitz and Leydesdorff 1995). The key is to widen the dyadic and often unidirectional university–industry collaboration by including governmental organisations.

Leydesdorff (2012) wrote about a possible "N-tuple of helices" meaning that additional helices can be necessary for understanding and analysing innovation but reminds us of the parsimony principle—the addition of factors should be motivated by explanatory needs. After this, the "N-tuple of Helices" have even been called a

"paradigm" for the development of increasingly better models (Park 2014). Business life and innovation are in a constant flux, and the changes are reflected in new and emerging characteristics.

During recent years, there has been a vivid discussion on open and user-driven innovation (see, e.g. Chesbrough 2003a, b; Huizingh 2011; von Hippel 2005; Gassmann 2006). The grand idea behind these concepts is that the contact surface of innovation needs to be widened. The concept of open innovation was introduced as far back as 2003 (Chesbrough 2003a, b), although similar principles have been applied in firms earlier. The core of the concept is twofold: on the one hand, firms are searching and utilising knowledge, technologies and other competences across the firm boundaries. On the other hand, the firms are willing to commercialise and allow technologies and ideas to be utilised outside the firm itself (e.g. by licencing). So, efficient innovation does not mean only efficient internal R&D, but capabilities to form networks with innovative actors outside the company (Diener and Piller 2010, 14).

Furthermore, open innovation is more than interaction between organisations, as individuals and communities formed by individuals enter the innovation scene. In this respect, the concept of crowdsourcing is very relevant (e.g. Brabham 2008). Crowdsourcing is a way for firms to harness the ideas and abilities of large, even unlimited groups of people. Although open innovation and crowdsourcing are not usually that unlimited, there is a new debate emerging around "targeted open innovation" (e.g. Hossain and Islam 2015). This concept refers to an open innovation model in which the openness of innovation is combined with a very strategic view on communities' role in the whole business model. Consequently, targeted open innovation is also a tool for building long-lasting and loyal relationships with customers and other relevant stakeholder communities. Customers of a company and users of a certain product or service are quite obvious examples of open innovation communities, but the role of individuals and communities in innovation can be understood even in wider sense.

In this respect, the concept of quadruple helix seems to be relevant. This concept adds to the triple helix one more actor group, namely the wider community. The quadruple helix can be seen as an action model of four kinds of stakeholders, which aims at generating innovations. (see, e.g. Arnkil et al. 2010). It is notable that this action model or principle can be applied in different scales to different innovations ranging from minor, incremental (product) innovations to fundamental, social innovations.

Carayannis and Campbell (2009, 2010) have named the fourth helix as "media-based and culture-based public" and "civil society." This emphasises democratic values as a part of the innovation process, which is not naturally inherent in the triple helix model. The addition of a fifth helix, the awareness of environment and social ecology, forms a quintuple helix model with an ecological dimension (Carayannis and Campbell 2010). The nature or formulation of the fourth and later fifth helix varies depending on the explanatory needs. Correspondingly, European Commission yearbook on open innovation 2.0 labels the fourth helix as "users", "citizens" or "civic society" (Open Innovation 2013). These formulations also point out that a triple helix may be possible without democracy while a quadruple helix is not. Including the fourth helix is part of the development required on the way to a knowledge-based and innovation-based driven democracy, a "creativity society" where creativity is developing not only within specific creative workplaces, professions or classes but also across the whole economy (Dubina et al. 2012).

Double-Coin Model of Knowledge-Based Regional Development

The purpose of this section is to set the scene for the case studies. The point of the departure is the basic logic of regional development. It is all about making changes that will turn the current direction of the region into a desirable future. It sounds easy, but that is not the case. Usually, the temporal journey between these two status quos is not straightforward and easy at all. In fact, the actual processes and dynamics of regional development have remained surprisingly veiled. So, it can be called the "black box" of regional development (see Fig. 1).

This above-mentioned "black box" needs to be unpacked. In most cases, the desirable future will not become true without deliberate actions. So, regional development calls for actors and activity. In this respect, the concept of "regional development network" is beneficial (e.g. Linnamaa 2004). It refers to a regional policy or governance network consisting of public, semi-public, private and third sector organisations which aim to contribute to the development of the region in question. The governance and policy networks have gained more and more influence, as increasing numbers of the societal and regional problems and challenges have become "wicked" in the sense that they cannot be solved by just one authority or by straightforward measures. "Wicked problems" need to be tackled by many actors simultaneously or sequentially. Regional development processes are in many cases alike: the contribution of many actors is needed in order to set off positive processes of change.

The regional development networks are usually informal and loosely coupled, and actors belonging to it may not even recognise their own role in the network. The intensity and internal cohesion of this kind of policy networks typically vary (cf. Kickert et al. 1997). In addition, they are not coordinated from one point, but the

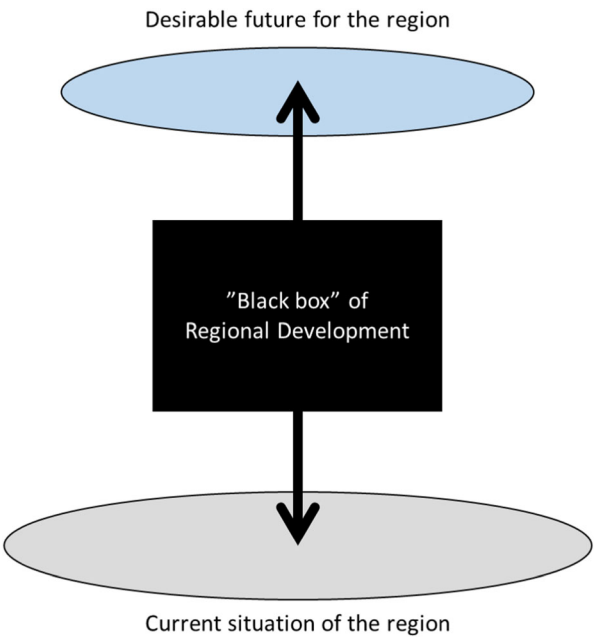

Fig. 1 The "black box" of regional development

coordination and leadership of these networks is shared in nature. Following this point, there is usually not that much formal regulation, but the coordination of the regional development network is more likely to be based on social coordination mechanisms, openness and reciprocity.

The typical triple helix actors usually belong to the regional development network. In addition, triple helix collaboration is multilateral in nature and also the innovation policies are formed by all the parties, not solely by government. The triple helix also encases the idea of the three institutional spheres adopting and performing the roles of the other spheres in addition to their own. This non-traditional approach to institutional roles is viewed as a potential source of innovation. However, it can be argued that in many European regions and localities this model may not be that relevant in its purest sense. In some remote, rural and less-favoured localities, there may not even be a university or other knowledge-intensive institution present. Also, the business community may be scattered and insufficiently developed in terms of innovation. And furthermore, these kinds of regions may also have a weak public sector struggling with the supervision of the basic public services. Consequently, in such areas, social and community groups may often play the dominant entrepreneurial role. The community may also play a significant part in those rural and remote regions where the basic elements of "triple helix" model are present, but potentially weak or insufficient: in this kind of region, all the actors and their capabilities should be included in order to make good use of its potential and to bring the region forward.

In this paper, the fourth helix of the quadruple helix is named as "community" referring to the actors of the local and regional civil society. Ultimately, the community consists of "ordinary people" and their joint, coordinated activities which can be organised either on temporary basis (e.g. joint projects and endeavours) or in more permanent manner (e.g. NGOs and associations). From the quadruple helix point of view, the "community" is assimilated to some extent with other helices. For example, in small, rural communities, the local government is very closely intertwined with both other community activities and local business life. Still, the local and regional government structures are separate from the community or communities, because they are part of larger governmental structures, such as nation state or EU. In any case, the concept of a "quadruple helix" is highly beneficial in the context of rural, peripheral and less-favoured regions. Furthermore, these regions could even be forerunners in inclusive economic development and innovation, which is of course a great challenge.

In sum, quadruple helix collaboration is seen as a specific, more intensive field of collaboration within the regional development network focusing on knowledge-intensive development. It aims directly or indirectly at positive changes of the region. It is worth noticing that quadruple helix collaboration is not usually bound to a certain region, but it is seen as a more general process in which academia, industry, government and wider communities are engaged in order to create new knowledge, technology and innovation meeting both economic and societal needs. However, in this paper, the quadruple helix collaboration refers to the same kind of collaborative processes, but in the regional context (see Fig. 2).

Knowledge-based development of remote, rural and less-favoured regions is very challenging, as the preconditions are not naturally inclined into that line of development. Achieving genuine and sustainable competitiveness calls for visionary, insightful and targeted strategic thinking. This is especially the case, as the competitiveness of a

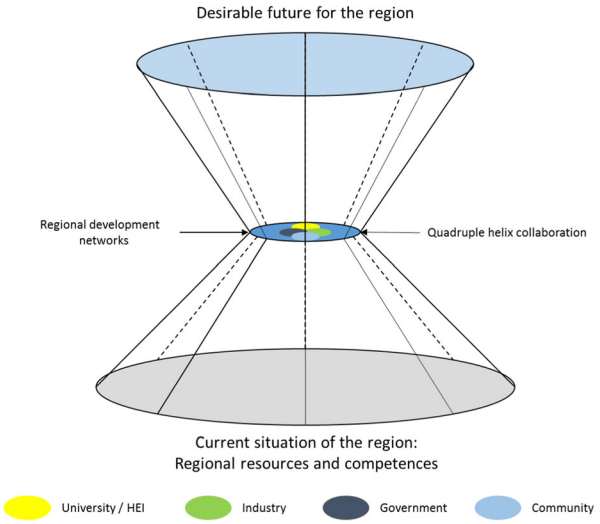

Fig. 2 Filling the "black box"

peripheral or disadvantageous region can be seen as a paradox. Namely, the seeds of the regional competitiveness may lie in the specific, or even disadvantageous characteristics of the regions (rurality, remoteness, harsh climate, sparse population etc). Rurality, for example, is the very basis for the competitiveness of smart food system development in South Ostrobothnia, Finland. Correspondingly, in the Highlands and Islands (Scotland), for example, versatile means of distance learning and other ICT-related solutions have been developed and utilised in order to overcome the long distances. This can be seen for example, as a basis for developing the excellence in digital healthcare. A harsh climate can in itself be a resource for development, for example, the winter-testing of vehicle components in Northern Sweden (Nybacka et al. 2007).

Thus, turning disadvantageous characteristics of a region into competitive assets requires good strategic thinking and actions, but also usually genuinely mutual interests, commitment to the collaboration and excellent quality in the collaborative processes of all the quadruple helix actors. It is also self-evident that all the quadruple helix actors need to pay attention to the quality of their own activities. Some deficiencies of an organisation can be compensated by collaborating with other organisations. Still, when aiming at sustainable and progressive knowledge-based regional development, quadruple helix collaboration needs to be based on complementary and value adding resources and competences of each quadruple helix partner. Thus, the collaboration should be seen as a motivational factor for the development of resources, competences and processes of every actor group.

Furthermore, there need to be prospects for further development concerning the collaboration itself and the actual substance of the collaboration. In the context of regional development and quadruple helix collaboration, these future prospects can be categorised as visions for the region. Each actor of the regional development network and each quadruple helix actor has their own visions concerning their own future and the whole region. Consequently, these actors are also executing their own strategies in order to attain their own visions. In this respect, it is not worth finding only one vision

concerning the desirable future of the region. Instead, it is worth having joint processes for finding and forming shared visions concerning the region. This requires actors—organisations or individuals—who are capable of "visioning between visions" (Sotarauta et al. 2007). Emphasising the role of individuals is important, as it is extremely difficult to achieve shared vision without personal level interaction in addition to the structural level connectivity of the organisations.

When dealing with regional knowledge-based development, these shared visions are usually related to regional research and innovation capacity. Collective "visioning between visions" and putting the shared visions into practice is not easy, and to do it collectively calls for regional leadership, which can be characterised as "relay in time and space" (see, e.g. Sotarauta 2014a, b).

All the actors of the regional development network have a kind of double role. On the one hand, the regional resources and competences related to innovation consist of the quadruple helices acting within the region. On the other hand, these organisations and communities create and utilise the other regional resources and competences by concrete measures and actions, e.g. by investing in some organisations, by funding research or by commercialising research results of a university. So, it is important to understand that each quadruple helix organisation or community is responsible for both utilising and creating regional resources and competences. When talking about knowledge-based regional development, these utilisation and creation processes are related mainly to regional knowledge resources and competences. Furthermore, it is worth noticing that the shared regional visions mentioned above will turn into reality only by these concrete measures and actions.

In sum, knowledge-based regional development culminates in the characteristics and activities of the regional quadruple helix actors. They need to be able to make a future together by having processes in which the joint and shared visions are shaped. They also need to undertake concrete actions to utilise and to create regional knowledge resources and competences. All of these processes call for joint, collective and collaborative activities among quadruple helix actors. All of these elements together constitute the framework for knowledge-based regional development (see Fig. 3). This heuristic framework is used—mutatis mutandis—in the following case studies.

Case Studies

South Ostrobothnia, Finland: From Fields to Food Systems

South Ostrobothnia is an inland region located in the western part of Finland. The population is about 194,000, and the population density is lower than the national average. South Ostrobothnia is a rural region and one of the key regions in terms of agriculture in Finland. So, large, open fields characterise the region. Seinäjoki is the central city of South Ostrobothnia having about 61,000 inhabitants. After year 2000, it has been one of the most attractive cities in terms of migration in Finland (Aro and Laiho 2013, 24; Sotarauta 2014b).

The economic structure of South Ostrobothnia is a traditional one. On the other hand, an exceptionally high number of firms characterises the economic landscape of

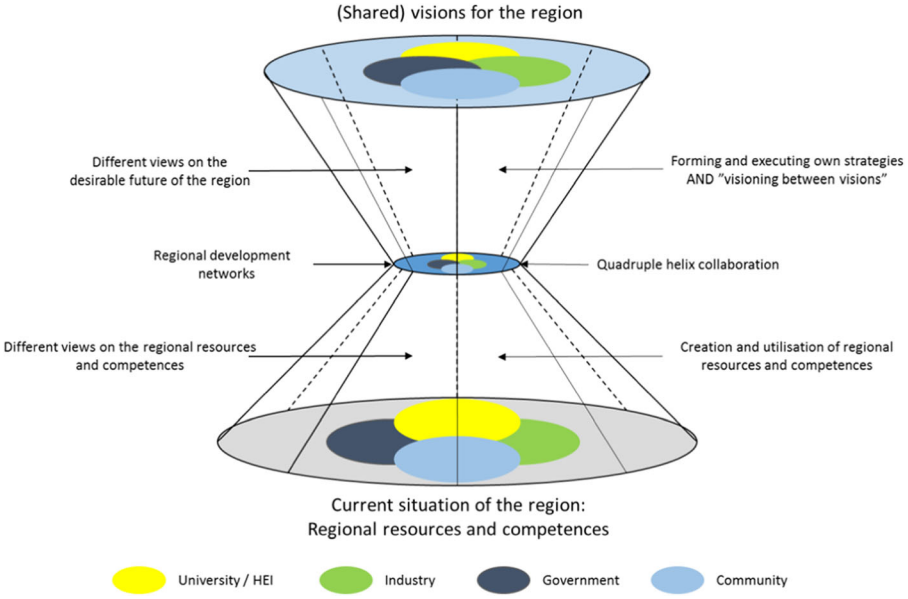

Fig. 3 Framework for the knowledge-based regional development

the region. The relative number of enterprises is one of the highest in Finland; 8.2 per 100 inhabitants while the national average is 5.9. Consequently, the great majority of the firms are very small, and a noticeable degree of them are specialised in traditional branches of business processing food, metal or wood. In addition, the SMEs are not usually internationally oriented and they are not that active in (formal) innovation activities. So, the R&D spending figures of South Ostrobothnia are quite low as a share of GDP; the figure in South Ostrobothnia is 0.8 % and the national figure is 3.7 %.

The level of education in this region, known for entrepreneurial spirit, has traditionally been one of the lowest in whole Finland. There has been very pragmatic orientation to the work in South Ostrobothnia: hardworking attitude and handicraft skills have been greatly admired. Despite this tradition, the region has been active in developing services of higher education. Local municipalities, by activation of individuals with educational pursuits, founded the regional university association in 1960. The association offered summer university courses and created a forum where active municipalities and individuals could interact and enhance academic services. Summer university experienced growth, and after 10 years, it was found out that a more permanent academic organisation was needed (Eilola 2010, 62).

After stubborn efforts, explicit progress was gained first in 1981 when University of Tampere founded the unit of Institute of continuing education in Seinäjoki. Seven years later, the Institute for rural research and training at University of Helsinki started its work in Seinäjoki. The University of Helsinki represented the most important academic organisation in agricultural and forestry education and research. The Institute, itself, was an organisational innovation in relation to the traditional agricultural, food and forestry sciences. The Institute took the mission to carry out research and educate people in order to discover new sources of livelihood and to develop services of the rural areas. All this was done in a multidisciplinary and collaborative way. From the

regional point of view, the institute created the targeted link between academic research and economic characteristics of the region.

In the early 1990s, Finland faced economic recession and South Ostrobothnia was one of the regions that suffered serious outmigration flow and decrease in population rate. Young people moved out, many of them to get a university degree. At that time, many of them did not have the opportunity to return, as the academic labour market was very weak. That was the case even after the recession, when new sectors of the Finnish economy (e.g. ICT and biotechnology) boomed at the end of 1990s.

The regional economy of South Ostrobothnia was poorly able to utilise and position itself in innovation- and technology-oriented development. This was seen to imply a serious danger that South Ostrobothnia would end up being some kind of "peripheral pocket" in national knowledge economy (Sotarauta and Kosonen 2004). In this situation, a few active individual people in academic organisations and public administration, called for a giant leap towards the knowledge economy instead of continuing development work with small concrete steps. This leap should bring the regional research, innovation and education activities to a totally new level.

So, this "visioning between visions" created a strong common ground among key regional players consisting of typical triple-helix parties: something has to be done, and it should be done by our own hands and with intensive organisational co-operation. Local media and active individuals, including some at private organisations—the regional community—largely supported this idea. Consequently, South Ostrobothnia decided in programme-agreement of 2001 to make considerable investments in research (Research and Innovation Programme 2000–2006). Those investments were targeted to new professorships on new and future-oriented fields of research that are tightly linked to the economic and otherwise profiling strengths of the region. Funding of the most important academic positions, like professors, is gathered from both public and private sources. Also local SMEs funded the professorships, which was an institutional breakthrough.

This fresh and collaborative approach aroused enthusiasm in South Ostrobothnia, and new research groups have been established during the years—currently there are 22 of them. In addition to the strengthened presence of universities in South Ostrobothnia, its own vocationally-oriented HEI—Seinäjoki University of Applied Sciences—has developed its activities significantly during the past 15 years. Also other significant investments in the knowledge-based development have occurred (see Kolehmainen and Alarinta 2009).

In sum, South Ostrobothnia and Seinäjoki as its central city have been committed to investing in building the regional innovation infrastructure and capacity. The region has benefitted from this knowledge-based development approach. However, as a recent analysis shows, there are still many challenges and obstacle to be overcome, such as the low level of internationalisation (Pelkonen and Nieminen 2015). It is obvious that building the overall innovation capacity is a long process, and it is clearly not enough on its own. In the beginning of 2010s, it became clear that the region called for more coherent joint strategy. Thus, several joint strategy processes were set to identify few common focal areas. "Sustainable food systems" was identified to be one of those and it is also the backbone of the region's smart specialisation strategy. Sustainable food system has unique characteristics: the role of individual consumers is important and the number of small independent firms is high. This called for new ways to conduct

innovation activities, and consequently, new innovation platforms, like living-labs, have been established for the agro-food machinery, for example. These collaborative and open, yet targeted innovation platforms have increased the number of firms attending the development work.

South Ostrobothnia and Seinäjoki were recognised also on the national level in 2013 when the Finnish innovative city-regions were elected as organisation of national innovation policy. The region received nation-wide mission to enhance innovativeness in the food systems of the bio-economy.

Västerbotten, Sweden: Multi-Institutional Learning Environments

The county of Västerbotten in Northern Sweden covers 13 % of Sweden's area, about the size of Denmark, but only 2.8 % of Sweden's population lives here, 4.3 persons per km^2 compared to 23.4/km^2 for Sweden and 120/km^2 for the European Union as a whole. The population is unevenly distributed—most live along the coast with its cities of Umeå and Skellefteå, and the inland and mountain area is even more sparsely populated, for some inland communities below 1 person/km^2. In the southeast of Västerbotten, the University of Umeå is situated, with about 35,000 students, Sweden's fifth in size. Students from the community of Skellefteå with 72,000 inhabitants have about 2 h commuting time south to Umeå University campus and as long north to Luleå University of Technology.

For most inland communities, the university campuses are clearly outside of daily commuting distance. This is has not been a problem for young traditional student groups as they move to education, but for lifelong learners, re-learners and non-traditional students, the university infrastructure becomes a big problem—for distant communities that want to have a competitive work force for proceeding in smart specialisation. This centralisation has proceeded since about 2010, and distributed learning alternatives have diminished (UKÄ 2014), partly because of changed state financing, but also in part because of ambitions such as of the city of Umeå, with the university, to become a hotspot of development by centralisation of people and resources.

This situation is a seedbed for creative open innovation, as a more active and concrete university presence seems required. The span between the actual state and the desired state of the region is not closing. The recommended black box of a centralised innovation function has low credibility to remote stakeholders. New universities or new university-driven branch campuses seem to be out of question. How can these communities then proceed?

Since the late 1980s, when videoconferencing came into use, communities without universities started learning centres with a video studio, counselling, meeting rooms, computer and broadband access, testing facilities, etc. This was not arranged by universities, but by the local communities that felt they must do something—and they negotiated with universities about education provision and helped recruit students to what was needed: education of teachers, nurses and other health workers, engineers, etc. Around these centres often grew development projects, new citizen services and co-operation with other communities in similar situation, such as "Akademi Norr" (www.akademinorr.se), an association with 13 communities with learning centres..

Bigger communities, like the city of Skellefteå which already had some technical education belonging to Luleå University of Technology, invested in the 1990s in

building a community-owned multi-institutional campus, Campus Skellefteå, a kind of a learning centre XL, including also full-time programmes on site, with today about 2000 students belonging to Luleå University of Technology, Umeå University, higher vocational education, adult education and online and blended courses. There are learner services in place, a university library, student sports facilities, restaurants and cafeterias and a national research institute. The recipe is to concentrate all there is of higher and adult education and research, make it visible, and develop it as a functional symbol of the knowledge society with the help of education and research partners with mobile services. Politicians in Skellefteå, together with local businesses and other organisations, have made this huge investment in building, owning and running a campus of their own as an almost conflict-free joint venture, and without regrets. The development was targeted—the lack of higher education visibility and access was critical, but can now be dealt with, even if it is not easy.

New community-supported environments like these are now emerging in many parts of the world. In Northern Europe, the UNICREDS project included three such campus environments; Campus Skellefteå in Northern Sweden, Campus Seinäjoki in Finland and Tremough Campus in Falmouth, Cornwall, UK (University Partnerships for Prosperity 2010). These North-European campuses all provide citizens with learning environments composed of services from different universities, with community invitation and support. In addition to these examples, it is worth noticing that multi-institutional learning institutions are becoming a global phenomenon: in the Middle East, "Education hubs" (Knight 2011) as Qatar Education City and Dubai International Academic City (Lane 2010) contain a mix of local, European and US universities and other education on locally built and owned platforms. In China, "university cities" (University city/ 学城 n.d.), as in Huangzho, Schenzen or Songjiang, are a national instrument for scaling up education by combining high-quality services from already existing universities, but in new local blends. In the US, the "university centres" often have background in the co-operation between communities far from a campus and a state-wide university system. One example of many is the University Center of Lake County outside Chicago, with today 19 universities represented at the same, small campus (Lee 2007). The initiative to these environments is community-based, increasing education access, differentiating and upscaling education provision.

North Great Plain Region, Hungary: Pharmapolis Innovative Food Cluster

The city of Debrecen is the centre of the North Great Plain region in Hungary. As part of the North-eastern area of Hungary, the North Great Plain region (17.729 km^2) with its 1.48 million inhabitants (2014[1]) is among the least developed regions both in the country and in the EU—the regional GDP lags both the national and EU averages. The region basically has a rural character with several urbanised centres and can be described as an area with low economic activity rate (58.1 % in 2014[2]) and relatively high unemployment rate (11.5 % in 2014[3]). Compared to past years, the number of

[1] http://ec.europa.eu/eurostat
[2] http://ec.europa.eu/eurostat
[3] http://ec.europa.eu/eurostat

registered enterprises, the performance value of investments as well as the volume of industrial production have increased.

Despite the fact that the North Great Plain region can be characterised as less-favoured the University of Debrecen is one of the most significant scientific bases of Hungary and it has been classified as "University of National Excellence". The University of Debrecen is committed to act in a more beneficial way for the economic growth of its region by utilising internationally recognised research and development potential. The city of Debrecen and the university have a long-term relationship; strengthened by the region's business and industry actors, an important innovation basis supports to find and create competitive advantages in the region, develop a new culture of collaboration and stimulate investments. In a recent collaboration agreement (2014), the University of Debrecen and the regional Chamber of Commerce and Industry joined forces to establish a new innovation agency aiming to enhance open innovation, coordinating and mediating market demands of regional business actors.

In addition to its traditional education and knowledge generating function, understanding the significance of universities as incubators for start-ups, the University of Debrecen performs new upcoming roles required for co-creation and made the first steps towards open innovation. This process is strongly supported by the recently established Technology and Knowledge Transfer Center of the university that is aimed to significantly improve knowledge transfer and consolidate the provision of innovation services.

In the North Great Plain Region clusters consisting of all the triple helix actor groups constitute the determinant form of partnerships in the region. They can be characterised as knowledge-based, specialised innovation systems in which the University of Debrecen acts actively as knowledge generator and knowledge diffuser. Debrecen-based Pharmapolis Innovative Food Cluster focuses on the production of healthy functional food products in which the recent scientific findings are used. The cluster is rooted in former research and development co-operations and partnerships in agro-biotechnology, involving different actors including universities, knowledge and research centres, administrative bodies, chambers as well as private members, companies and SMEs. The cluster sets together development ideas of both large and small companies and research experiences of the University of Debrecen.

Bringing closer good ideas, different initiatives and particularly commercialising those, a new form of marketing research results and products has been introduced at the University of Debrecen when the Innovation Shop (I-Shop, http://www.i-bolt.hu/) opened in 2010. Applying the latest research results, but keeping the local traditions at the same time, the I-Shop offers functional food products developed by the University of Debrecen and its cluster partners and provides the floor for potential customers to test these newly created products and to assess their potential success and value on market. In the first months, particularly the employees and students of the university visited the I-shop and tested the innovative products, but for now there is a wide range of customers seeking for healthy products. Daily contact with food producers and idea owners makes it possible to speed up the marketing of fresh ideas, first results and products.

Stepping over the frames of triple helix, the management of the cluster added a fourth group of innovation actors and involved the general public and local community members. Widening the scope of I-Shop and trying to engage further stakeholders, I-

Club was opened in the university in 2012 providing side events with topic-related presentations and discussions at a regular basis where participants can share ideas on potential future needs and have their comments on tested products.

These events ensure that the members of the local community, citizens and small groups focusing on different healthy food issues have the opportunity to meet, provide feedback and generate future research and development ideas. It is especially important for all parties taking part in the innovation process, as the cluster is planned to have an important future role in food, health and wellness sector studies and developments concerning the development of related instruments and diagnostics.

Highlands and Islands, Scotland, UK: the Centre for Health Science

The Highlands and Islands region of Scotland is broadly the Scottish Highlands plus Orkney, Shetland and the Western Isles and has a population of ~450,000 and a population density of 9.1 persons per km^2 (compared to the Scottish figure of 67.5 persons per km^2). The major industrial and economic activities include, e.g. renewable energy, life sciences, tourism, food and drink and creative industries. Approximately 99 % of the Scottish business population are small- and medium-sized Enterprises (SMEs), of these more than 80 % are microbusinesses.

The University of the Highlands and Islands (UHI) achieved full university title only in 2011—prior to that, there was no higher education institution based in the region, resulting in young people leaving the region to access higher education and limited support for SMEs and R&D. UHI is a partnership of 13 independent colleges and research institutions (~7000 students) and is the R&D and educational stronghold of the region. The presence of the university in the region has been calculated to have added 3813 new jobs to the region and £246 million to the local economy.

UHI's role in the Centre for Health Sciences (CHS) is an excellent example of a knowledge-based regional development that reflects the predominantly remote, rural and isolated nature of the region. The aim of the Centre is to become the innovation hub in the Highlands and Islands region for the health sector. The hub unites the quadruple helix of public, private, academic and community sectors and is focused on excellence in health science and biotechnology, bringing together research, education, training, patient care and business development.

The main remit of the hub is to stimulate innovation and creativity and encourage collaboration across the Highlands and Islands, building upon the health science research, education and training activity in the region, which is encouraged through collaboration, knowledge transfer, improved clinical outcomes, publications and commercialisation.

The Centre has been hugely important to the region, creating jobs, generating income and offering exciting new opportunities for training and research and has a GVA of ~£6.2 million per annum.

Although located in Inverness, the Centre aims to impact across the entire region though a hub and spokes mechanism, with outreach projects and activities. An example of how this operates can be seen from a specific project titled "O4O" (older people for older people) which was carried out by CHS's Centre for Rural Health as part of an EU Northern Periphery Programme Project. This example illustrates the potential role of Higher Education Institutions in using project-based activities to connect helix partners

together and bring entrepreneurial and innovative processes to the community—the fourth strand of the quadruple helix. It also illustrates a means of widening the innovation "contact surface" through targeted, user-driven open innovation to develop local healthcare solutions for remote, isolated and rural communities.

The O4O project was designed in response to findings that there was a greater proportion of older people in the population in remote, rural and isolated areas compared with central urban regions. It was becoming increasingly difficult to provide services to sparsely populated rural areas due to high costs and difficulties of recruiting and retaining staff. If people in the more remote, rural and isolated communities could do more to help themselves, in partnership with public sector local councils or municipalities, this would increase provision and limit the costs and problems for the public sector of trying to find ways to provide services to rural areas.

O4O sought to share knowledge internationally on how older people can contribute to sustainable, vibrant communities and how to maintain people living independently in their own communities for as long as possible. The project set out to involve older people in the design and development of service provision for other older people.

To better understand user needs, the O4O project engaged with many local communities in the more remote, rural and isolated parts of the Highlands and Islands. As a result of the knowledge gained, new processes and new mechanisms were developed that allowed people in rural communities to take more responsibility for service provision (e.g. transport, care, domestic tasks for each other, etc). One means of achieving this was through setting up new social enterprise companies. This approach combined business and commercial ideas and techniques (business development training, market research, business planning) for the first time with the social desires of rural community members. In many cases, viable new services have subsequently been developed, which have brought people together to generate new ideas and opportunities—as well as social benefits. The project demonstrated that older people themselves are central in developing solutions to the challenges they face. A toolkit was also produced that enables O4O type services to be set up in communities throughout Europe.

The project was also recognised by winning an EU Regiostars 2012 award for projects "addressing the challenge of demographic change and supporting active ageing".

Discussion and Policy Recommendations

This paper deals with the knowledge-based development on remote, rural and less-favoured regions: How can this kind of region be propelled into the path of sustainable knowledge-based development? The sketched "double-coin model of knowledge-based regional development" suggests that quadruple helix actors have pivotal role in this process. All four illustrative case studies showed that the quadruple helix approach can and has been applied to support the knowledge-based development and innovativeness of remote, rural and less-favoured regions. Even more importantly, positive developments will not take place without deliberative and decisive actions: regional development calls for actors and activity. In addition, the cases pointed out further questions and notions concerning the quadruple helix and regional development.

The *South Ostrobothnia* (*Finland*) case revealed that reaching a solid, shared vision for the region in question is a long-lasting process in which encouraging milestones are important. The central question is how to organise, maintain and occasionally intensify the development process which may be very complex and lengthy. It could be argued that this is a matter of leadership which calls for personal level enthusiasm and the ability to motivate and energise representatives of different quadruple helix actor groups. At different stages of the development process, different people or actor groups may be in charge of the process.

In any case, there need to be regional forums and arenas in which shared visions can be discussed and shaped among different quadruple helix actor groups. Consequently, in rural circumstances, it is very important to support and offer mental "space" for the activity of local people. That has been the case in South Ostrobothnia. Organisational support for organisational innovations is needed to facilitate and boost local and regional development processes. In creating shared vision and planning, and especially carrying out concrete common measures, people that have a connecting role in local and regional networks have an important role. They should act as the brokers in interweaving the networks and explaining objectives for different stakeholders. Formal, common, and also written, contracts with common goals are also needed when resources are allocated over several financial years.

The *Västerbotten* (*Sweden*) case showed that developing multi-institutional learning environments is a solution for a remote and peripheral region to response to the educational needs and to open up new avenues for the development. The internationally increasing number of this kind of arrangements implies that they are an applicable tool for the knowledge-based development. So, these multi-institutional learning environments initiated by the communities are, we argue, an important innovation with a future. As university research priorities are increasingly globalised and specialised, the education will presumably follow the same path. MOOC courses can be one of the first signs of this. However, learners are not placeless, but they live and work in communities which are trying to find their role in (global) smart specialisation. At the same time as the specialisation and globalisation of universities is progressing, regions around universities are in need of versatile higher education. In this respect, it is an interesting thought that higher education learning environments, although not education and research in themselves, can become a community responsibility. University and campus first unbundle, but then re-bundle, creating new possibilities for further development and smart specialisation. As a policy implication, this all demands "glonacal strategies" (see Marginson and Rhoades 2002). One such strategy is to recognise and support multi-institutional campuses and learning centres, as community-based service and innovation platforms, which enables local access to globalised research and education in the spirit of open innovation.

The *North Great Plain Region* (*Hungary*) case illustrated the ways how a research-intensive university can vitalise and strengthen its regional ties. Triple-helix collaboration is very important in this respect, but the University of Debrecen has also discovered the value of the fourth helix. For example, the Innovation Shop is a serious attempt to involve customers' views and expertise in innovation processes. But the fourth helix can gain even stronger foothold in the future.

Based on the recent process of formulating a solid, regular and co-operative communication and discussion between the regional/local triple helix actors, the

development of the innovation potential of the North Great Plain Region's economy clearly demands the coordinated co-operation and co-working of the active local communities and civil society even beyond the city borders. It is especially needed for the targeted cluster policy of the North Great Plain Region of Hungary. The strengthening university activity and engagement towards the real involvement of rural communities in the region strongly promotes the definition of sector-specific needs of these communities. At the same time, the vibrant and inspirational members of the civil society, associations and other local communities of these rural areas can significantly contribute to the success of innovative solutions/regional innovation through the appropriate combination of local knowledge, expertise and regionally available professional university, government and/or business expertise. This process is essentially important in the dynamics of the regional innovation system. So, the policy recommendation would be that universities can and should be active in involving different user and civil society communities in the knowledge-based regional development processes.

The *Highlands and Islands* (*Scotland*) case showed that a very peripheral region can achieve excellence in a certain field. This calls for intense local and regional collaboration among triple-helix actors. In addition, the national support (e.g. National Health Service) and EU funding have played a major role in this development. However, it has been very important to involve new actors in the development of health service provision. In this respect, an important lesson learned from the CHS O4O project is the importance of gaining local community input into local issues, rather than assuming a top-down, one-size-fits-all approach. Searching for and adopting relevant ideas and knowledge wherever they can be found, and maintaining a strategic view of the community's needs, can help policymakers design strategic programmes that better fit local, regional and national needs. Thus, the policy implication from the CHS example is that a hub and spoke mechanism can provide research and innovation benefits across a region—as long as you ensure that the strategy includes outreach projects and activities, such as the O4O project, that spread the impacts and benefits of research and innovation activity to the entire region and not just the urban centres. So, both the "hub" and "spokes" need to be active and willing to collaborate to make regional difference.

In sum, different kinds of communities seem to have an increasing role in innovation activities and thus also in knowledge-based regional development. In this scene, the triple helix configuration has traditionally been in the dominant position. In this respect, the key question is, how can the actors of the traditional triple helix support the empowerment of the local and regional communities? What kind of inclusive practices do they have? If they have an introverted attitude, organisational policies and priorities in formal procedures of business, research and administration, then there is only limited room for community interaction and personal level co-operation.

This notion brings us to the second key point. The individuals—people acting in regions—are fundamentally important from the point of view of regional development dynamics. This notion is highlighted when the role of regional and local communities is discussed. However, it is important to notice that civil servants, researchers and entrepreneurs are also members of these communities. If there exist decentralised competences to active behaviour and network-building, then the regional or local system can possess structural dynamics. If the right conditions for envisaged

development are missing, some stakeholder or responsible actor will have to take the innovative initiative towards shared action—otherwise nothing will happen. It can be argued that especially in rural, peripheral and otherwise less-favoured regions the questions of regional development come closer to people's personal lives than in bigger cities. Some individuals in these communities can be acting in more than one role in a quadruple helix model, or shift between them. These people usually make a difference.

References

Alarinta, J. (1998). *Maaseutu innovatiivisena ympäristönä. Verkosto paikallisen elinkeinopolitiikan toteuttajina. [Rural areas as innovative environment. Networks as realizers of the regional economic development]*. Seinäjoki: Helsingin yliopiston Maaseudun tutkimus- ja koulutuskeskus, sarja A:4.

Arnkil, R., Järvensivu, A., Koski, P., & Piirainen, T. (2010). *Exploring quadruple helix: outlining user-oriented innovation models*. Tampere: Tampereen yliopisto, Yhteiskuntatutkimuksen instituutti, Työelämän tutkimuskeskus, Työraportteja 85.

Aro, T. & Laiho A. (2013). *Kuuden suuren kaupunkiseudun demografinen kilpailukykyanalyysi. Muuttoliikkeen määrä ja rakenne suurilla kaupunkiseuduilla 2000-luvulla. [The analysis of the competitiveness of six large city regions. The Quantity and structure of the migration in large city regions after 2000]* Ministry of Finance. http://www.vm.fi/vm/fi/04_julkaisut_ja_asiakirjat/03_muut_asiakirjat/Kuusi_kaupunkiseutua_raportti_ARO_final.pdf. Accessed 3 August 2015.

Brabham, D. C. (2008). Crowdsourcing as a model for problem solving. An introduction and cases. *The International Journal of Research into New Media Technologies, 14*(1), 75–90.

Carayannis, E. G., & Campbell, D. F. J. (2009). "Mode 3' and 'quadruple Helix': toward a 21st century fractal innovation ecosystem'. *International Journal of Technology Management, 46*(3/4), 201–234.

Carayannis, E. G., & Campbell, D. (2010). Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a transdisciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development, 1*(1), 41–69.

Chesbrough, H. W. (2003a). The Era of open innovation. *MIT Sloan Management Review, 44*(3), 35–41.

Chesbrough, H. W. (2003b). *Open innovation: the new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.

Diener, K., & Piller, F. D. (2010). *The market for open innovation. Increasing the efficiency and effectiveness of the innovation process*. Aachen: Aachen University, TIM Group.

Doloreux, D. (2003). Regional innovation systems in the periphery: the case of the Beauce in Quebec (Canada). *International Journal of Innovation Management, 7*(1), 67–94.

Doloreux, D., & Dionne, S. (2008). Is regional innovation system possible in peripheral regions? Some evidence from La Pocatiere, Canada. *Entrepreneurship & Regional Development, 20*(3), 259–283.

Dubina, I. N., Carayannis, E. G., & Campbell, D. F. J. (2012). Creativity economy and a crisis of the economy? Coevolution of knowledge, innovation, and creativity, and of the knowledge economy and knowledge society. *Journal of the Knowledge Economy, 3*(1), 1–24.

Eilola, J. (2010). *Usko, tieto ja tutkimus. Etelä-pohjanmaan korkeakouluyhdistys 1960 – 2010. [faith, knowledge and research. The university association of south Ostrobothnia 1960 – 2010]*. Ylivieska: Etelä-Pohjanmaan korkeakouluyhdistys ry.

Etzkowitz, H. (1998). The norms of entrepreneurial science – cognitive effects of the new university–industry linkages. *Research Policy, 1*(27), 823–833.

Etzkowitz, H. (2002). *MIT and the rise of entrepreneurial science*. London: Routledge.

Etzkowitz, H., & Leydesdorff, L. (1995). The triple helix–university–industry–government relations: a laboratory for knowledge-based economic development. *EASST Review, 14*(1), 14–19.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from national systems and "mode 2" to a triple helix of university–industry–government relations. *Research Policy, 29*, 109–123.

Foray, D. (2015). *Smart specialisation: opportunities and challenges for regional innovation policy*. Abingdon–New York: Routledge.

Gassmann, O. (2006). Opening up the innovation process: towards an agenda. *R&D Management, 36*(3), 223–228.

Goddard, J., & Vallance, P. (2013). *The university and the city*. Oxford: Routledge.

Gunasekara, C. (2006). Reframing the role of universities in the development of regional innovation systems. *The Journal of Technology Transfer, 31*(1), 101–113.

Hossain, M., & Islam, K. M. Z. (2015). Ideation through online open innovation platform: dell IdeaStorm. *Journal of Knowledge Economy*. doi:10.1007/s13132-015-0262-7.

Huizingh, E. K. R. E. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*, 2–9.

Karlsen, J., Isaksen, A., & Spilling, O. (2011). Challenge of constructing regional advantages in peripheral areas: the case of marine biotechnology in tromsø, Norway. *Entrepreneurship & Regional Development, 23*(3–4), 235–257.

Kickert, W. J. M., Klijn, E.-H., & Koppenjan, J. F. M. (1997). Introduction: a management perspective on policy networks. In W. J. M. Kickert, E.-H. Klijn, & J. F. M. Koppenjan (Eds.), *Managing complex networks. Strategies for the public sector*. London: Sage Publications Ltd.

Knight, J. (2011). Education hubs: a Fad, a brand, an innovation? *Journal of Studies in International Education, 15*, 221–240.

Kolehmainen, J., & Alarinta, J. (2009). *University consortium of Seinäjoki* (pp. 17–19). Finland: Bringing South Ostrobothnia to the Knowledge Economy. Regions, (273).

Lane, J. E. (2010) International branch campuses, free zones, and quality assurance: Policy issues for Dubai and the UAE. Policy Brief No. 20, August 2010. Dubai School of Government. http://www.researchgate.net/publication/260592891. Accessed 25 June 2015.

Lee, M. (2007). *A comparative case study of four partnership campuses : origin, administration, academics, and student services*. Thesis (Ed. D.), University of South Dakota.

Leydesdorff, L. (2012). The triple helix, quadruple helix, …, and an N-tuple of helices: explanatory models for analyzing the knowledge-based economy? *Journal of Knowledge Economy, 3*, 25–35.

Linnamaa, R. (2004). *Verkostojen toimivuus ja alueellinen kilpailukyky. HAUS Kehittämiskeskus Oy*. Tampere: Cityoffset Oy.

Marginson, S., & Rhoades, G. (2002). Beyond national states, markets, and systems of higher education: a glonacal agency heuristic. *Higher Education, 43*(3), 281–309.

McCann, P., & Ortega-Argilés, R. (2013). Smart specialization, regional growth and applications to European Union cohesion policy. *Regional Studies, 47*(8), 1–12.

Nybacka, M., Larsson, T. & Ericson, Å. (2007). Collaboration in automotive winter testing - real-time simulationsboosting innovation opportunities. In N. Leon-Rovira (Ed.), International Federation for Information Processing (IFIP), Trends in Computer Aided Innovation (pp. 211–220). Brighton, Springer.

Open Innovation. (2013). *Directorate-general for communications networks, content and technology*. Luxembourg: European Commission.

Park, H. W. (2014). Transition from the triple helix to N-tuple helices? An interview with Elias G. Carayannis and David FJ Campbell. *Scientometrics, 99*(1), 203–207.

Pelkonen, A., & Nieminen, M. (2015). How beneficial is a knowledge-based development strategy for peripheral regions? A case study. *European Planning Studies*. doi:10.1080/09654313.2015.1047740.

Research and Innovation Programme (2000–2006). *The Thematic Programmes of South Ostrobothnia (in Finnish)*. Etelä-Pohjanmaan liitto 2001.

Sotarauta, M. (2014a). Reflections on mobilizing leadership in cities and regions. *Regional Science, Regional Studies, 1*(1), 28–31.

Sotarauta, M. (2014b). Territorial knowledge leadership in policy networks: a peripheral region of South Ostrobothnia, Finland as a case in point. In R. Rutten, P. Benneworth, D. Irawati, & F. Boekema (Eds.), *The social dynamics of innovation networks*. Abingdon, Oxon: Routledge.

Sotarauta, M., & Kosonen, K.-J. (2004). Institutional capacity and strategic adaptation in less favoured regions. A South Ostrobothnian University network as a case in point. In P. Cooke & A. Piccaluga (Eds.), *Regional economies as knowledge laboratories*. Cheltenham: Edward Elgar.

Sotarauta, M., Kosonen, K.-J., & Viljamaa, K. (2007). *Aluekehittäminen generatiivisena johtajuutena - 2000-luvun aluekehittäjän työnkuvaa ja kompetensseja etsimässä. [Regional development as generative leadership: In search of the competences of regional development officers of the 21st century and the nature of their work]*. Tampere: Tampereen yliopisto, Alueellisen kehittämisen tutkimusyksikkö, Sente-julkaisuja 23/2007.

Suutari, T., & Rantanen, M. (Eds.). (2011). *Innovaatiotoiminnan edistäminen maaseudulla: kohti paikallista elinvoimapolitiikkaa.* [*Promoting innovation in rural areas: towards local vitality policy*]. Helsinki: Ministry of Employment and the Economy. Regional development 38/2011.

UKÄ, Universitetskanslersämbetet (2014). Universitet och Högskolor – Årsrapport 2014. Universitetskanslersämbetet, p.30. http://www.uka.se/download/18.32335cb414589905b28acd/1421418511183/arsrapport-2014.pdf. Accessed 25 June 2015.

University City / 大学城. (n.d.). Baidu web page used in translated version. http://baike.baidu.com/view/46244.htm. Accessed 25 June 2015.

University Partnerships for Prosperity. (2010). Interreg IVC UNICREDS project final report. http://unicreds.eu/latest-news/item/97-university-partnerships-for-prosperity-unicreds-final-report.html. Accessed 18 December 2014.

von Hippel, E. (2005). *Democratizing innovation*. Cambridge–London: The MIT Press.

Wiig, H. & Isaksen, A. (1998). *Innovation in ultra-peripheral regions: The case of Finnmark and rural areas in Norway.* The STEP Report Series, 2/1998.