Discovering the regional innovation potential for Smart Specialization: the case of the two Baltic Sea Regions

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Discovering regional innovation potential for Smart Specialization: the case of the two Baltic Sea regions

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Abstract

The EU Commission launched an innovation strategy called Smart Specialization in 2012. Smart Specialization is a framework for developing policies unleashing place-based economic potential. Evaluations, however, have shown that appropriate innovation policy decisions are difficult. There is an innovation policy potential that must first be unleashed. This article shows how the application of a method – connectivity analysis – developed through a Baltic Sea Region project 'LARS – Learning Among Regions on Smart Specialization,' can be used to support Smart Specialization. The method includes transnational comparisons and targeted policy recommendations for public sector institutions operating within various institutional frameworks and different clusters. It consists of instruments (gaps and factors) measuring collaboration through interviews of 141 quadruple-helix stakeholders across eight Baltic Sea regions.

Introduction

According to Oxford Languages, providers of language data, the notion of *potential* refers to 'latent qualities or abilities that may be developed and lead to future success or usefulness.' Potential means that there is something latent or hidden, which must be discovered and managed to attain success. Unleashing regional innovation potential means discovering a possible improvement in regional networks or systems of innovation. Innovation potential should be seen as distinct from economic potential. The concept of *economic potential* was introduced by C. Clark as a tool with the potential to be used to explain past patterns of regional development and forecast future patterns of growth (Peaker 1971). The first period of Smart Specialization (2014–2020) used the economic potential of regions as its point of departure. The research question guiding this article relates to how regions can discover latent orhidden innovation potential. By answering this question, the article presents a method of regional innovation potential governance that can improve Smart Specialization.

The method applied to discover innovation potential consists of first mapping innovation networks and then discussing the outcomes of that mapping with a focus on enhanced regional connectivity. The mapping and comparison processes are based on two related sets of indicators characterizing the importance of relations and gaps in innovation networks (see below). The dialogs on these indicators open new ways to understand and improve the potential for regional innovation. As we will explain below, this method of governance overcomes a major difficulty in implementing Smart Specialization, that of decision-making. The method is general in the sense that it is tested on a broad variety of innovation networks in different regions in different countries. As examples to illustrate the methodology, the article presents two cases with different thematic priorities: the bio-economy in Lithuania (via consideration of the development of biogas) and energy technology in Ostrobothnia.

The decision-making problem of Smart Specialization

Smart Specialization is a growing part of the European Union's (EU) Cohesion policy (McCann and Ortega-Argilés 2016). Early evaluations of Smart Specialization highlighted different combinations of policy prioritization choices made by member states and regions, seeking evidence of the extent to which weaker regions might start to develop based on their *policy choices* (McCann and Ortega-Argilés 2016). These *policy choices* targeted the *economic potential* of the regions. Yet this somewhat simplistic focus on policy choices soon opened an avenue for criticism of Smart Specialization. It soon turned out that regions were unable to decide on enough specific priorities for Smart Specialization.

According to Marques and Morgan (2018), Smart Specialization is based on implicit heroic assumptions that might limit its impact, especially in less developed regions with low institutional capacity. The program places enormous demands on the stakeholders involved, especially public sector organizations with a key role in program design (Hassink and Gong 2019; Mäenpää 2020). Political habits, practices, and routines (the policy-making modes) are vitally important to the degree of efficacy and efficiency with which Smart Specialization can be implemented (Estensoro and Larrea 2016). Radosevic (2017) concludes a review of case studies on the implementation of Smart Specialization by remarking that the experimental nature of Smart Specialization is repressed by political and administrative requirements. The operationalization of Smart Specialization creates difficulties regarding the complicated design and the lack of a coherent set of analytical tools that would guide policies. This makes the implementation of Smart Specialization strategies very difficult (Balland et al. 2019; Foray 2020).

Regions were unable to make decisions on their priorities because there were flaws in their systems governing innovation. We have to move from economic potential to innovation potential. This is also a movement from a decision (which cannot be made) to a somewhat more functional point of view of understanding how the innovation system works, and why its potential is not realized.

Revealing the innovation potential

Our method (connectivity analysis and methods of closing gaps), which is detailed below, reveals the institutional and structural obstacles that *prevent* innovation potential being realized. The innovation potential is hidden behind the gaps and flaws of regional institutional networks and arrangements which block heroic Smart Specialization decision-making from unleashing the relevant economic potential. This means that the governance of Smart Specialization must start with governance of innovation potential. That is how the method of governance presented in this article can enhance the successful implementation of Smart Specialization.
The analytical tool aiming to resolve the challenge is the so-called connectivity analysis, which takes as its point of departure that Smart Specialization is based on the idea of a stakeholder-led, bottom-up process. To enhance the success of the entrepreneurial discovery process (EDP), connectivity analysis measures the cooperation and identifies the biggest bottlenecks to cooperation – gaps. This analysis can bolster the implementation efforts of public organizations by addressing three underlying challenges in Smart Specialization implementation: stakeholder inclusion, knowledge generation, and dominant actors.

By discovering and analyzing challenges of connectivity, the model enhances participation by offering multiple opportunities for regional dialogue, facilitating regional discussion with the help of the new type of knowledge (gaps) and restricting the influence of dominating stakeholders, as the analysis backs up the process and makes it difficult to implement wish lists of activities not shown in the analysis (Mäenpää 2020, 90). Connectivity analysis is also used to operationalize the quadruple helix (QH) approach in the context of Smart Specialization because the participation of a wide range of stakeholders is an important aspect of a successful EDP, as a new type of knowledge may appear through overlapping helices, as demonstrated by Leydesdorff and Etzkowitz (1998) and recently confirmed by Mäenpää (2020).

The empirical cases informing this study are from the Baltic Sea Region, but the connectivity analysis can be used as a tool for improving cooperation for Smart Specialization throughout the EU and beyond. The key idea is that the cooperation between regional QH actors (companies, universities, public organizations, and non- governmental organizations) improves the innovation capability and performance of a regional economy.
The core of connectivity analysis is a gap index indicating the difference between potential and present innovation cooperation between QH actors. The gap index can be used as a basis for transnational learning since good connectivity can offer a benchmark and learning for actors in other regions. The crucial roles in these processes are those of appropriately selected QH actors, that is, stakeholders (Mäenpää 2020), who hold sufficient power and legitimacy to change the innovation implementation pathway and in an urgent manner when necessary. The data provided by the gap index metric is also used to identify deeper structural differences between the regions. These structural differences go beyond the purview of the short-term EDP process of closing gaps but may indicate the need for a larger and more coordinated form of cross-sector policy activity.

The Baltic Sea Region

The Baltic Sea Region (BSR) is one of the EU's macro-regions formed by several regions and countries (Gänzle 2017). Macro-regional strategies are based on common challenges and opportunities. The EU's *Strategy for the Baltic Sea Region* (EUSBSR) responds to urgent environmental challenges and contributes to the economic success of the region and its social and territorial cohesion, and also to the competitiveness of the EU (Council of the European Union 2009; Gänzle 2017). There are significant differences in innovation performance between the countries comprising the BSR as measured by the European innovation scoreboard (European Commission 2020): Sweden is an innovation leader in the EU, followed by Finland and Denmark. Germany, Norway, and Estonia are strong innovators and Lithuania, Latvia, and Poland are moderate innovators. The research was conducted as a part of the Interreg Baltic Sea Region Program 2014–2020 project 'LARS – Learning Among Regions on Smart Specialization.'

The structure of this article is as follows. First, the conceptual framework of the analysis is provided with the help of a QH model; namely the concepts of Smart Specialization, regional innovation potential, and entrepreneurial discovery that require cooperation and co-creation among stakeholders. Second, the connectivity analysis is introduced as a tool for governance and one solution to the challenges of Smart Specialization, which requires stakeholder inclusion. The third section introduces the methodology around and materials for analysis of regional innovation potential in the BSR. The fourth section discusses some findings of the comparative analysis based on indices comparing the structural position of the regions. This is followed by an analysis of two cases: bio-economy (biogas) in Lithuania and energy technology in Ostrobothnia (Finland).

Analytical framework

Smart Specialization as exploration and QH collaboration

Smart Specialization is a set of methods and processes related to the governance of EDP. This process is expected to build on the economic potential, existing knowledge, and industrial strengths in the regions combined with external assets. The mainstream of the cohesion policy of the EU has been its Research and Innovation Strategies for Smart Specialization (RIS3) based on EDP and Smart Specialization. The RIS3 program coordinates the search for new business areas (Virkkala and Mariussen 2019) and to seize new opportunities over time and progressively create new options for economic transformation (Morgan 2015). The RIS3 strategy is based upon rethinking local capabilities and making new combinations of them (Boschma 2015) by involving relevant QH actors that could drive locally identified prosperous innovations by adopting a new approach to existing activities, thus expanding the regional economy. The EDP as a method for governing the search is a collective idea generation mechanism addressing the future of the region in terms of the knowledge economy (Foray 2017). This article approaches the prioritization process from the functional point of view and focuses on innovation potential. The approach involves viewing improving connectivity in the regional network by bridging gaps or building new intra-regional or extra-regional links as a precursor of allowing economic potential to emerge.

Collaboration between stakeholders is a necessary element of the EDP because the knowledge of opportunities, constraints, and challenges is dispersed, embodied by, and possessed by different stakeholders (Virkkala and Mariussen 2019; Mäenpää 2020). Single stakeholders have their own experiences and the entrepreneurial knowledge possessed by any single actor of a narrow scope. This knowledge is valuable, but it should be positioned with entrepreneurial knowledge collected from other sources in the discovery process (Morgan 2015; Virkkala and Mariussen 2019). A broad and inclusive partnership is needed that involves a wide variety of stakeholders within local societies (Gianelle et al. 2016; Mäenpää 2020).

In recognition of the necessity to mobilize the joint overlapping power of science, industry, and government, the Triple Helix (TH) innovation model (Leydesdorff and Etzkowitz 1998) was originally designed to act as a framework for mutual collaboration; however, the TH model proved insufficient to deliver the aims of RIS3 (Markkula and Kune 2015; Carayannis and Grigoroudis 2016). Prior research indicates the three helixes 'represented specialization and codification in function systems which evolve from and within society' (Leydesdorff and Etzkowitz 2003), so society was broadly represented by the three helices. Recent decades have seen how society as a whole is, however, no longer coordinated by any central authority. Accordingly, society has become a fragmented system, which independently represents its interests and embodies powerful interaction with actors, institutions, etc. The situation led to the development of the QH model encompassing four overlapping groups of contributors – science, industry, governments, and citizens – that emphasized the interaction required of those actors to promote knowledge co-creation and exploitation, opportunity exploration, and capacity building as innovation enablers of RIS3 (Markkula and Kune 2015; Höglund and Linton 2018). The QH actors are expected to be at the forefront of the EDP and they should work in unison in their search for new growth potential. Better cooperation creates more opportunities for innovative interaction, which can expand the intersection between helices and form a point of departure for additional EDPs (Virkkala, Mäenpää, and Mariussen 2017).

Scientists recognized that variances across regions promote QH structures for the implementation of RIS3 as they promote engagement among institutions, to create regional place-based strengths to bolster competitiveness (Carayannis and Rakhmatullin 2014). At the same time, it was observed, that remote, rural, and less- favored regions, which do not have universities or other knowledgeintensive institutions within them, can greatly increase their competitive capabilities by employing collaboration based on the QH model. Consequently, the QH model has been applied in support of RIS3 in the EU (Roman et al. 2020; Marques et al. 2020).

There is emerging literature on the use of the QH model in Smart Specialization (Carayannis and Rakhmatullin 2014; Roman et al. 2020; Marques et al. 2020) and a great deal of discussion on the role of the fourth helix. The QH approach, however, is often used in a rather abstract way and more effort will be required to operationalize the QH approach in the context of RIS3: Connectivity analysis is one approach that can be deployed to respond to this challenge.

Connectivity analysis as a tool of governance for revealing innovation potential in the Quadruple Helix

The connectivity analysis is based on relational geography (Bathelt et al. 2011) with a focus on relations and networks in addition to territory. According to the evolutionary TH tradition, however, the analysis of relations is not a purpose, but a means to study the potential synergy in new arrangements (Leydesdorff and Deakin 2011). In the case of EDP and RIS3, the synergy can be created through exploring new fields (business domains) that can be discovered with the cooperation of QH actors, and the connectivity analysis method was developed to reveal the innovation potential which can be energized for this purpose (Virkkala, Mäenpää, and Mariussen 2017; Mariussen, Mäenpää, and Virkkala 2019; Mäenpää 2020).

It should be stated that the analysis of innovation systems can be performed using different methods, including innovation biography and statistical patent data (Hassink and Gong 2019) among others. Innovation biography is an appropriate qualitative method in EDP analysis for research focusing on the main actors, their ideas, and the development of the process in different steps (Hassink and Gong 2019). The current research focuses on discovering innovation potential at the regional level, so the overall interactions in the process and the connectivity between the actors are more important than the individual actors and their pathways. As a result, innovation biography would not constitute a suitable method. The quantitative statistical patent data analysis method would also have shortcomings. Statistical patent data analysis is broadly applied in measuring innovation strategy effects (normally an ex-post evaluation) (Hassink and Gong 2019). Accordingly, patent data analysis would be of little help in disclosing the qualitative nature of interactions in innovation systems and the innovation potential of targeted regions in this research. Therefore, connectivity analysis constitutes the most suitable method to meet the aim of this research. Connectivity analysis assumes that improving connectivity favors regional development. Improvement, however, might sometimes require extra-regional links to avoid a regional lock-in situation.

The connectivity analysis as an operationalized QH model focuses on innovation networks that form the relations between various stakeholders, including gaps measured as tensions between expectations and experiences. We apply network analysis and follow Ranga and Etzkowitz (2013) by defining the helices as nodes and the relationships between helices or helix actors as linkages or ties (see Figure 1). We are interested in the characteristics of the relationships: their strength, quality, and the tensions between the QH actors. The connectivity analysis is based on the idea that the driver of a change in a relationship between two actors is the tension between expectations of the relationship, which may be confirmed and strengthened or frustrated. The role of expectations driving changes in innovation networks is the application of the social system perspective of Luhmann (1995).

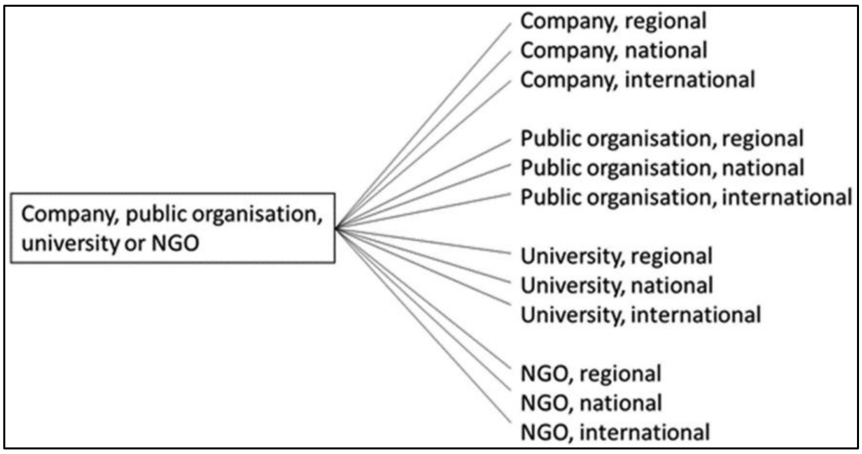

Figure 1. Mapping the innovation network between quadruple helix actors.

The structure and dynamism of an innovation network can be described with the help of three dimensions of its relationships: the strength of relations, quality of relations, and tensions in relations. The strength of a relationship depends on the level of importance of an innovation partner (a specific QH actor). The strength of the relation can be measured as the importance of the relationship, considering that the relationship between X and Y can be different from the point of view of partner X than that of partner Y. The quality of the relationship depends on the expectation and experience the partner has of a specific relationship. If both are high, the relation is demanding but satisfying. The gap describes the differences between expectation and experience and a high gap index means that the relationship is troubled and requires attention.

With the aid of the dimensions of the importance of partners, expectations, and experiences of the relationships, the structure and dynamics of the QH network in a region can be described. In the network, there are relations of different strength, different quality, and there is tension in relationships which create dynamism in the system. Exploring QH networks and their connectivity requires identifying the collaboration gaps that need to be closed.

The gap between expectations and experiences is used as an input in a structured dialogue in focus groups involving the relevant stakeholders and QH actors. Discussions on such gaps can improve the connectivity between stakeholders and can open the door to the discovery of connections (weak relations that may be strengthened) and structural holes (lack of relations), which may reveal an opportunity for discovery processes in the region as entrepreneurial actors resolve the issues hindering cooperation on various aspects of innovation. Not all relations and gaps are relevant, however. Gaps in important relations are more crucial for Smart Specialization than gaps in less relevant relations. Connectivity analysis can be used to help construct a shared vision and pool scattered resources, but also to detect the need for policy actions, for example, the alignment of educational, research, and innovation policies in line with the regional strategy. Such usage adds experimental learning and gradual improvements to RIS3 (Virkkala, Mäenpää, and Mariussen 2017).

Materials and methods

A connectivity analysis was conducted on eight Baltic Sea Regions. The contributors were asked to concentrate on the identification and analysis of their innovation network. The research process started with the selection of intervention areas, which were relevant value chains, clusters, or sectors defined in the RIS3 in the respective Baltic Sea area countries or regions (Figure 2). The bio-economy, wood building, metal, the circular economy, robotics, and energy technology were selected as intervention areas. The relevant QH actors were mapped based on their power, urgency, and legitimacy (see Mitchell, Agle, and Wood 1997).

In the second phase, interviews were conducted in the target regions using a standardized questionnaire to identify the innovation potential, that is, the structure and dynamics of the innovation network in terms of bottlenecks and good practices (see Figure 2). The questionnaire measured the relationships of the respondents (who represented the QH actors) in the innovation network. The respondents were informed that an innovation partner was any organization that is important to the innovation activities of their organization, with the caveat that both sides must genuinely interact. A distinction between four types of possible partners was made based on the QH model: companies, public organizations, universities, and NGOs (non-governmental organizations) (the latter usually being nonprofit interest organizations involved in issues regarding business, the environment, social security, public policy, education, etc.). We asked the respondents about their innovation cooperation in the target regions. Since innovation networks extend over regional borders, the questions were also targeted at the features of cooperation of the QH actors with their national and international innovation partners (see Figure 2).

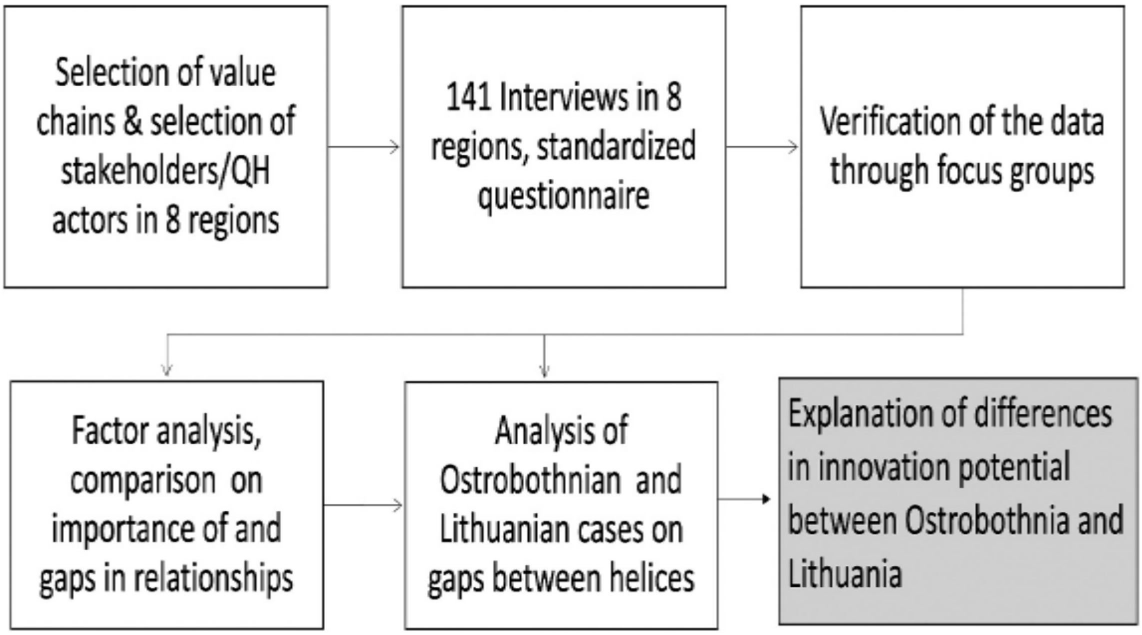

Figure 2. Research methodology: revealing innovation potential in the BSR.

During face-to-face interviews, respondents first assessed the importance of their partners according to the helices and geographical levels (regional, national, or international) on a scale from 1 to 10 (from lowest to highest, using 0 to denote no connection). Second, the respondents assessed the extent of collaboration in terms of expectations and experiences of the relationships with the innovation partners from the different helices. Expectation in this context means the expectation of what cooperation should be in an ideal situation/what the respondent wants it to be. This was measured with a value from 10 to 1, with 10 indicating a very high expectation, 1 a very low expectation, and 0 signifying no expectation. Experience means the collaboration in practice which was measured from a *very good experience* (=10) to a *very bad experience* (=1), with 0 denoting *no experience* (Mariussen, Mäenpää, and Virkkala 2019; Mäenpää 2020). The relationships between helix actors and their partners were measured in terms of the dimensions of the collaboration, for instance, the relationships from other helix actors such as companies, public organizations, other regional universities, and NGOs toward universities were mapped based on the functions of universities like research, education, and development (Mariussen, Mäenpää, and Virkkala 2019).

At least three respondents from each helix (public organizations, companies, universities, NGOs) were interviewed in each region, which led to 13–23 interviews per region. Each interviewee reported on his/her relationships with partners in all four helices in three different spatial units (regional, national, and international). Altogether, there were 12 relations (three spatial levels and four helices) per value chain (see Figure 3). Not all respondents, however, had relationships with other stakeholders in all helices and on all spatial levels. The values of such missing relationships in terms of importance, expectation, and experience were treated as zero. The survey data ultimately generated measurements of importance, expectations, and experiences of the relationships derived from 141 informants. The survey was conducted in 2018 and 2019.

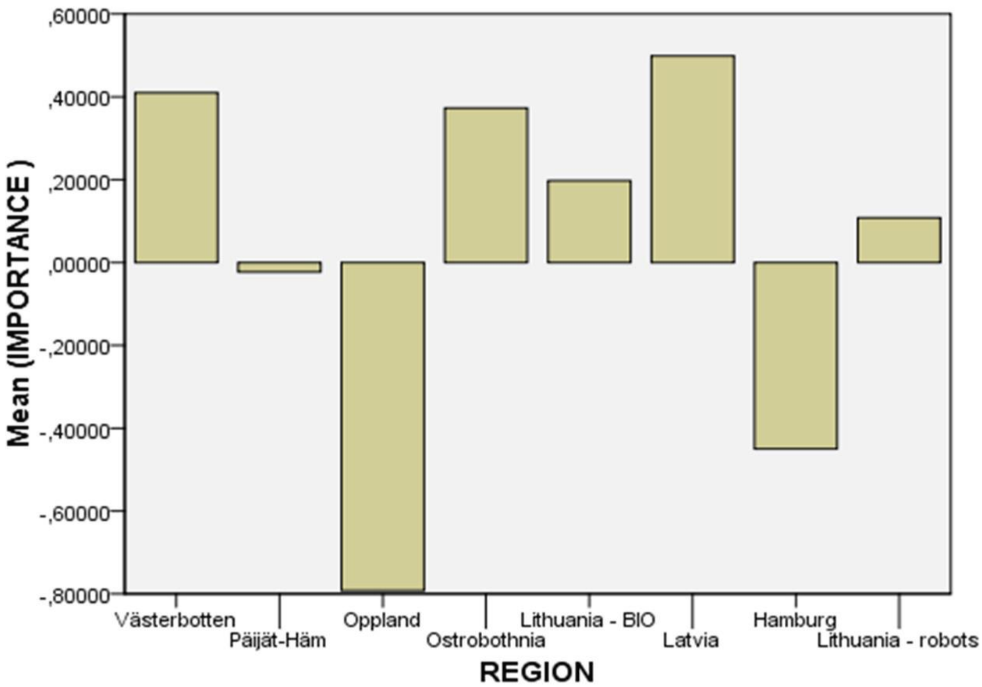

Figure 3. Mean IMPORTANCE in regions researched.

In the third phase, the interview data gathered was reformed into averages: the average importance of the partners of different helices, the average expectations and experiences as well as the gaps regarding different aspects and types of relationships. The data especially on the gaps between expectations and experiences was verified in the focus group meetings of the relevant stakeholders in the eight regions, and the gaps, the issues with connectivity between helices, and potential good practice were discussed. We used the verified data as a basis for factor analysis and in the analysis of the two cases.

In the fourth phase, new variables were created to summarize the interview data and discover deeper patterns in the data to reveal the innovation potential in the target regions. This stage was aided by factor analysis, which serves to generate abstract variables from many empirical variables and their values. Factor analysis demonstrates the differences between the regions in that the scales generated by the factor analysis are based on comparisons between respondents along with a new variable where the average is 0. The differences can be seen in the distances of the diagrams (see Figures 3 and 4). Those diagrams show the distribution of the values of variables (factors) and the deviation of the regions from the mean value of the variable (factor).

In the fifth phase, the connectivity analysis and the findings of the factor analysis were illustrated by two cases. The selection of these two cases was based on three criteria. First, Lithuania and Ostrobothnia (Finland) were selected as representatives of the BSR to have one Nordic region and one Baltic state, which in terms of regional innovation management systems are considered similar regions. Second, the cases are sufficiently different in terms of size and sectors present to demonstrate connectivity analysis as a general method. In addition, Ostrobothnia (Finland) is an innovation leader and Lithuania a moderate innovator (European Commission 2020). Third, the authors have had years of engagement with the case regions and, therefore, could apply their accumulated knowledge and experiences to the analysis.

The data has limitations, in that they are based on only 141 interviews, and some helices in the researched regions and value chain are represented by only three respondents. The values are based on subjective evaluations on the part of the respondents relating to their expectations of and experiences with the innovation partner and the importance of the relationship. The interviewers, however, used a guide to ensure they applied common scales.

Findings: network integration and gaps in connectivity defining innovation potential

The data acquired from the interviews is utilized in two ways: first, we use factor analysis to determine the innovation potential from detailed data on the level of innovation cooperation of the respondents. Second, we describe and compare the gaps between helix actors in innovation cooperation in two cases: Ostrobothnian energy technology and the Lithuanian bio-economy. This means that we go back to the averages of gaps per helix in the interview data in the two cases. Third, we refer to historical reviews to explain the differences in the gaps resulting from the different history and development paths of the chosen cases.

Structure and dynamics of the innovation networks: Factor analysis of eight cases in the BSR

Connectivity between companies, universities, public organizations, and NGOs is a precondition of a well-functioning system of innovation (which is measured through high levels of expectation and experience between and within helices). The connectivity depends on the structure of the innovation network, which is measured as the importance of the partners to a respondent, and the dynamics measured in the tensions of the relationship. Importance and gaps between expectation and experience are the main elements of regional innovation potential.

To discover the innovation potential, we first summarized the different dimensions of importance (the importance to the respondents of the various QH actors at the various spatial levels) in the interview data with the help of factor analysis. The result was a new variable, an indicator for ‘IMPORTANCE.’ This indicator shows the strength of the QH relations in a region. A high score on IMPORTANCE means that the respondents recognize the importance of the relations to other helices. The indicator IMPORTANCE also describes how integrated or fragmented the innovation network is, since the more important the relations are, the more centralized the network. Companies with strong relations to other companies, for instance, universities, public organizations, and NGOs (high IMPORTANCE) have higher expectations and better experiences with their innovation networks than companies in fragmented regions, where relations with universities, public institutions, and NGOs are weaker.

The indicator 'GAP' is a new variable created from the interview data on innovation network with the help of factor analysis and summarizes the differences between the respondents' expectations and experiences of their relationships with other helix actors in their own region, other regions in their own country, and international helix actors. The indicator gap describes the tensions in relations, and it can be seen as driving the change in the network. A high score on the gap indicator means that the relationship needs more attention and should possibly be closed.

Some relationships are important, carrying high expectations and equally high evaluations of experience (close to 10), and some are less important with low expectations and experience levels (close to 0).

Important relations are at the core of networks of innovation. In a stable system, important relations should be characterized by high expectations and equally matching positive experiences. Here, gaps between expectations and experiences should be close to 0 or at least low. In other, less important relations in stable systems, gaps might be wider. In other words, in a stable system the correlation between expectations and importance is high. A dynamic system would be expected to exhibit tensions in important relations, which will be visible as gaps between expectations and experience. It would be expected that gaps increase in line with increasing expectations. The gap is the urgency driving innovation. Expectations are likely to reduce in important relationships.

The deviations in connectivity across the regions can provide a space in which to search for good practice from which others can learn. The mean score on the indicator IMPORTANCE is a measure of network centrality for the target regions. High levels of IMPORTANCE mean that networks both within and between the helices are relatively strong. Well-connected companies, public organizations, universities, and NGOs can each be a source of good practice.

Our findings illustrate that the regions recording the highest levels of IMPORTANCE (Latvia, Ostrobothnia, and Västerbotten, Sweden) have more integrated networks than regions with a low score (Oppland, Norway, and Hamburg) (see Figure 3). Regions with a high level of QH integration (reflected by a high score for IMPORTANCE) may be able to inspire regions with lower levels. Different levels of network integration should be taken into consideration in discussing innovation strategies. Regions with high levels of integration, however, may have sectors and companies similar to those in regions with a lower score. Some regions with low or moderate scores for IMPORTANCE, such as Oppland and Päijät-Häme (Finland) are aware of the challenges facing their regions and are working to improve connectivity in various ways. A typical method involves providing public sector support to NGOs and supporting knowledge brokers connecting researchers and small companies (Mariussen, Mäenpää, and Virkkala 2019).

A large gap might signal the absence of relations or relations with disruptive institutional players who block progress. It is also important to know, for instance, whether the gaps are large or small in terms of the relations with important stakeholders. The presence of a significant gap with important stakeholders might be more crucial than the same size gap with less important ones. This means that there is a correlation between the importance of stakeholders and expectation and experience. A high level of IMPORTANCE, combined with low levels of expectation and experience indicates a potentially harmful relation between helices, with a wide gap or the absence of relations. This might be indicative of the presence of ‘sleeping giants,’ important actors who do not bother to engage (Mariussen, Mäenpää, and Virkkala 2019). Regions with wide gaps and high levels of IMPORTANCE have innovation potential, albeit realizing that potential might require them to undertake dynamic change and absorb good practice from other regions.

The collaboration promoting RIS3 in the regions studied identified in the form of gaps (see Figure 4) suggests several points for discussion. Regions vary greatly in their approach and the actions undertaken to implement RIS3, which stresses the different use of their endogenous collaboration potential. The innovation leaders researched (gOstrobothnia, Päijät-Häme) and the strong innovators (Västerbotten and Oppland) had small collaboration gaps, and, therefore, exhibit a good match between expectations and experience which demonstrates a successfully empowered endogenous potential. While moderate innovators (the Lithuanian bio-economy and Latvia) demonstrate weak empowerment of endogenous potential, they still lack a match between expectations and experience in terms of collaboration in innovation and thus exemplify unused potential. The other Lithuanian case on robotics, however, demonstrates an average gap size.

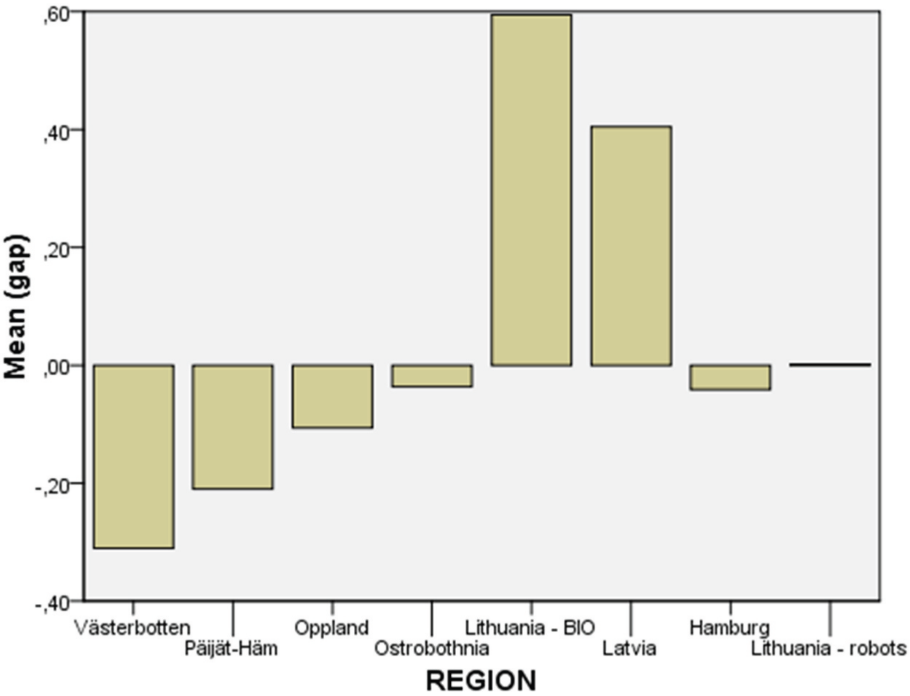

Figure 4. Mean GAP in regions researched (n = 141). Source: Mariussen, Mäenpää, and Virkkala (2019).

The current state of collaboration in support of RIS3 in the EU in some regions clearly remains nascent, given that large collaboration gaps demonstrate the early stage or early experiences of boosting the implementation of innovation. Innovation leaders and strong innovators exemplify a shift toward broad cooperation on innovation implementation, which is proved by existing small gaps. Large gaps in important relations among moderate innovators, however, offer a strong indication that the system is evolving fast; there is a tension that is driving change.

There is a considerable variation among the respondents within regions and helices regarding the innovation potential defining with the indicators IMPORTANCE and GAP (see Table 1). The most integrated innovation network is to be found in Latvia. Västerbotten has an integrated network with small gaps, which indicates that it is a stable system. Comparing Ostrobothnia and Lithuania (BIO) we can conclude that Ostrobothnia has integrated innovation networks and small gaps, whereas Lithuania (BIO) has relatively (medium) integrated innovation networks and large gaps compared to the other case regions. In the next section, the gaps for these two regions are comprehensively analyzed.

Table 1. Innovation potential in the regions researched

Importance (QH integration)	GAPS		
	Large	*Medium*	*Small*
High	Latvia		Västerbotten (Sweden) Ostobothnia (Finland)
Medium	Lithuania (BIO)	Lithuania (Robotics)	Päijät-Häme (Finland)
Low		Hamburg (Germany)	Oppland (Norway)

Comparison of cases from Lithuania and Ostrobothnia

In mapping the innovation networks in the case regions (presented in Boxes 1 and 2), we examined the different relationships of each helix actor with the other four types of helix actor, on three spatial levels: own region, own country, and international level, but Lithuania (and Latvia) in this research context had only national and international levels since it has no regional-level RIS3. Finland lacks a national RIS3 but has delegated the strategies to the regional level, and Ostrobothnia is one of the 18 regions in Finland, with 181,000 inhabitants. Although Lithuania is larger and has about 2.9 million inhabitants, the authors of this article think that the connectivity analysis enables a comparison of the gaps in the innovation network between the Ostrobothnian region and Lithuanian (BIO) national levels. Instead of factors, we analyze the gaps as differences between experience and expectation between helix actors based on the interview data in the Lithuanian (BIO) case (see Table 2) and the Ostrobothnian case (see Tables 3 and 4). The data on Lithuania (BIO) is harvested from the content of 13 interviews with representatives from four companies, three universities, three public organizations, and three NGOs while the data on Ostrobothnian energy technology is harvested from 22 interviews with representatives from nine companies, five universities, five public organizations, and three NGOs.

Table 2. Gaps between expectations and experience in Lithuania BIO, national level

To/From	Companies	Public organizations	Universities	NGOs
Companies	2.11	2.58	1.83	1.75
Public organizations	2.11	0	1.78	2.44
Universities	2.11	2.57	**5.33**	**3.78**
NGOs	**5.33**	**6.56**	**7.67**	0

Table 3. Gaps between expectations and experiences in Ostrobothnia, regional level.

To/From	Companies	Public organizations	Universities	NGOs
Companies	1.11	0.93	1.41	0.37
Public organizations	**1.93**	1.00	**2.13**	0.80
Universities	0.33	−0.53	0.40	1.27
NGOs	0.67	1.11	**1.89**	0.78

When studying bio-economy (biogas) for Lithuania as a QH case, it was noted that the most important innovation partners for companies are other companies, national public organizations, and universities (Vilke, Gedminaite-Raudone, and Vidickiene 2020). Companies have the greatest experience of operating at the international level, so they act as the main route to international collaboration. Public organizations recognized the high importance of innovation partners at the national and international levels alongside other public organizations, and also universities; and NGOs at the national level. Lithuanian public organizations considered companies at the national level to be less than moderately important innovation partners. In the Lithuanian (BIO) case, universities recognized the importance of all innovation partners both at the national and international levels, except international public organizations and NGOs. NGOs consider other NGOs, public organizations, universities, and companies at the national level as important, whereas the international level was not that important overall. The non-existence of innovation partners limits their potential to learn and cement their role in overall development. In general, QH actors identify very few innovation partners at the international level.

The Lithuanian (BIO) case illustrates a vast mean GAP in terms of stakeholders' relations with QH actors compared to other regions (see Figure 4). Drilling down into the gaps at the national level, the research results reveal that NGOs have huge collaboration gaps with all QH stakeholders (measured values vary from 5.33 to 7.67) except for other NGOs (Table 2). Apparently, NGOs feel that they are not welcome to join innovation activity programs. Universities report a moderate gap at the national level with the remaining three helices: NGOs (3.78), public organizations (2.67), and companies (2.11). Companies also report an existing moderate collaboration gap with public organizations.

The vast mean gaps reported by stakeholders in relation to QH actors in the Lithuanian (BIO) case are explained by the very high expectations of the stakeholders and the expectations of the research dimension of universities are particularly high. In the research context, large gaps are not a disadvantage; instead, tensions in relations are the driving force behind change. Large gaps can be a sign of a dynamic system that needs to adopt good practice from other regions. Such large gaps might also signal the absence of relations or relations with disruptive institutional actors who might be blocking progress. In Lithuania (BIO) gaps are wide, and the importance of relationships is relatively high. In the context of this research, this suggests a large potential for innovation. Studying Ostrobothnia as a QH case (see Box 2) revealed that companies are more important partners for QH actors than in other regions. The QH network in Ostrobothnia is relatively integrated compared to other regions. Compared to the Lithuanian (BIO) case, in Ostrobothnia, energy technology gaps are significantly smaller (see Tables 3 and 4) in terms of respondents' cooperation with both regional and national QH actors.

Table 4. Gaps between expectations and experiences in Ostrobothnia, national level

To/From	Companies	Public organizations	Universities	NGOs
Companies	0.70	0.67	1.04	0.41
Public organizations	**2.07**	**2.07**	1.60	1.33
Universities	0.87	0.67	0.73	0.60
NGOs	0.89	1.00	1.11	0.78

Companies are the most important innovation partners for other regional helix actors. They build the core of the regional innovation network. Networks between companies and the three other helix actors seem to be enabled through strong companies that are well connected with other companies, in the region, and/or globally. Global connections are important to other helix actors and most connections are with companies. The gaps between Ostrobothnian companies are small (1.11), as there are many local subcontractors. Subcontractors, however, feel that they need more data from global companies to remain competitive in the future.

Universities are mostly important partners to global companies, as smaller companies do not see cooperation with universities as particularly beneficial. Universities are also said to lack proper facilities, especially in robotics, and an 'internet-of-things' laboratory was suggested to be important in the future. Universities seem to be very happy cooperating with regional public organizations since the experience of cooperation exceeded expectations (−0.53). Ostrobothnian public organizations, however, were not content with regional universities, as shown by an intermediate gap (2.13). Public organizations enjoy more cooperation with various sizes of companies and are not content with cooperation between local companies and universities. Public organizations would need more input regarding the strategic development of the region and this dialogue is largely missing, resulting in a gap (1.93).

Local NGOs are in a sense an extension of energy cluster companies, as they primarily develop the energy sector directly or indirectly and organize an annual Energy Week event, which gathers energy specialists from all over the world. All actors cooperate during Energy Week and the cooperation has been increasing overall. New platforms developed by the University of Vaasa, the company Wärtsilä, and the Wasa Innovation Center offer proof of this development, which has already spurred greater dialogue between different helices.

Box 1. Lithuanian bio economy sector.

The Lithuanian case is from the biogas sector. Lithuania has more than 20 years of experience in biogas production. In 2011, the Republic of Lithuania passed a law on renewable energy and started promoting biogas production to accelerate the bio-economy. The first biogas auction winners fixed the electricity purchase tariff in January 2013 with an approved 18 MW (megawatts) approved quota (Vilke, Gedminaite-Raudone, and Vidickiene 2020). Further biogas production promotion was not pursued, however. There were 36 operating biogas plants in Lithuania in 2018 producing 13.3 MW (megawatts) of energy from agricultural waste (14 plants), landfill waste (9), sewage sludge (8), and biowaste and industrial waste (5). In total, 36 power plants in Lithuania provide a capacity of 9.481 MWth (megawatts thermal) and 30.218 MWel (megawatts electric). Although the biogas sector is developing quickly, Lithuania remains among the lowest producers of biogas in the EU. For this reason, the development of biogas production from agricultural waste and residues has been identified as one of the priorities of Lithuania's Smart Specialization strategy. Such an important tool in the post-industrial economy as collaboration to support Smart Specialization, however, has not been taken into account during strategy formulation or in the proposed implementation plan.

Box 2. Ostrobothnian energy cluster.

The Ostrobothnian case is from the energy technology cluster. The emergence of the cluster in this region in western Finland has been organic and enterprise-led. The cluster was created in 1906 when John and Jakob Wickström established a motor factory in Vaasa, the regional capital of Ostrobothnia. The successful business attracted other parties to the business, and soon the Wickströms experienced fierce competition in the region. The energy technology cluster emerged through spin-offs around large firms, the foundation of new companies, and attracting firms from outside. The supplier network developed because of the needs of nearby trusted suppliers. The educational institutes adapted to the cluster by supplying skilled workers to the companies. National expertise programs supported the growth and renewal of the cluster between 1995 and 2014. The cluster includes about 160 companies, and the manufacturing spans from simple engines to a wide range of sophisticated power plants (generators) to high-value and high-tech components for appliances that generate energy (windmills, powerplants, etc.). The cluster companies encompass 90% of Finland's R&D work within electricity and automation. In addition to Wärtsilä and ABB, several global energy technology companies are present in the region, such as Danfoss, Hitachi, The Switch, etc. Currently, Wärtsilä is building a Smart Technology Hub in Vaasa, which will extend the cluster further, as it will be an important part of the company's worldwide network of centers of expertise (Ship Technology 2018).

Discussion of differences in the innovation potential between Ostrobothnia and Lithuania; a historical review

First, it is important to state that in the Lithuanian case, democracy is relatively new and civil society is weak compared to the Nordic countries, and, more specifically, the cooperation culture found in Finland. Therefore, the reason for the large observed gaps in Lithuania (bio-economy) is attributable to the historical background. Lithuania became the first Soviet republic to declare independence in 1990. Alongside the restoration of national independence, many processes from the previously industrialized planned economy merged into a form of 'creative destruction.' With a rich 50-year experience of state-commanded forced cooperation in the agricultural sector in the form of planned Soviet collective farming (the *kolkhoz* system) and the negative treatment that entailed (shadow crafting and trading), the first decade of the independent Republic of Lithuania was challenging for many reasons typical of young transitional market economies. There were economic blockades, wild capitalism, bank crises, social and economic consequences of illicit privatization, the emigration of the qualified workforce, an unformed civic society, corruption in state and municipal institutions, etc. Historically Lithuanian labor was based on traditions, individual work, and the natural environment. Therefore, the observed huge collaboration gaps from all helices regarding public institutions and NGOs seem to be a natural outcome of the historical background of the country. Collaboration with public authorities in creating any prospective all-sides-win activity, and the role of NGOs in creating a collaboration culture for Smart Specialization, is a brand-new phenomenon in Lithuania.

Historical path-dependency made bio-economy sector research more static in terms of innovation. The other Lithuanian case, robotics, however, shows smaller cooperation gaps, but it is a new prospect sector initially accelerated by new entrepreneurs, often graduates from universities in western democracies. They brought completely different collaboration values and culture to the Lithuanian robotics sector.

In Finland, civil society has developed in particular at the local level; thus, a high level of trust now exists among the population in institutions like public administration, the courts, universities, politicians, and parliament. The actors, decision-makers, and stakeholders have found consensus in times of crisis. High levels of trust, a consensus-driven culture, and a relatively strong democracy might explain the smaller gaps observed.

Furthermore, an explanation for the smaller gaps in Ostrobothnia is the wide range of intermediary organizations and development agencies involved in regional development. The function of such organizations is often to transfer relevant knowledge from universities and research institutes to regional industry. They have been established as bottom-up institutions with arms-length functions by municipalities and regions. Lithuania's experience regarding intermediary organizations is completely different. Lithuania developed a system of consultancy and development agencies, which are not well connected to regional planning or a specific region's needs. These agencies in Lithuania hardly serve to narrow the collaboration gaps, since the genuine purpose of their activity is far from building collaboration for Smart Specialization in regions, especially in the bio-economy sector in Lithuania.

In Finland, the last 30 years have seen many national and regional development programs focusing on technology, the development of specific sectors, horizontal priorities, or regions. These programs have encouraged cooperation between QH actors, and indeed the participation of many types of actors has been a precondition of program implementation. In the Lithuanian case, none of the national or regional programs mandated cooperation across different helices. Particular initiatives had already been expedited in separate fields by the EU. Such initiatives, however, are just evolving in Lithuania, and they might serve in closing the collaboration gaps, at least in separate fields of activity.

Finally, the Nordic countries have a tradition of transnational learning in regional, economic, and technology development policies. The resulting good practice has offered examples of policy learning for others. The Nordic countries also have institutions like the Nordic Council and Nordregio which share learning among the countries. In the Lithuanian case, transnational learning, especially from public institutions, is treated as equating to going on a business trip and seeing an isolated practice, and the best outcome anticipated is to be able to copy and paste that practice into a particular field of activity in Lithuania. Any broader understanding of transnational learning with the desired outcome of learning, then modeling the current situation for driving actual change, and then moreover ensuring its implementation is a very rare practice, especially at the level of public institutions.

Conclusion and discussion: from economic to innovation potential and back

Considering the potential as a future opportunity which has not yet been realized, further concluding thoughts regarding the pathway from economic to innovations and back are fulfilled by the following prospective discussion concerning the researched context. The EU has pushed RIS3 policy obligations for regions, including the necessity to focus on and make decisions with reference to the economic potential of place-based activities. As demonstrated in the current article, with reference to evaluations of the first phase of Smart Specialization (2014–2020) this initial focus on economic potential has revealed the need to take a sharper look at innovation potential. The regional decisions needed to unleash economic potential are not taken owing to the state of networks and systems of innovation.

Innovation potential governance means initiating a process capable of unlocking the innovation system and network barriers. The first phase is to discover the mechanisms locking up the innovation potential. The current study introduces a tool for operationalizing the QH model of innovation, connectivity analysis. The tool measures the expectations, experiences, and, therefore, existing gaps in QH cooperation. It has been used in eight regions within the BSR.

The research findings suggest several points for discussion regarding innovation potential. First, the degree to which innovation partners cooperate affects the design and implementation of RIS3. We measured the innovation network in terms of the perception of the importance of the innovation partners and the gaps in relations. With the help of these indicators, we have defined the perceived innovation potential: the more important the partners and the larger the gaps in relations, the greater the perceived innovation potential. This new way to measure QH connectivity complements the macro-level synergy indicators developed in the TH literature by Leydesdorff and Meyer (2006) and by Leydesdorff and Park (2014) to measure the overlap of the helices. We have revealed that in the eight cases studied (for the factor analyses) the Lithuanian bio-economy and Latvian metal industry have the largest innovation potential.

Second, we noted that the innovation networks stretch across the regions and consist of important national and international partners. This finding is in line with earlier studies on innovation processes, according to which geographical proximity is important to the innovation processes of firms, but the innovation processes stretch geographically and occur at multiple sites (Nygaard Tanner 2018; Boschma 2005). Third, in terms of innovation potential governance, indicators of the analysis such as the gap index have been used by the helix actors when reflecting on their own innovation ecosystem and to improve the connectivity between helices in their regions, often with extra-regional linkages. Focusing on innovation potential shifts attention from the decisions needed to unlock the economic potential to discussions of gaps, which can open the door to the discovery of emergent connections (weak relations that may be strengthened) and structural holes (the absence of relations), which may reveal an opportunity for discovery processes in the region as actors resolve the issues hindering cooperation on various aspects of innovation. Through focus group discussion the abstract figure of a gap is transformed into a concrete development issue, which can be resolved. The main point among the stakeholders in both case regions is to learn to reflect on the innovation networks at a systemic level with the aid of connectivity analysis, especially with the gap index.

Fourth, the stories above on the Lithuanian bio-economy and also that of Ostrobothnia (Finland) show path-dependency affecting regional development, history, and culture matter. In both regions, however, there are incremental efforts that improve the connectivity between QH actors and thus the implementation of RIS3. Lithuanian bio-economy actors have introduced network strategy and Ostrobothnian actors a pilot of knowledge brokering between the university and small companies. The governance aspect of connectivity analysis has been included in Ostrobothnia's RIS3. The region has labeled this a *learning process* and ensured it includes gap analysis and focus group discussions, which are part of connectivity analysis (liitto 2020).

Fifth, connectivity analysis is based on the knowledge of the regional actors and practitioners themselves. With help of professional researchers, who manage to codify appropriately the tacit knowledge, and translated by practitioners, models, and indices for use as measures of connectivity might be produced. Using these professionally elaborated connectivity analysis results, fragmented networks acquire the possibility to be appropriately improved. Again, it might move to a further stage of improvement with professional help from researchers.

For the regional stakeholders, this kind of micro-level analysis and development tool might be more helpful than a macro-level analysis of patent data. The tool does not merely contribute data, but also includes dialogue with stakeholders, which allows for a new type of regional interaction. This sort of development dialogue is also beneficial for RIS3 implementation, as it allows for greater inclusion and a wider EDP process if the stakeholders feel that they are involved.

The findings of this research indicate that the developed methodology concerning the connectivity analysis might be helpful for innovation policymakers devising new solutions based on scientifically grounded analysis of the existing issues in the field. Connectivity analysis helps organize the regional dialogue, generates a new type of knowledge, and diminishes the potential effects of dominant stakeholders, allowing for a more efficient implementation of an EDP. In addition, innovation potential calculations can also be used by scientists planning further development focusing on possible good practice transferability choices, aiming to close the existing gaps with experience discovered in a relevant area of intervention in the BSR. In terms of contributions to Smart Specialization, the method applied here illustrates how dysfunctional innovation systems and networks may be removed, opening the path to unleashing the economic potential of the region.

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References

Balland, P. A., R. Boschma, J. Crespo, and D. L. Rigby. 2019. "Smart Specialization Policy in the European Union: Relatedness, Knowledge Complexity and Regional Diversification." *Regional Studies* 53 (9): 1252–1268. doi:10.1080/00343404.2018.1437900.

Bathelt, H., and J. Glückler. 2011. *The Relational Economy: Geographies of Knowing and Learning*. Oxford: Oxford University Press.

Boschma, R. 2005. "Proximity and Innovation: A Critical Assessment." *Regional Studies* 39 (1): 61–74. doi:10.1080/0034340052000320887.

Boschma, R. 2015. *Smart Specialization and Regional Innovation Policy*. Milan: Franco Angeli.
Carayannis, E., and E. Grigoroudis. 2016. "Quadruple Innovation Helix and Smart Specialization: Knowledge Production and National Competitiveness." *Foresight and STI Governance* 10 (1): 31–42. doi:10.17323/1995-459x.2016.1.31.42.

Carayannis, E. G., and R. Rakhmatullin. 2014. "The quadruple/quintuple Innovation Helixes and Smart Specialisation Strategies for Sustainable and Inclusive Growth in Europe and beyond." *Journal of the Knowledge Economy* 5 (2): 212–239. doi:10.1007/s13132-014-0185-8.

Council of the European Union. 2009. "EUSBR EU Strategy for the Baltic Sea Region." Accessed 9 June 2020. https://www.balticsea-region-strategy.eu/about/about

Estensoro, M., and M. Larrea. 2016. "Overcoming Policy Making Problems in Smart Specialization Strategies: Engaging Subregional Governments." *European Planning Studies* 24 (7): 1319–1335. doi:10.1080/09654313.2016.1174670.

European Commission. 2020. "European Innovation Scoreboard." https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf Accessed 1 July 2020.

Foray, D. 2017. “The Economic Fundamentals of Smart Specialization Strategies.” In *Advances in the Theory and Practice of Smart Specialization*, edited by S. Radošević, A. Curaj, R. Gheorghiu, L. Andreescu, and I. Wade, 37–50. London: Academic Press.

Foray, D. 2020. “Six Additional replies–one More Chorus of the S3 Ballad.” *European Planning Studies* 28 (8): 1685–1690. doi:10.1080/09654313.2020.1797307.

Gänzle, S. 2017. “The European Union’s Strategy for the Baltic Sea Region (EUSBSR): Improving Multilevel Governance in Baltic Sea Cooperation?” *Journal of Baltic Studies* 48 (4): 407–420. doi:10.1080/ 01629778.2017.1305205.

Gianelle, C., D. Kiriakou, C. Cohen, and M. Przeor. 2016. *Implementing Smart Specialisation Strategies: A Handbook*. Seville: European Commission/Joint Research Centre.

Hassink, R., and H. Gong. 2019. “Six Critical Questions about Smart Specialization.” *European Planning Studies* 27 (10): 2049–2065. doi:10.1080/09654313.2019.1650898.

Höglund, L., and G. Linton. 2018. “Smart Specialization in Regional Innovation Systems: A Quadruple Helix Perspective.” *R&D Management* 48 (1): 60–72. doi:10.1111/radm.12306.

Leydesdorff, L., and M. Deakin. 2011. “The triple-helix Model of Smart Cities: A neo-evolutionary Perspective.” *Journal of Urban Technology* 18 (2): 53–63.

Leydesdorff, L., and H. W. Park. 2014. “Can Synergy in Triple Helix Relations Be Quantified? A Review of the Development of the Triple Helix Indicator.” *Triple Helix* 1 (4). doi:10.1186/s40604-014-0004-z.

Leydesdorff, L., and H. Etzkowitz. 1998. “The Triple Helix as a Model for Innovation Studies.” *Science and Public Policy* 25 (3): 195–203.

Leydesdorff, L., and H. Etzkowitz. 2003. “Can ‘The Public’ Be Considered as a Fourth Helix in university- industry-government Relations? Report on the Fourth Triple Helix Conference, 2002.” *Science and Public Policy* 30 (1): 55–61. doi:10.3152/147154303781780678.

Leydesdorff, L., and M. Meyer. 2006. “The Triple Helix, Indicators, and Knowledge-based Innovation Systems.” *Research Policy* 35 (10): 1441–1449. doi:10.1016/j.respol.2006.09.016.

Leydesdorff, L., and H. W. Park. 2014. “Can Synergy in Triple HelixTriple HelixTriple Helix Relations Be Quantified? A Review of the Development of the triple HelixTriple HelixTriple Helix Indicator.” Triple HelixTriple HelixTriple Helix 1 (4): 1–18. doi:10.1186/s40604-014-0004-z

Liitto, P. 2020. “Pohjanmaan innovaation ja kasvun strategia 2019–2022: Älykäs erikoistuminen.” *Österbottens förbund Pohjanmaan liiitto*. https://www.obotnia.fi/assets/Sidor/1/45/S3-strategia-SUOMI.pdf

Luhmann, N. 1995. *Social Systems*. Stanford: Stanford University Press.

Mäenpää, A. 2020. “The challenges of public organisations in coordinating smart specialisation and a connectivity model as one solution.” PhD diss., University of Vaasa.

Mariussen, Å., A. Mäenpää, and S. Virkkala. 2019. "Revealing the Innovation Potential in the Baltic Sea Region: A Comparative Analysis." *LARS WP3 Report*. Accessed 23 May 2020. https://osuva.uwasa.fi/ bitstream/handle/10024/9766/mariussen-m%C3%A4enp%C3%A4%C3%A4-virkkala_2019a_comparative%20analysis.reportfinal.pdf?sequence=5

Markkula, M., and H. Kune. 2015. "Making Smart Regions Smarter: Smart Specialization and the Role of Universities in Regional Innovation Ecosystems." *Technology Innovation Management Review* 5 (10): 7–15. doi:10.22215/timreview/932.

Marques, C., A. V. Marques, V. Braga, and V. Ratten. 2020. "Technological Transfer and Spillovers within the RIS3 Entrepreneurial Ecosystems: A Quadruple Helix Approach." *Knowledge Management Research & Practice* 19 (1): 1–10.

Marques, P., and K. Morgan. 2018. "The Heroic Assumptions of Smart Specialisation: A Sympathetic Critique of Regional Innovation Policy." In *New Avenues for Regional Innovation Systems: – Theoretical Advances, Empirical Cases and Policy Lessons*, edited by A. Isaksen, R. Martin, and M. Trippl, 275–293. Cham: Springer International Publishing.

McCann, P., and R. Ortega-Argilés. 2016. "Smart Specialisation, Entrepreneurship and SMEs: Issues and Challenges for a results-oriented EU Regional Policy." *Small Business Economics* 46 (4): 537–552. doi:10.1007/s11187-016-9707-z.

Mitchell, R. K., B. R. Agle, and D. J. Wood. 1997. "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts." *Academy of Management Review* 22 (4): 853–886. doi:10.2307/259247.

Morgan, K. 2015. "Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy." *Regional Studies* 49 (3): 480–482. doi:10.1080/00343404.2015.1007572.

Nygaard Tanner, A. 2018. "Changing Locus of Innovation: A micro-process Approach on the Dynamics of Proximity." *European Planning Studies* 26 (12): 2304–2322. doi:10.1080/09654313.2018.1529143.

Peaker, A. 1971. "Regional Growth and Economic potential—A Dynamic Analysis." *Regional Studies* 5 (2): 49–54. doi:10.1080/09595237100185081.

Radosevic, S. 2017. "Assessing EU Smart Specialization Policy in a Comparative Perspective." In *Advances in the Theory and Practice of Smart Specialization*, edited by S. Radosevic, A. Curaj, R. Gheorghiu, L. Andreescu, and I. Wade, 1–36. London: Academic Press.

Ranga, M., and H. Etzkowitz. 2013. "Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society." *Industry and Higher Education* 27 (4): 237–262. doi:10.5367/ ihe.2013.0165.

Roman, M., H. Varga, V. Cvijanovic, and A. Reid. 2020. "Quadruple Helix Models for Sustainable Regional Innovation: Engaging and Facilitating Civil Society Participation." *Economies* 8 (2): 48. doi:10.3390/ economies8020048.

Ship Technology. 2018. “Wärtsilä to Build €200m Smart Technology Hub in Finland.” *Ship Technology*, 23 August. Accessed 17 July 2020. https://www.ship-technology.com/news/wartsila-build-e200m-smart -technology-hub-finland/

Vilke, R., Z. Gedminaite-Raudone, and D. Vidickiene. 2020. “Collaboration for the Socially Responsible Development of Rural Regions: Biogas Production in Lithuanian Farms.” *Social Responsibility Journal* 16 (6): 877–898. doi:10.1108/SRJ-07-2019-0235.

Virkkala, S., A. Mäenpää, and Å. Mariussen. 2017. “A Connectivity Model as A Potential Tool for Smart Specialization Strategies.” *European Planning Studies* 25 (4): 661–679. doi:10.1080/09654313.2017. 1283391.

Virkkala, S., and Å. Mariussen. 2019. “Self-discovery Enabling Entrepreneurial Discovery Processes.” In *The Entrepreneurial Discovery Process and Regional Development*, edited by Å. Mariussen, S. Virkkala, H. Finne, and T. M. Aasen, 11–34. London: Routledge.