CONNECTIVITY AND INNOVATION POTENTIAL IN POMORSKIE ICT AND ENERGY

COMPARISON ACROSS THE BALTIC SEA REGION

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1 Introduction

Baltic Sea Region (BSR) is one of EUs macro regions formed by several regions and countries. Macro-regional strategies are based on common challenges and opportunities. European Union's Strategy for the Baltic Sea Region (EUSBSR) responses to urgent environmental challenges, and contribute to the economic success of the region and to its social and territorial cohesion, as well as to the competitiveness of the EU. (Council of the European Union, 2009; Gänzle 2017). The ambition of smart specialization in BSR is to create regional growth through better ways of combining and using place-based resources and improved macro-regional networks. A key element of achieving this is improved regional governance and partnership coordination. At the regional and national level governance mechanisms, partnerships and networks of innovation are often seen as self-evident and given. The approach in this report focuses on governance of innovation networks in the context of two smart specialization areas (ICT and energy) in Pomorskie region, Poland.

We aim to reveal the *innovation potential in cooperation of Quadruple helix* in these two specializations in Pomorskie. According to Oxford Languages the concept "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 in order to reach success. A regional innovation potential means to discover a possible improvement in regional networks or systems of innovation. The method of discovering the innovation potential is based on the connectivity analysis (Virkkala et al. 2017, Mäenpää 2020), and is comprised of mapping of innovation networks and comparisons of the outcome of these mappings with a focus on enhanced regional connectivity.

Pomorskie Marshall office is an associated partner of project LARS (Learning among regions on smart specialization) which implements the Interreg Baltic Sea region programme. The other partners are from Finland, Sweden, Norway, Lithuania, Latvia and Germany (Figure 1.1). Project LARS attempts to help the public sector operating within various institutional frameworks to support innovation processes in their regions, and to connect innovation networks across and beyond the borders of regions. LARS is looking for improvements in public sector policies, supporting innovation.

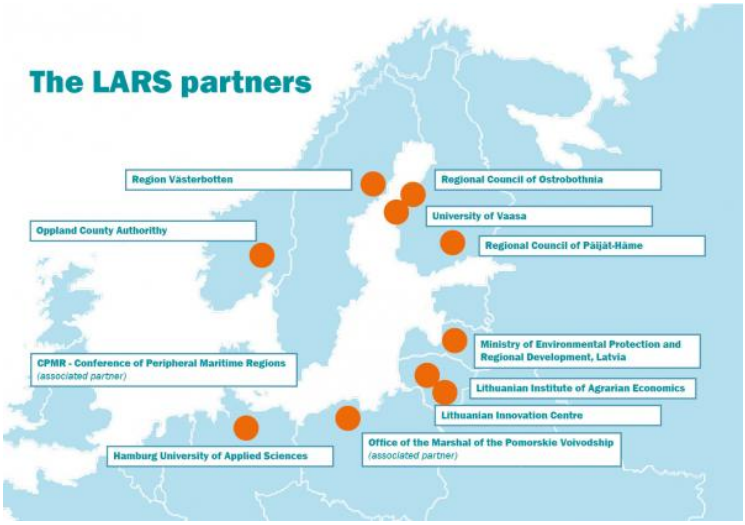


Figure 1.1 LARS partners

LARS project is an effort to implement experimental governance (Sabel and Zeitlin 2010) based on the ideas of transnational learning in the BSR. LARS is an experiment related to policy learning among regions in BSR, and it aims to test the relevance of transnational learning in policy design and implementation. LARS partners have mapped the innovation networks and their bottlenecks and good practices in selected intervention areas, searched for good practices, analyzed and translated them or their elements in their own regions, as well as prepared plans for implementation of the practices in their context. In this process, it is important to be familiar with the factors hindering and supporting the policy change. The experiment is made in the coalition with relevant stakeholders representing business, academy, government and NGOs. (target group). LARS method as an experimental policy approach gives a concrete instrument for policy makers, which can lead to institutional innovations and policy changes.

Mapping the innovation networks, identifying good practices and development challenges, as well as transnational learning on good practices is a policy experimentation under condition of strategic uncertainty. This effort may have success or failure, but the main thing is that in the process the capabilities of relevant stakeholders are increasing in reflecting their own regional innovation system and the possible solutions for bridging gaps in their innovation system i.e. the result of the effort is policy learning. In addition, during the process the policy networks among regions in BSR will be created or strengthened.

LARS project partners have selected important or emerging value chains for their innovation strategies, analyzed the selected value chains and their relevant stakeholders, conducted surveys on connectivity and functioning of the innovation networks, and organized focus group meetings to verify and discuss findings through structured dialogues.

This report describes and analyses the findings of survey on ICT and energy specializations in Pomorskie region based on the interviews and reports made by TECH-ACC. It also compares the findings with the other LARS partner regions based on comparative analysis (Mariussen et al. 2019). The comparative analysis is based on the numerical data delivered in the partner reports. Data contains 141 (167 with Pomorskie) interviews with carefully

selected companies, public organizations, universities and NGOs. This is supplemented with qualitative analysis from interviews, partner reports and focus group meetings, where the quantitative data were verified by the informants, explanations of findings were discussed, and seen in context with outcomes of stakeholder and value chain analysis.

The bridge from the interview data to a strategy of policy innovation comes through expectations, experience and importance of relations. We use measurements of importance to identify the structure of networks, and measurements of expectation and experience to identify the dynamics and the gaps of the networks. Gaps may be differences between expectations and experiences in specific relations inside a region. Gaps are points of tension and frustrations, where actors may be willing and able to act, initiate pilots, closing the gap. Informants in the same region may, for several good reasons, experience their positions within their networks, their gaps and their region in very different ways. After all, they have different positions. In addition, different regions have different structures. Their strengths may also be explained in different ways, with different indicators.

Sometimes, innovation is done inside firms with no or limited external assistance. However, well-functioning innovation processes rely on wide reaching networks of innovation. This is why connectivity between companies, universities, public organizations and NGOs is a precondition for well-functioning systems of innovation. We refer to the fields where networks between and within different societal institutional areas develop as quadruple helices.

The triple-helix (TH) model (Leydesdorff and Etzkowitz, 1998; Etzkowitz and Leydesdorff, 2000, Virkkala et al, 2017) is used to describe both dynamic interaction between universities, companies and public organizations and institutional continuity, which functions in different ways. Helices follow different codes of conduct. Universities, as scientific systems, communicate and function in accordance with the code of true/false, companies in accordance with the code of profit/loss, and the public sector in accordance with the code of right/wrong. By adding the fourth helix, civil society, we refer to various types of NGOs. They may be regional, national and international. The triple-helix models with the fourth helix is called Quadruple helix (QH) model (Carayannis and Cambell 2012).

In order to measure the networks, we used three core concepts: importance, expectation and experience. Usually, if an external actor or institution in your helix or a different helix is seen as important, and if you have high expectation, as well as good experience from your relation, the connectivity is good, and it is likely that the partner is contributing to your innovation. Some regions are characterized by high levels of connectivity, both inside the region and into wider areas. If experience and expectation are close to each other, the relation is good and functioning on a high level. Other relations are characterized by various forms of gaps between expectations and experiences. As shown in this report, there can be several types of gaps.

The concept “region” has different meaning in different parts of the Baltic Sea Region. Pomorskie region is one of regions in Poland with regional autonomy. In Norway, Sweden and Finland, regions are institutionalized political-administrative entities covering large geographical areas, within the context of national states, which are similar to a German Land. There is an on-going debate on reforms regarding the division of responsibilities and power between these levels. LARS German partner, Hamburg, is a city region with a high level of autonomy, within the context of a large federal state, the German Federal Republic. The institutional arrangements defining

these German relations are stable. Baltic countries are autonomous states, with a rather weakly developed regional level. In this instance, national data is sometimes treated as regional data, in order to make comparisons. In this report, we are referring to these different units as “regions”, and we use comparisons between them in order to discover good practices and problems, driving policy innovations.

In moving from individual level data with a lot of variation to a more generalized understanding of the deeper patterns of frustrations, tensions and gaps in regions and networks, we use well-known statistical methods reducing variation, like means (chapter 3) and factor analysis (chapter 4). In this way, we can discover differences between regions. We use factor analysis to summarize the partner importance variables, and we examine the link between partner importance and expectations of the QH relationship with the help of factors analyses and correlation matrices. Expectations are seen as a driving force in an innovation system.

According to LARS approach good practices on regional innovation policies/innovation systems are defined by the features of specific value chains, the features of relevant stakeholders in terms of urgency, legitimacy and power, as well as connectivity between the relevant stakeholders (regional, national and international), gaps between expectations and experiences**.** The challenges of connectivity in innovation systems and innovation policies depends on the same dimensions/factors, and our aim is to explore this phenomenon.

Next chapter will compare the characteristics of Pomorskie region with other LARS regions, and present the smart specialization strategy of Pomorskie. After that we present the LARS approach of mapping QH innovation networks, and a summary of the findings of a survey made by TECH ACC on two selected priorities of Pomorskie smart specialization strategy. In chapter 4 we compare the findings of the analysis of Pomorskien ICT and energy specializations with the 8 other cases in the LARS project. In order to reveal the innovation potential of the researched cases and to reduce the variation we use factor analysis. Chapter 5 presents a strategy of innovation based on the experiences of LARS 8 cases, and it suggests some good practices of connectivity of LARS project which might be relevant for Pomorskie region.

2 Pomorskie compared to LARS regions and smart specialization strategy of Pomorskie

Pomorskie Marshall Office is an associated partner of project LARS and Pomorskie is the target region of this case study. Compared to other LARS partner regions: Hamburg, Lithuania, Latvia, Oppland (Norway), Ostrobothnia (Finland), Päijät-Häme (Finland) and Västerbotten (Sweden), Pomorskie region is a relatively populated region having 2,3 millions inhabitants and somewhat smaller than Lithuania (2,8 million inhabitants) but bigger than Latvia with 1,9 million inhabitants, and Hamburg with 1,8 million inhabitants. The Nordic regions are sparsely populated: Västerbotten (270 000 inhabitants), Päijät-Häme (200 000), Oppland (190 000) and Ostrobothnia (180 000). Compared to Lithuania and Latvia with decreasing population the Pomorskie region has favourable population development and slight growth between 2008-2018 like Ostrobothnia, Västerbotten and Oppland.

Compared to the other LARS regions, the population of Pomorskie region is younger i.e. the share of population over 65 years was 16 % year 2018, when in Nordic regions this share was between 21-25% and in Lithuania and Latvia 20%. The share of inhabitants in urban settlements in Pomorskie region is 68,5% which is bigger than in other LARS regions except Hamburg with 100%. (Saarinen 2020) Much of the population in Pomorskie region is concentrated in the metropolitan Tri-City area (Gdansk, Gdynia and Sopot).

The level of education of population has been growing in Pomorskie region in 2008-2018 and 92 % of the inhabitants between 25-64 ages has higher-level education with upper secondary, post-secondary or tertiary education. The share of population with higher-level education is bigger only in one LARS region: Lithuania (95%), and lowest it is in Hamburg (85%) and Hedmark and Oppland (79%). However, the share of university level (tertiary education) population in Pomorskie region is lowest of LARS regions - 33 % of inhabitants of 25-64 ages has tertiary education - and highest in Lithuania (42%) and Ostrobothnia (Western Finland) (42%). However, the share of population with tertiary education has increased in all LARS regions including Pomorskie region between 2008-2018. (Saarinen 2020) The labour force of Pomorskie can be characterized as skilled workers with higher-level education, but not necessary university level education.

If we look the industrial structure of LARS regions, we can notice that public administration is a large employer in all regions, in the Nordic region it is the largest employer. Wholesale and retail is another major employer, it is the largest employer with 24 % in Pomorskie region, and also largest employer in Hamburg and in the Baltic states. The share of industry is 22 % of employment in Pomorskie region, which is the largest share in LARS regions. Agriculture, forestry and fishing employed 7 % of population in Pomorskie region in the year 2018. Information and communication is an important employer in Hamburg and in Western Finland, but smaller in Pomorskie region. (Saarinen 2020) Industrial sectoral distribution of employment varies notably between the regions. In Pomorskie region, other manufacturing was the largest industrial employer, followed by food, drinks and tobacco (16 %) in 2018. (Saarinen 2020). Pomorskie region has long-standing industrial specializations in shipbuilding and transport, shipping and logistics and a growing knowledge intensive services sector. (Potter & Lawton Smith 2019; OECD 2019). In recent years, Foreign Direct Investment (FDI) has been an important driver of regional growth, with an increase from some 3,000 foreign establishments in 2000 to 5,000 in 2016. Much of the FDI is in ICT specialization area. (ibid)

The average size of companies measured with employees is in Hamburg much bigger (more than 50 employees) than in other LARS regions. In Pomorskie region and in Oppland (No), the average size is the smallest of LARS regions 10-11 employees per company. (Saarinen 2020)

The openness of the economy can be measured with the share of exports of GDP. Measured with the share of export, Pomorskie region is as open economy as Lithuania, both being the most open economies of LARS regions with the share of more than 60 % of export of GDP (2014). The Norwegian region Oppland is the most closed LARS region with 8 % export of the GDP since the region serves mostly domestic market.

According to the European Regional Innovation Scoreboard Pomorskie region belongs to the moderate innovators with Lithuania and Latvia. The Finnish regions Ostrobothnia and Päijät-Häme belong to innovation leaders, the Swedish region Västerbotten is a strong innovator +, Hamburg is strong innovator and Oppland is strong innovator -. However, according to the OECD (2019) Pomorskie region is advanced and has lot of strengths, like high business start-up rate compared to the Polish average and a growing number of start-up success stories, including high tech start-ups. It has also well-developed local innovation support infrastructure including science parks, several incubators and accelerators. Its regional government has a good quality (Potter & Lawton Smith 2019; OECD 2019).

Bailey and de Propis (2019) has compared the automation and digitalization in the production process in terms of share of enterprises whose business processes are automatically linked to suppliers/customers in the EU countries based on Eurostat and the EU regional innovation scoreboard (2017). Based on the Figure 2.1 we can notice that Germany, Poland, Lithuania and Finland have the greatest number of enterprises already automatically linked to suppliers/customers. The high shares in Poland Lithuania and Finland might be that their production systems are more integrated to Germany that that of Sweden, Latvia and Norway.

Figure 2.2. presents the degree of digital penetration which is measures by people's digital skills (Bailey and de Propis 2019 based on Eurostat, data from 2013) and it shows that the digital skills are high in Finland, Sweden, and Baltic states, and somewhat lower in Norway and Poland, and lowest in Germany. In Germany the production system might be automatized and digitalized but the level of digital penetration among population is lower than in other countries among Baltic Sea Region.

Pomorskie region also has a large higher education institutions (HEI) sector, with 28 HEIs, including important university anchors such as Gdansk University of Technology, University of Gdansk, and Gdansk Medical University (OECD 2019). Pomorskie region has an above-average economic performance among Polish regions and a relatively high proportion business R&D. (Karo et al. 2017, Miezkowski 2017) Pomorskie region has experienced relatively strong economic growth in recent years, associated with low unemployment. Its rate of new business creations and share of high-growth enterprises are above the Polish average. (OECD 2019:14).

Compared to other LARS regions, Pomorskie

- has a relatively big and slightly growing population;
- is highly urbanized area;
- has the second-best accessibility in transport modes (Hamburg is the first) (ESPON 2013;
- has a young population (share of people over 65 years is lower than in other regions);

- has labour force with higher education, but less university level educated than in other LARS regions;
- is very open economy, and the share of industry in employment is higher than in other LARS regions;
- is specialized in food etc. and transport etc. shipyards;
- has a lowest average size of companies with Oppland (Nor);
- is a moderate innovator like Lithuania and Latvia.

The different features of labour force, firm structure and innovation vary in different sectors and localities of the regional economy.

Pomorskie region has changed its development path during last decades from one based on traditional industry to knowledge economy with new knowledge-intensive and high-tech industries. Employment increase for high-technology manufacturing and knowledge-intensive has been fast in 2004-2016. Persons with tertiary education as share in active population has grown fast and was higher than average share in the EU in 2016. (Wojnicka-Sycz,2018)

The main factors behind the new knowledge-based development path has according to Wojnicka-Sycz (2018) been the innovation policy directed towards the economic transformation of the region, which consisted of both using and upgrading endogenous potential, and using available exogenous factors. Human resources and willingness of the inhabitants to increase their qualification have been important as well as the metropolitan agglomeration with strong universities and educational institutes trying to meet the needs of the new industries. Infrastructural investments and networks of cooperation, as well as supporting institutions have contributed to the transformation of the regional economy. Important Exogenous factors contributing to the new development path have been using the windows of locational opportunities, i.e. potential created by European integration, and inflow of Foreign Direct Investments and migrants.

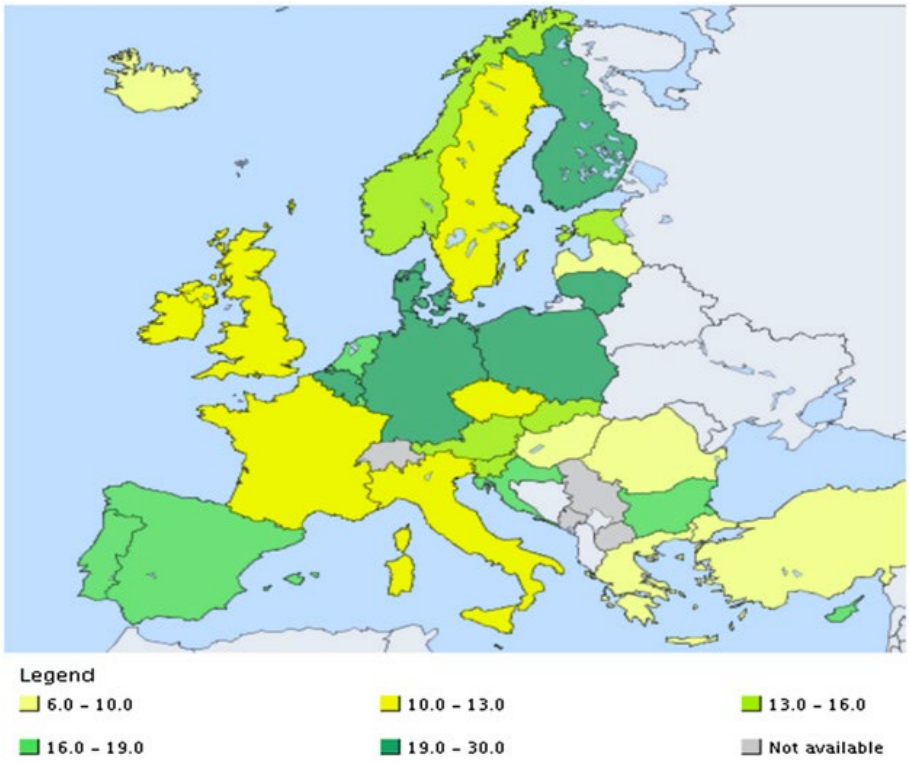


Figure 2.1 Enterprises whose business processes are automatically linked to suppliers/customers (Bailey & de Propis 2019: 73)

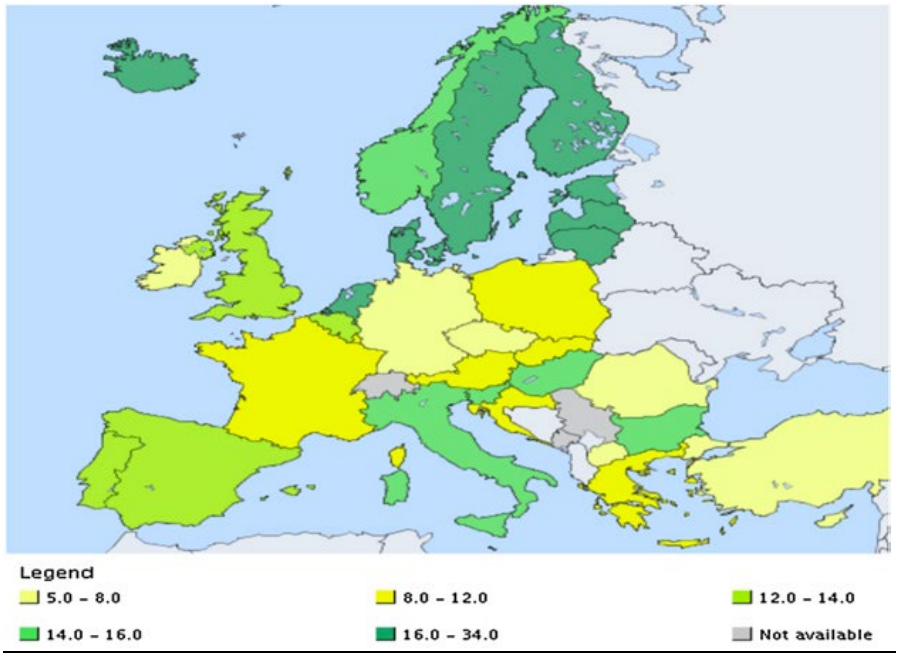


Figure 2.2 Internet skills (Bailey & de Propis 2019: 73)

Smart specialization strategy of Pomorskie region

In Poland RIS3 process was exercised at national and regional level. According to Karo et al. (2017: 284-285) and Miezkowski (2017), RIS3 design and implementation in Pomorskie region can be seen as a success story. Pomorskie has developed its own approach to entrepreneurial discovery (which is the key method in smart specialization), focusing on economic activities with a high level of export orientation and value added, and based on job requiring high-level skills (Karo et al. 2017). Pomorskie RIS3 governance included wide number and scope of stakeholders from a very fair bottom up perspective compared to the earlier regional innovation strategies (Miezkowski 2017). The design process involved people with a mix of business, research and innovation backgrounds, not just public authorities and research institutes. The S3 in Pomorskie region was prepared in a bottom-up process, in which the regional government first invited relevant universities and companies to a conference and a series of workshops aimed at generating partnerships of actors to propose joint projects in potential smart specialization areas. (OECD 2019; Potter & Lawton Smith 2019). The process was competitive and comprehensive with the inspiration of top-down analysis, which met the condition of decentralization based on competition. The open tender for consortia of the smart specialization areas and partnerships allows stakeholders to contribute to the policy-making process in direct way. (Miezkowski 2017; OECD 2019) The regional government has sought to keep the RIS3 consortia active through continued workshops and peer-learning events (OECD 2019; Potter & Lawton Smith 2019).

The RIS3 of Pomorskie region focuses on four specializations:

1. Offshore, port and logistic technologies (maritime)

2. Interactive technologies in an information-saturated environment (ICT)

3. Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction (energy)

4. Medical technologies in the area of civilisation- and ageing-associated diseases (medical technologies)

Smart specializations 1 (maritime) and 2 (ICT) reflect the largest existing business and research concentrations in the region. The existing scale of activity to build on is smaller in the case of smart specializations 3 (energy technologies) and 4 (medical technologies). The aim is to promote cross-sectional technologies and potential products in these areas. Innovative start-ups and scale-ups and innovation in existing enterprises will play a key role in the development of these smart specializations (OECD 2019).

For the purpose of this case study, only two specializations could be thorough studies with the connectivity analysis. Based on their in-depth knowledge and analysis, the regional government of Pomorskie selected two relevant smart specializations for the case study: ICT and energy.

3 Connectivity of the quadruple helix actors in ICT and energy smart specializations in Pomorskie

3.1 Introduction and method

In order to reveal the innovation potential in the selected specializations we have made a survey on the structure and dynamics of innovation networks. In the mapping we used so called connectivity analyses developed by University of Vaasa (Virkkala et al. 2017 and 2014; Mäenpää 2020) and used in the LARS project. The aim was to measure the importance and depth of as well as tensions in relationships between the Quadruple helix (QH) actors in order to reveal the innovation potential related to collaboration between the actors and improve the connectivity in innovation system of the selected specializations. The structure and dynamism of an innovation network was described with the help of three dimensions of its relationships: strength of relations, quality of relations, and tensions in relations. The strength of a relationship depends how important is an innovation partner of a specific QH actor. The strength of the relation can be measured as the importance of the relationship, taking account that the relationship between X and Y can be different from the point of partner X than from the point of partner Y. The quality of relationship depends on the expectation and experience the partner has on a specific relationship. If both are high, the relation is demanding but satisfying. The gap describes the differences between expectation and experience and high gap index means that the relationship needs attention. The innovation potential is defined in the connectivity framework with the help of gap index and importance: the more important the relationship is for innovation cooperation of a respondents and the larger the gap (between expectations and experiences), the larger the innovation potential in the relationship.

When studying the networks within and between helices, we used three core concepts: importance, expectations and experiences, which are measured on a scale from 1 to 10 (10=high importance/expectation/experience and 1=low importance/expectation/ experience, 0=no importance/expectation/experience). Usually, if an external actor or institution in a helix is seen as important, if you have high expectations, and good experiences from your relation, the connectivity is good, and it is likely that the partner is contributing to the innovation. Some regions are characterized by high levels of connectivity, both inside the region and into wider areas. If experiences and expectations are close to each other, the relation is good and functioning on a high level. Other relations are characterized by various forms of gaps between expectations and experiences.

1. **Connectivity.** A high level of importance, expectations and experiences, with small gaps between expectations and experiences, indicates that the partner has a high connectivity good practice, from which other partners might learn.

2. **Gaps in important relations**. A high level of importance, expectations and experiences, with gaps between expectations and experiences, indicates that the quadruple helix actors have a need for policy improvement.

3. **Disruptive relations**. A high level of importance, combined with low levels of expectation and experience or big gaps indicate a lacking or potentially harmful relation between helices, where a deep gap or a missing relation between helices might disrupt innovations.

4. **Missing relations**. The respondent does not have any opinion. The question appears to be irrelevant.

After selecting the specializations, relevant stakeholders representing four different helices (companies, public organization, universities, NGOs) were selecting. They were leading informants from a) companies (b) public sector authorities c) universities or educational institutions and (d) NGOs (Chambers of commerce, trade unions) in the specialization areas. The leading informants operate at the strategy level of their organizations and are expected to be well informed about the external relations of their own organization. At least three informants from each of these helices were selected to interview.

The third phase was interviews in the selected specializations. The interviews were made by the Polish expert TECH-ACC according to the LARS method September-December 2019. The interview questionnaire and the interviews focused on relationships of QH actors (see Appendix 1). Every interviewed responded on his/her relationships towards partners in all 4 helices in 3 different spatial units (regional, national and international). Altogether, it was 12 relations per interviewed (see Figure 3.1.). However, not all interviewees had relationships with other stakeholders in all helixes and all spatial levels. The values of these relationships (expectation, experience) were treated as zero. Collaboration was measured in detailed dimensions of the relationships. The relationships between companies and their partners (in a company, public organization, university, and NGO helices) were measured regarding the dimensions of the collaboration like regarding production networks, innovation network and future ventures. The relationships between public organizations and their partners were measured with dimensions of collaboration in regional development, collaboration regarding innovation network and collaboration regarding future ventures. The relationships between universities and their partners were measured with a dimension of collaboration in education, in development, and in research. The relationships towards universities from other helix actors were mapped based on their functions like research, education and development. The relationships between NGOs and their partners were measured with dimensions of collaboration in regional development in product/service development and collaboration regarding future ventures.

The fourth phase was analysis of interview data made by University of Vaasa in the same manner as the other LARS partners. The gained interview data was counted as averages: the average importance of the partners of different helixes, the averages of expectations and experiences as well as the gaps regarding different aspects and types of relationships. It was presented in three tables: 1) the importance of partners of different helices for respondents; 2) respondents' expectations and experiences towards cooperation of partners in different helices; and 3) gaps in the cooperation with partners. (See sections 3.2. and 3.3.)

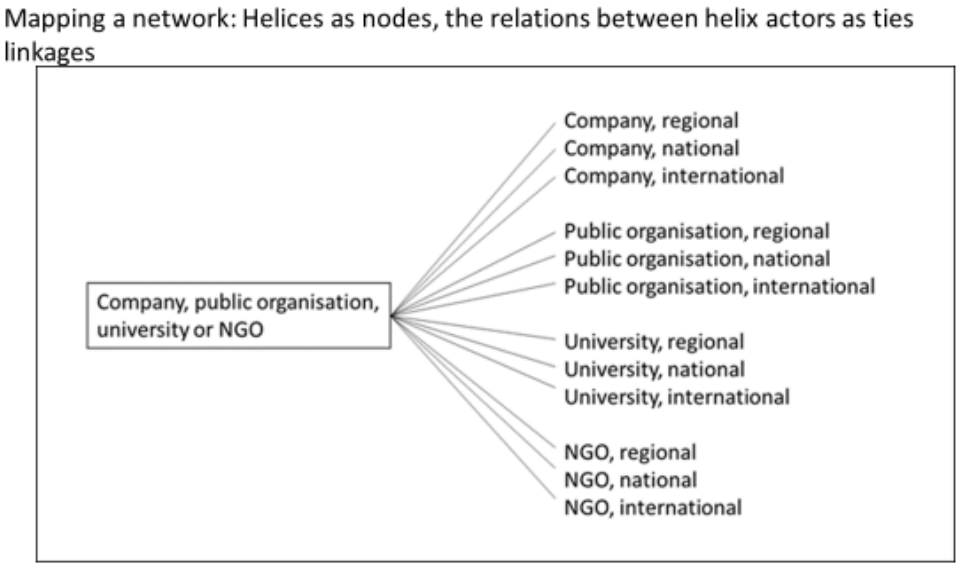


Figure 3.1. Mapping innovation network between quadruple helix actors

In the fifth phase, new variables were created in order to summarize the interview data and discover deeper patterns in the data to reveal the innovation potential in target regions. This was done with the help factor analysis. Factor analysis is inductive to generate abstract variables from many empirical variables and their values. Factor analysis demonstrates the differences between regions. The scales generated by factor analysis are based on comparisons between respondents along with a new variable where the average is 0. The differences can be concretely seen in the distances of the diagrams. They show the distribution of the values of variables (factors) and the deviation of the regions from the mean value of the variable (factor). The comparison between 8 LARS cases and Pomorskien ICT and energy specializations based on factor analysis is discussed in the chapter 4.

The data has also limitations, since it is first based only on 13 interviews in both specializations in ICT and energy specializations in Pomorskie, and many helices are represented only for three interviews. However, the selection of informants and their organizations was carefully planned in order to give maximum representation of views and attitudes in the selected specializations. All the major figures were involved including the public sector, universities and NGOs. Their opinions matter greatly in strategic discussions. The selection was consulted with the representatives of the department responsible for smart specialization at the Pomorskie Marshal's Office responsible for operational cooperation with smart specialization stakeholders. (TECH-ACC 2020a and b).

Second limitation is that values are based on subjective evaluations of the interviewees regarding expectation and experience of the relationship and importance of the innovation partner. However, it was tried to use common scales. Third, the use of means in the tables (chapter 3) and the use of factors (indicators in chapter 4) reduces the variations. Nevertheless, the importance and gap indices enable the comparison with other LARS region with the similar survey.

Table 3. 1 Research methodology and process in Pomorskie region

Step 1. Selection of relevant smart specializations	***ICT and Energy***
Step 2. Selection of relevant stakeholders in the specializations	***Selection of leading informants based on Mitchell's et al. (1997) methodology: power, urgency and legitimacy of stakeholders:*** 1. Companies; 2. public organizations; 3. Universities; 4. NGOs
Step 3. Interviews based on standardised questionnaire	***Aspects of collaboration among QH actors:*** 1. Importance of innovation cooperation 2.Expectations and experiences in regional, national and international collaboration 3. Collaboration with business, public organisations, universities and NGOs 4. Collaboration for different dimensions like research, education and development with universities
Step 4. Data-analysis: counting averages	***Averages on relations between helix actors*** 1. Importance of innovation partners; 2. Expectations at regional, national and international levels; 3. Experiences at regional, national and international levels 4. Gaps as difference between expectation and experience
Step 5. Comparison with other LARS cases on innovation potential based on factor analysis	Building Indicators (factors) IMPORTANCE, GAPs, and innovation potential Comparison with the LARS cases

3.2 ICT specialization in Pomorskie: Interactive technologies in an information-saturated environment

The data on ICT consists of 13 interviews: three companies, three public sector organisations, three universities and four NGO representatives. The interviewees were key players that define the strategy and steps for the whole ICT community in the Pomorskie region starting from strategy planning on the level of self-government ending with day-to-day operations among ICT startups. All the interviewed informants were either owners or co-owners (co-founders) and CEOs of companies or directors responsible for project cooperation or operational activities, Presidents of the boards at NGOs, leading figures at universities (including one Deputy Rector) responsible for advising the university authorities and directors of departments, heads of offices at public institutions. Nearly all of the interviewed informants have taken active role in the Smart Specialization process (meetings, discussions). All interviewees were leading figures in their relevant helices – for instance leading founders of the ICT companies. (TECH-ACC 2020a). The selection of informants and their organizations was carefully planned in order to give maximum representation of views and attitudes in the ICT specialization. All the major figures were involved including the public sector, universities and NGOs. Their opinions matter greatly in strategic discussions. The selection was consulted with the representatives of the department responsible for smart specialization at the Pomorskie Marshal's Office responsible for operational cooperation with smart specialization stakeholders. (TECH-ACC 2020a)

The rich data allows us to examine many aspects of the quadruple helix network of ICT specialization. We describe first the importance of innovation partners for different helix actors. Second, we analyse the dynamics of the relations in terms of expectation and experience given by the respondents towards the cooperation with different helix actors. Third, we describe the gaps between experiences and expectations from the point of view of helix actors. Fourth, we explore the same gaps at different spatial levels in order to find out the role of different spatial scales for the dynamics of the ICT specialization.

The importance of partners in the same helix and between helices is influenced heavily by funds and financing core businesses of every one of them. (Table 3.2) Companies favor other companies because they see value in cooperation with partners of the same mindset, dealing with the same kind of problems. Similar discovery was also noticed in other LARS regions (Mariussen et al. 2019). The companies value very much tangible effects. Sometimes they prefer to cooperate with or subcontract R&D activities to other companies rather than to universities. Sometimes it even turns out that external R&D in another company is cheaper than in the university. The other companies on a regional and national level are more important partners for companies than on the international level (TECH-ACC 2020).

Universities are still important to companies, sometimes because of grant call rules, where this kind of cooperation is asked for or the co-funding rate is lower for company-university cooperation than company-company relations. Public organizations are important to companies mostly because they are often responsible for designing and managing the distribution of cohesion funds on regional level, and national organizations on national level are also important. The cooperation with regional self-government is rated highly both by the companies and universities, except some exceptional cases where a kind of conflict arose during the cooperation with specialized agendas for grant distribution. (TECH ACC2020a)

Both companies and universities do not rate NGOs highly as innovation partners. However**,** there are very active NGOs in Pomorskie region and they cooperate closely with companies, but the latter see them as networking and address book kind of partners. (TECH ACC2020a) For public organizations regional and national NGOs are quite important.

Table 3.2 Importance of partners for different helix actors in ICT specialization in Pomorskie region

			Companies	Universities	Public organisations	NGO´s
Questions		Data type	all	all	all	all
How important are companies as innovation partners for your organisation	regional level (0, 1-10)	averages	8,67	6,67	8,67	7,25
	national level (0, 1-10)	averages	8,67	8,67	8,00	5,25
	international level (0, 1-10)	averages	8,00	5,33	5,33	5,75
How important are public organisations as innovation partners for your organisation	regional level (0, 1-10)	averages	8,00	9,33	6,33	9,00
	national level (0, 1-10)	averages	8,00	9,33	7,33	7,00
	international level (0, 1-10)	averages	6,67	8,00	6,33	5,00
How important are universities as innovation partners for your organisation	regional level (0, 1-10)	averages	8,00	6,33	8,33	7,25
	national level (0, 1-10)	averages	7,67	7,33	6,67	6,00
	international level (0, 1-10)	averages	4,67	9,00	4,67	6,50
How important are NGOs as innovation partners for your organisation	regional level (0, 1-10)	averages	4,33	3,33	7,67	7,25
	national level (0, 1-10)	averages	4,33	3,33	7,67	7,25
	international level (0, 1-10)	averages	0,67	3,33	5,00	5,00

When examining the relationships between QH actors in terms of expectations and experiences the respondents had towards their partners, we can notice that ICT companies in the Pomorskie region have the highest expectations towards universities and public institutions and simultaneously there are also the largest drops in experiences with these helices (Figures 3.2 and 3.3). High expectations arise from the fact, that in companies' view, in a perfect or near perfect innovation ecosystem, universities should be feeding the system with innovative ideas, projects and prototypes of the highest quality and more open to business, market-orientated. The same applies to public organizations, which should be flexible, open-minded and less bureaucratic. For companies it does not matter whether the university is from the Pomorskie or from any other region, the same applies to public organizations – whether they are regional or in Warsaw. Expectations and experiences towards other companies are gradually declining when moving from regional to international, which is quite natural since many companies are just beginning their expansion outside. The least important partners for companies are NGOs, where the differences are quite small since nothing exceptional is expected from them. (TECH-ACC 2020a)

Public organizations have the highest expectations towards other public organizations and companies. Companies are in fact the most important partners on the receiving end of any aid or incentive in innovations. The differences between expectations and experiences aren't that extreme as it was the case in companies towards public organizations. Moving towards international experiences, the public organizations cited that they were not familiar with realities of public administration and procedures in Poland. Public organizations do not really expect much from the NGOs in general, especially when it comes to innovations in ICT. Universities are in between and it's quite natural, since the importance is shifting towards companies, especially with processes like entrepreneurial discovery. (ibid)

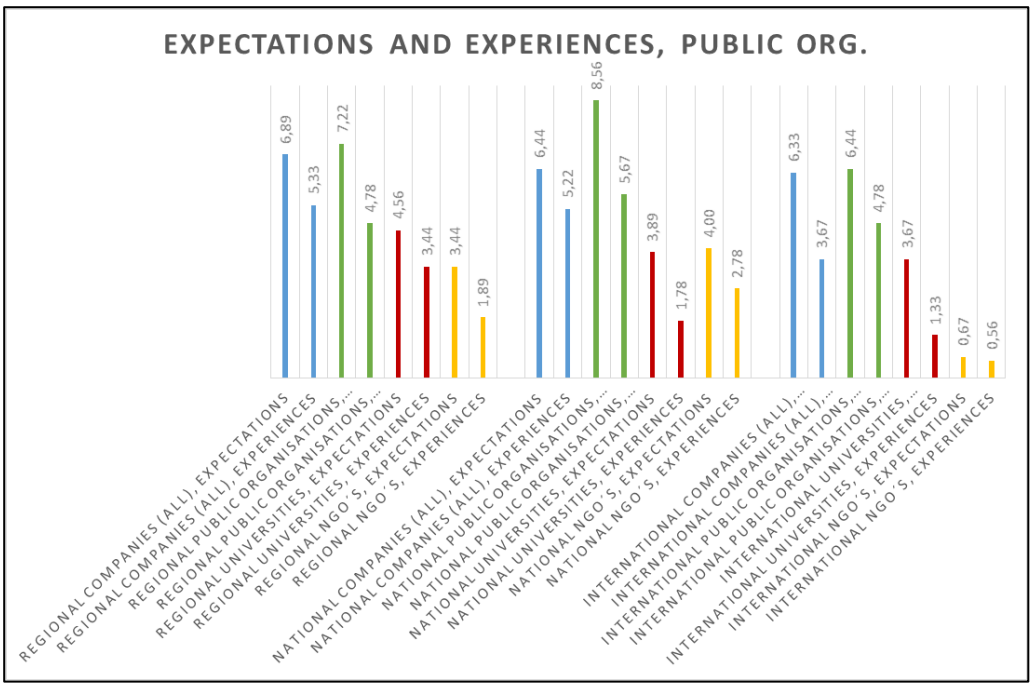
Pomorskie universities have the highest expectations towards companies on regional and national level as well as towards public organizations on all level, with universities exchanging with companies on international level. It's quite natural, since universities eagerly launch international R&D projects, but interviewees raise a point that it's really hard for universities from Central Europe to access high quality international R&D projects or to be invited to high-level consortia. The differences between expectations and experiences in cooperation with companies aren't that stark as vice versa, not on a regional level. The largest falls in expectations vs experiences are in relation to other universities. In some aspects it results from keeping information to themselves, some kind of rivalry between the universities. (ibid)

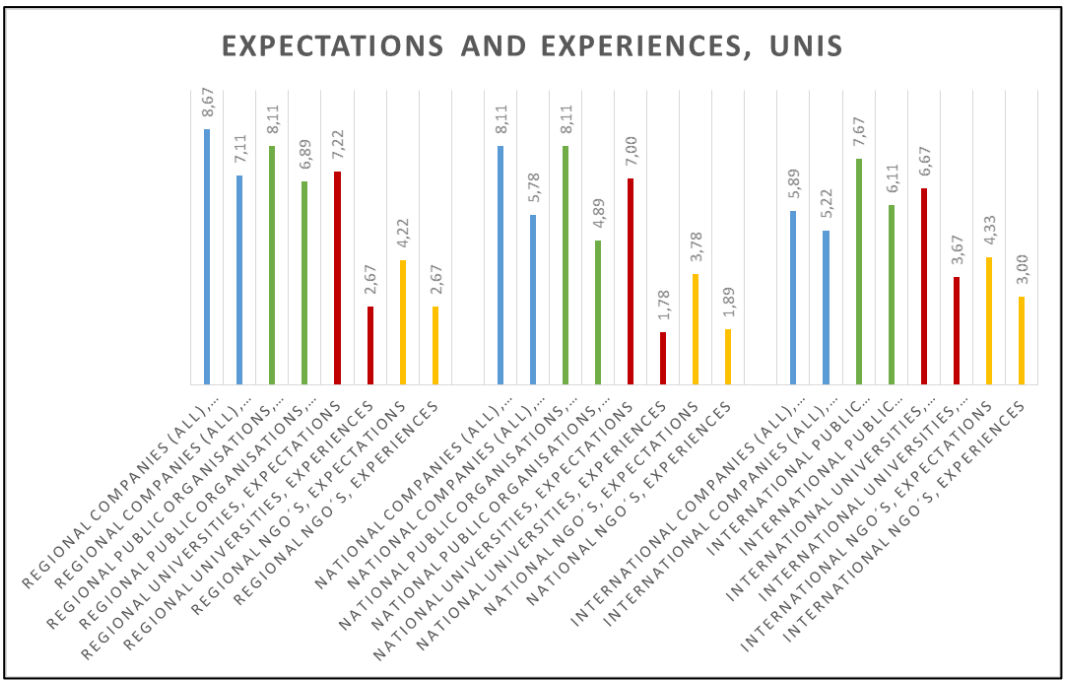
NGOs have the highest expectations towards companies and public organizations. This is quite natural, since NGOs in this particular field were either created by or for companies to help them organize themselves (i.e. clustering activities). Expectations towards public organizations come from the fact that, NGOs see them as designers of certain funding strategies and have resources to help NGOs organize the activities of the whole sector. (TECH-ACC2020a)

The findings are in that way similar to the findings in other LARS regions that the expectations were highest towards the actors in own helix. In addition, regional actors were generally more important than the national and international helix actors for the respondents.

The difference between the values of expectation (scale 0-10) and experience (scale 0-10) on an innovation cooperation with a partner being in the same or different helix is a gap. A high gap index means that the relationship needs attention. However, tensions in important relations may drive innovation, and gaps might increase with increasing expectations. In a dynamic system, we would expect that there are tensions in important relations.

Figure 3.2. Quadruple helix co-operation: expectations and experiences in the relationships towards innovation partners, ICT specialization




EXPECTATIONS AND EXPERIENCES, UNIS
8,67
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1,78
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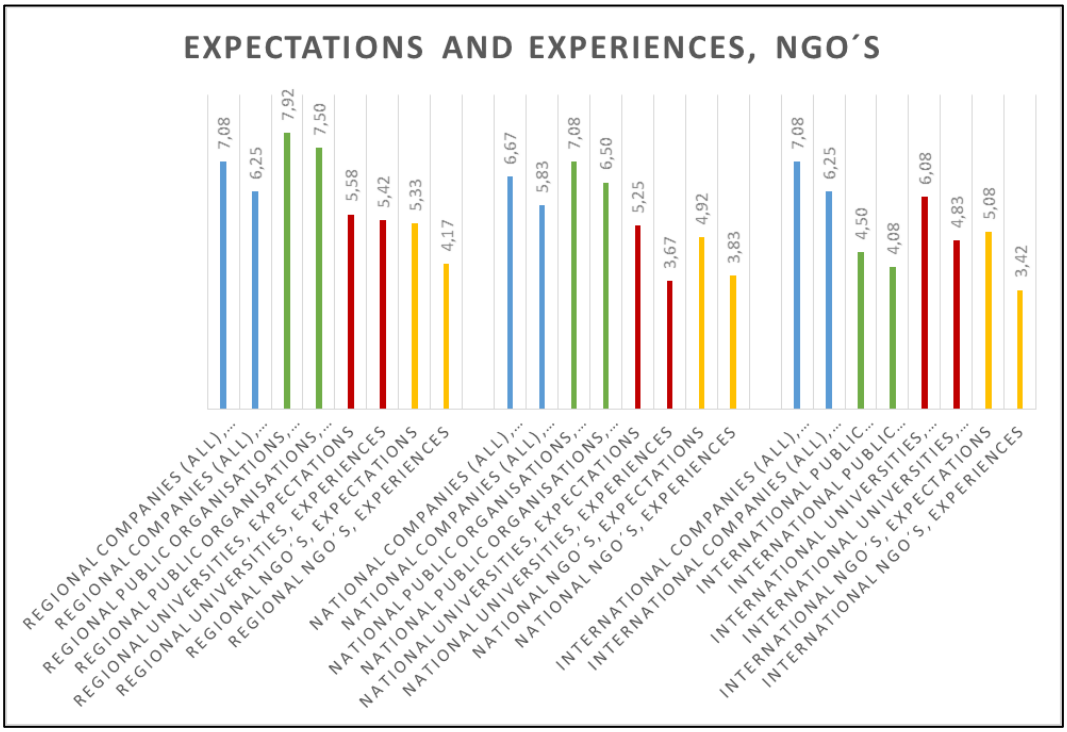
3,67
4,33
3,00
REGIONAL COMPANIES (ALL),...
REGIONAL COMPANIES (ALL),...
REGIONAL PUBLIC ORGANISATIONS,...
REGIONAL PUBLIC ORGANISATIONS,...
REGIONAL UNIVERSITIES, EXPECTATIONS
REGIONAL UNIVERSITIES, EXPERIENCES
REGIONAL NGO´S, EXPECTATIONS
REGIONAL NGO´S, EXPERIENCES
NATIONAL COMPANIES (ALL),...
NATIONAL COMPANIES (ALL),...
NATIONAL PUBLIC ORGANISATIONS,...
NATIONAL PUBLIC ORGANISATIONS,...
NATIONAL UNIVERSITIES, EXPECTATIONS
NATIONAL UNIVERSITIES, EXPERIENCES
NATIONAL NGO´S, EXPECTATIONS
NATIONAL NGO´S, EXPERIENCES
INTERNATIONAL COMPANIES (ALL),...
INTERNATIONAL COMPANIES (ALL),...
INTERNATIONAL PUBLIC...
INTERNATIONAL PUBLIC...
INTERNATIONAL UNIVERSITIES,...
INTERNATIONAL UNIVERSITIES,...
INTERNATIONAL NGO´S, EXPECTATIONS
INTERNATIONAL NGO´S, EXPERIENCES


EXPECTATIONS AND EXPERIENCES, NGO´S
7,08
6,25
7,92
7,50
5,58
5,42
5,33
4,17
6,67
5,83
7,08
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4,50
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6,08
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3,42
REGIONAL COMPANIES (ALL),...
REGIONAL COMPANIES (ALL),...
REGIONAL PUBLIC ORGANISATIONS,...
REGIONAL PUBLIC ORGANISATIONS,...
REGIONAL UNIVERSITIES, EXPECTATIONS
REGIONAL UNIVERSITIES, EXPERIENCES
REGIONAL NGO´S, EXPECTATIONS
REGIONAL NGO´S, EXPERIENCES
NATIONAL COMPANIES (ALL),...
NATIONAL COMPANIES (ALL),...
NATIONAL PUBLIC ORGANISATIONS,...
NATIONAL PUBLIC ORGANISATIONS,...
NATIONAL UNIVERSITIES, EXPECTATIONS
NATIONAL UNIVERSITIES, EXPERIENCES
NATIONAL NGO´S, EXPECTATIONS
NATIONAL NGO´S, EXPERIENCES
INTERNATIONAL COMPANIES (ALL),...
INTERNATIONAL COMPANIES (ALL),...
INTERNATIONAL PUBLIC...
INTERNATIONAL PUBLIC...
INTERNATIONAL UNIVERSITIES,...
INTERNATIONAL UNIVERSITIES,...
INTERNATIONAL NGO´S, EXPECTATIONS
INTERNATIONAL NGO´S, EXPERIENCES

We examine first the gaps between helix actors in ICT specialization, and then the same relations at different spatial levels. One can see, that the relationship is different depending on the respondents - the relationship between X and Y is different from the relationship between Y and X. According to the table 3.3. companies' gap (between expectation and experience in the innovation cooperation) to regional public organizations is 2,67 and to regional universities is 3,67. We can assess the same relationship from the view of public organizations and universities, and notice that public sector organizations and universities have much lower gaps in their relationship towards companies (1,56).

Biggest gaps in innovation cooperation of *companies* are with their partners in public sector and universities (Tables 3.3, 3.4 and 3.5). Companies see the public sector as too bureaucratic and sometimes detached from business reality. Some even expressed the opinion, that public sector has no interest in entrepreneurs but this kind of opinions are isolated cases. Some companies gave example of a very bad experiences with public institutions or their agendas, imposing a lot of paper work and other additional works, a lot of bureaucracy in relation to applying for and managing grants. Regarding universities, the answers varied heavily on the status of a company. The largest one, because of its assets didn't have to rely on university in the R&D activities, even considered that it would be difficult to find better experts at universities that there are in their company. Small and medium sized companies must, to some extent, rely on external partners, especially universities when it comes to staff and expertise. They however see this cooperation as troublesome; universities have high expectation but offer little, universities do not try to adjust to market needs, they have their old rules, and mostly the academic staff just wants to find grants to fund their teams and not solve real market problems. In most cases, universities are looking for partners to finance their projects, when companies are looking for certain knowledge. Even universities outside of Pomorskie are not ready for cooperation, their expectation are unreal in terms of costs vs value and terms of cooperation. (TECH-ACC 2020a). ICT companies are especially unhappy in the cooperation in research with universities, but also education and development cooperation has relatively high gaps. (see appendix 2)

Biggest gaps among *public organizations* are especially within the public helix and to some extent also with companies. During interviews, it turned out that companies were more open and more willing to share ideas before, the situations has changed for worse for some reason. It can be said that companies are now focused on winning tenders. There are some examples of good cooperation within the IT sector, but it is too early to give final judgement. Gaps with other public organizations arise to some extent from political differences between central government and regional self-government. There is a kind of centralistic mindset, the national public institutions have their own vision, do not want to exchange experiences and learn from experiences, there is sometimes no cooperation but competition between national and regional public bodies. On regional level it is better but still interviewees feel that, there are initiatives but with no progress, public administration institutions do not cooperate, they keep their knowledge to them-selves, there is a sentiment that asking questions would be shameful, isolated solutions, no linking (networking). All of them are counting on further strengthening of links and cooperation. The gaps in cooperation with universities are smaller, but it was mentioned that universities treat the public institutions as test beds and data banks rather than real partners. Additionally, public institutions are not rated highly as partners for innovative projects and the researchers or graduates do not see public sector as their optimal career choice. (TECH-ACC 2020a).

Biggest gaps of universities are towards other universities. With regards to public sector, universities mostly share the same sentiment as companies. When it comes to university – university relations, it turns out that there is very little or even no cooperation in the Pomorskie region. In opinion of one of them – nothing worthy happens on the regional scale. There is strong competition with other universities from Poland for funds. Universities also see the drawbacks in cooperation with companies -small amount of interesting projects, companies are writing grant proposals but very rarely they are awarded with financing, mixed reactions or nothing valuable happens. There not so many companies with really innovative projects, those that have must search for financing, what extends the whole process. (TECH-ACC 2020a)

When looking at the gaps at different spatial levels (tables 3.3., 3.4. and 3.5) we can conclude that generally the regional helix actors seem to be quite happy in their innovation cooperation with companies in Pomorskie region, but companies themselves have larger expectations than experiences (gaps) in the innovation cooperation especially towards regional public organizations (2,67) and universities (3,67). The largest gaps *at regional level* are between universities (4,65). Regional public organizations are frustrated with the other regional public organizations, since they show a gap (2,44) between their expectations and experiences. The large gaps are indications of high expectations in the cooperation between regional companies, public organizations and universities, and in the context of this study and LARS project the large gaps mean a dynamic system which is evolving through high expectation towards the innovation partners. Large gaps also are a sign of cooperation potential (and hidden innovation potential) between these helix actors. Both expectations and experiences of other helix actors towards regional NGOs are much lower in Pomorskie, even if for instance cluster organizations are important players in the regional innovation system of ICT.

Table 3.3 Gaps between helix actors in ICT specialization in Pomorskie, **regional level**

From\to	Companies	Public sect	Univers	NGOs
Companies	1.11	**2,67**	**3,67**	1,11
Public sector	1,56	**2,44**	1,12	1,55
Universities	1,56	1,22	**4,65**	1,55
NGOs	0,83	0,47	0,16	1,26

Pomorskien actors of ICT specialization have very high gaps towards *national level* actors, because they have high expectations but are frustrated especially with the national universities and national public organizations. Both companies and universities have very high gaps towards Polish universities outside Pomorskie (4,34 and 5,32). Their expectations in innovation cooperation with national universities are also high. They have also high gaps towards national public organizations (3.00 and 3.22). The high gaps of Pomorskie universities towards national helix actors (expect NGOs) indicate frustration in innovation cooperation with innovation partners in other parts of Poland. Again, we can observe that the Pomorskie helix actors have small gaps towards national NGOs, but this is because of the also have low expectations towards the national NGOs. Pomorskie NGOs also have smaller gaps towards all helix actors at the national level.

Table 3.4 Gaps between helix actors in ICT specialization in Pomorskie, national **level**

From\ to	National companies	National public organizations	National universities	National NGOs
Companies	1,00	**3,00**	**4,34**	0,78
Public sector	1,22	**2,89**	**2,11**	1,32
Universities	**2,33**	**3,22**	**5,32**	1,58
NGOs	0,84	0,58	1,58	1,09

When looking the innovation cooperation of Pomorskien helix actors of ICT with *international helix actors*, we can conclude that generally expectations of the cooperation are somewhat lower than expectations towards regional and national helix actors. However, the Pomorskie companies seems to be highly frustrated on their innovation cooperation with international universities (gap 6,34). Also, Pomorskie universities and public organizations have a relatively large gap between expectations and experiences in cooperating with international universities.

Table 3.5 Gaps between helix actors in ICT specialization in Pomorskie, international **level**

From\to	Companies	Public sect	Univers	NGOs
Companies	0,45	O,10	**6,34**	1,00
Public sector	**2,66**	1,66	**2,34**	0,11
Universities	0,17	1,56	**3,00**	1,33
NGOs	0,83	0,42	1,25	1,66

The figure 3.3. combines the importance and gaps in one type of relationship: from Pomorskie ICT companies to regional, national (outside Pomorskie region) and international universities. We can observe that the regional universities are more important for the ICT companies than the national and international ones, and the gaps are smaller towards regional universities than towards national and international ones. The innovation potential is the highest between companies and regional universities.

The ICT sector in Pomorskie region is well developed and in fact it is one of the strongest points in the context of careers and employment in relation to overall IT industry in Poland, having in mind that all the major operations are done in the capital – Warsaw. Pomorskie and especially Tri-City (Gdansk, Gdynia, Sopot) has evolved in the past few years as one of the hottest location points for international companies and especially among those from Scandinavia (shorter distance and the quality of life (i.e. work-life balance, quality of air, access to sea and beaches) in comparison with Warsaw, Krakow or Wroclaw. (TECH-ACC 2020a; Wojnicka-Sycz 2018)

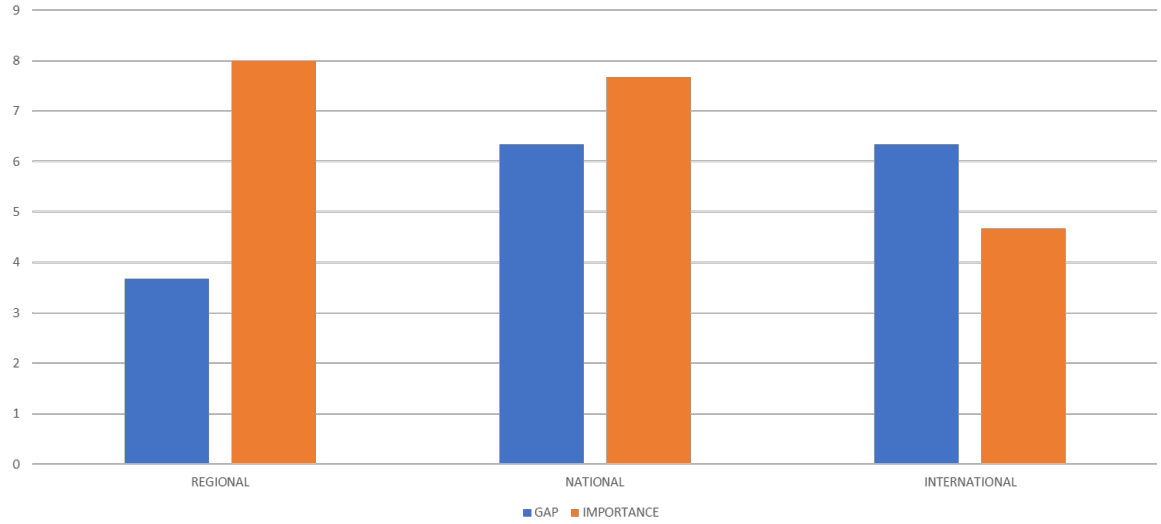


Figure 3.3. Company-university relations in Pomorskie ICT specialization across spatial levels

The ICT sector is undoubtedly strong and has the potential to stay as a leading factor for attracting foreign high-skilled workers and international companies from various sectors. The informants expressed however their desire to integrate more and become more open to outside initiatives, as well as to learn from foreign companies how to cooperate in a more quality manner. (TECH-ACC 2020a)

OECD (2019: 77-78) states that the ICT specialization includes a large number of major Foreign Direct Investments (FDI) affiliates, many recent start-ups, specialist university departments contributing research and training and a pool of skilled employees and managers. The local networks among entrepreneurs and between entrepreneurs and HEIs and large firms are already fairly strong in the ICT sector in Pomorskie region. There has been networking initiatives and well-developed business support programmes for start-ups. ICT specialization is developing through ongoing upgrading of skills and production capabilities, and it has potential to grow quickly and support the regional economy through provision of specialist IT services to the other smart specializations. Pomorskie produces nearly 1 200 IT and electronics graduates every year and the overall number of IT and electronics students (including PhDs) is growing. Despite these advantages, start-ups and scale-ups in Pomorskie are suffering from shortages of skilled ICT personnel (ibid: 50).

ICT can be seen also as key enabling technology in the region used by other sectors and activities, and the deeper cross-sectoral connections would strengthen the regional economy. (OECD 2019)

3.3 Energy specialization in Pomorskie: Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction

The data on energy specialization consists of 13 interviews: three companies, four public sector organizations, three universities and three NGO representatives. All the interviewed informants own/work for companies, universities, public institutions and NGOs that are well known and well established in the energy sector in Pomorskie region including the leading universities, the leading companies (large, medium and small), leading NGOs. They are the key players that define the strategy and steps for the whole energy community in the Pomorskie region starting from strategy planning on the level of self-government ending with day-to-day operations among energy startups. Many of the interviewed institutions were the originators of the smart specialization in Pomorskie. The interviewed informants hold a strategic position at their institutions - either owners or co-owners (co-founders), CEOs of companies, managers or directors responsible for innovations or energy divisions, Presidents of the boards at NGOs, leading figures at universities responsible for advising the university authorities and directors of departments, heads of offices at public institutions. Nearly all of the interviewed informants take active role in Smart Specialization (meetings, discussions). All of them are signatories of Smart specialization, and some of them hold the functions of the members of the council of the smart specialization in Energy. The selection of informants was chosen because of their activity in smart specialization. From that point one can see active members of the sector, leaders, innovators and biggest contributors. All the major figures were involved including the public sector, universities and NGOs. Their opinions matter greatly in strategic discussions. The selection was consulted with the representatives of the department responsible for smart specialization at the Pomorskie Marshal's Office responsible for operational cooperation with smart specialization stakeholders. (TECH-ACC2020b)

The data allows us to examine many aspects of the quadruple helix network of energy specialization, and compare with the ICT specialization. We describe first the importance of innovation partners for different helix actors. Second, we analyze the dynamics of the relations in terms of expectation and experience given by the respondents towards the cooperation with different helix actors. Third, we describe the gaps between experiences and expectations from the point of view of helix actors at different spatial levels.

The energy specialization companies equally judge their own and other helices as important, even though there was strong position on making business as a core of their existence. (See table 3.6) The importance of other companies dynamically fades away when moving from regional to international level, which can be understandable, as most of the companies in the energy field act locally. In order to improve their business, companies need partners providing them with fresh ideas. Regional companies are important innovation partners for energy companies, but they need to obtain new technologies somehow. Because most of them do not have R&D departments, it is easier and cheaper to obtain it from university partners. NGOs (Clusters) are seen by companies as an extension of phonebook - NGOs are a perfect place to meet new partners, verify their possibilities, etc. During interviews clear patterns could be seen - Companies + companies = money, companies + university = funds for R&D, companies + NGOs = value built on extended partnerships. (TECH-ACC 2020b)

For universities and research institutes, companies are the most important partners, what has been clarified above. Companies from the energy sector are natural clients for their research, hence the specificity of this sector, monopolies and regulated areas of business. For public organizations, companies and universities are most important partners as either providers of technology in area of energy conservation and energy management. They have also common projects. The importance drops when advancing to national and international level, since the local public organization's aim is to foster local energy companies and environment. For NGOs public organizations are the most important partners as both these helices cooperate closely in promoting new ideas in the energy industry and promote local and renewable sources of energy, based on the potential of Pomorskie region. (TECH-ACC 2020b).

Comparing the importance of innovation partners between ICT and energy specializations in Pomorskie, we can conclude that innovation cooperation with different type of partners is somewhat less important for energy helix actors than it is ICT actors. This means that the networking is less developed in the case of energy. Generally, international partners are in both specializations less important than regional and national innovation partners are. This finding is similar to other LARS regions. Both ICT and energy specialization also indicate lower importance of NGOs than other helix actors as innovation partners.

Table 3.6 Importance of partners for different helix actors in energy specialization in Pomorskie

			Companies	Universities	Public organisations	NGO´s
Questions		Data type	all	all	all	all
How important are companies as innovation partners for your organisation	regional level (0, 1-10)	averages	7,67	8,33	8,75	7,33
	national level (0, 1-10)	averages	7,67	8,67	7,50	6,33
	international level (0, 1-10)	averages	6,67	8,00	7,50	7,33
How important are public organisations as innovation partners for your organisation	regional level (0, 1-10)	averages	7,67	6,33	7,00	8,00
	national level (0, 1-10)	averages	7,67	7,00	7,25	7,00
	international level (0, 1-10)	averages	3,67	5,67	6,25	7,67
How important are universities as innovation partners for your organisation	regional level (0, 1-10)	averages	8,00	6,33	8,25	6,67
	national level (0, 1-10)	averages	7,00	6,00	7,75	5,00
	international level (0, 1-10)	averages	4,33	6,33	2,50	7,33
How important are NGOs as innovation partners for your organisation	regional level (0, 1-10)	averages	7,33	5,67	7,50	6,67
	national level (0, 1-10)	averages	7,67	5,67	6,50	6,33
	international level (0, 1-10)	averages	2,33	2,67	4,75	3,00

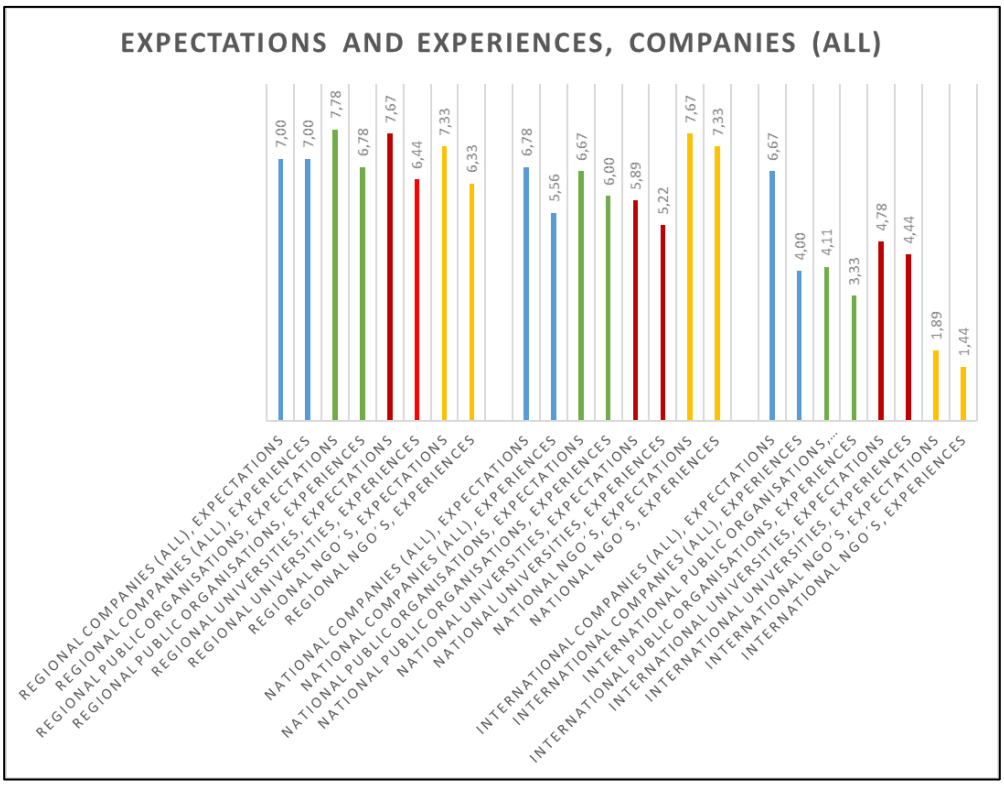
Companies have almost equal distribution of expectations and experiences towards other companies and other helices with very slight drops (See figure 3.4.) The largest expectations are towards public organizations and universities on regional level with companies and NGOs on national level. The lowest expectations and experiences can be observed in relation to companies on international level. According to the interviewed, international companies are perceived as something better, with higher quality, good example but after a cooperation perception of them changes severely; they seem to have totally different business culture, just looking for cheap labour and not eager to share experiences, and they wanted to sell rather than buy, they had big budgets but actually in some cases ended with spending less money than national and regional partners. NGOs on national scale provide companies with important activities and knowledge exchange platforms through which companies can get new relationships. (TECH-ACC2020b)

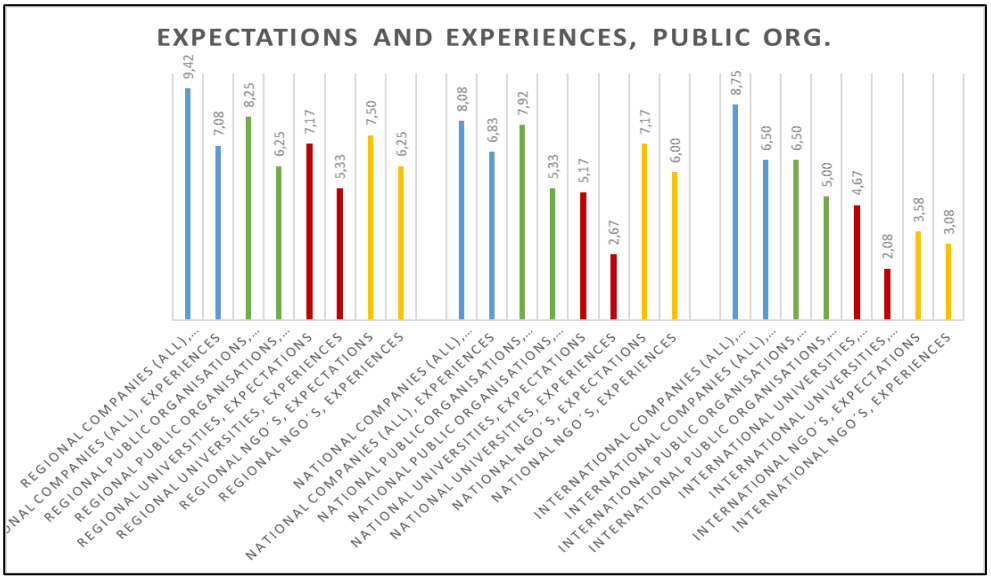
For public organizations, two most important helices are companies and other public organizations on all levels – from regional to international. It is positive that public organizations have high expectations of companies, especially on regional level, since the whole idea of smart specialization arises from their activity. Strong relationships give the opportunity for inspiration, specific ideas and relationships will allow to develop projects, and local patriotism is still very active. Drops in experiences can be observed in all helices but the largest are with national and international universities. Cooperation between those two helices (company and public organization) can be a problem. Exchange of ideas is miserable because of lack of trust and perspective. According to some interviewees, foreign universities focus on brain and idea drainage and are not interested in real exchange of information. (ibid)

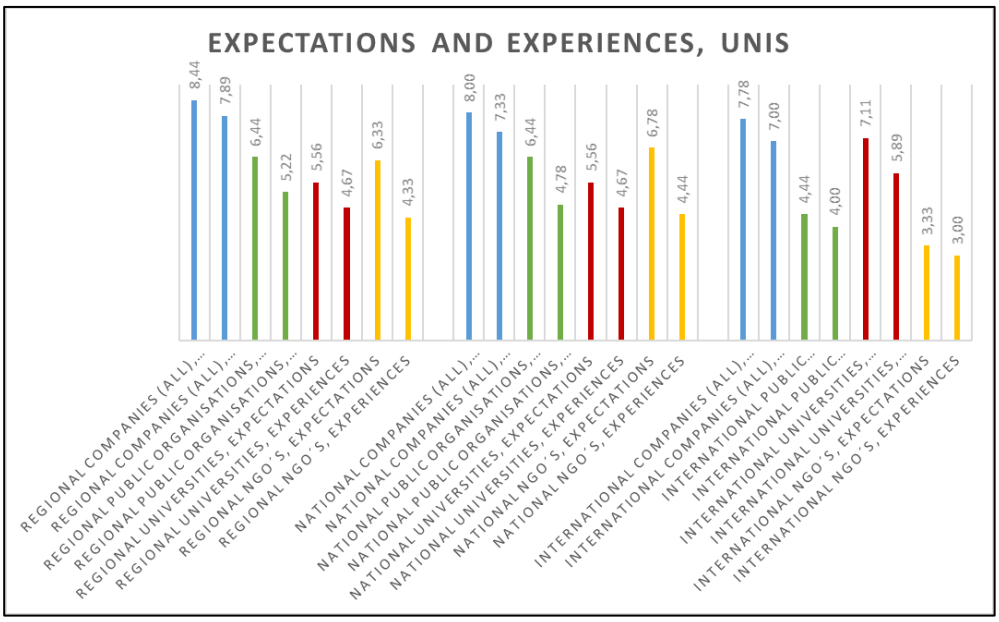
Universities also have the highest expectations in innovation cooperation towards companies on all spatial levels with small/moderate drops in experiences. From the point of view of the regional development this is a positive message - a link between the research and company can be viable especially for building local value chains. Universities have largest gaps towards NGOs on regional and national level due to very little or even no cooperation at all in some cases.

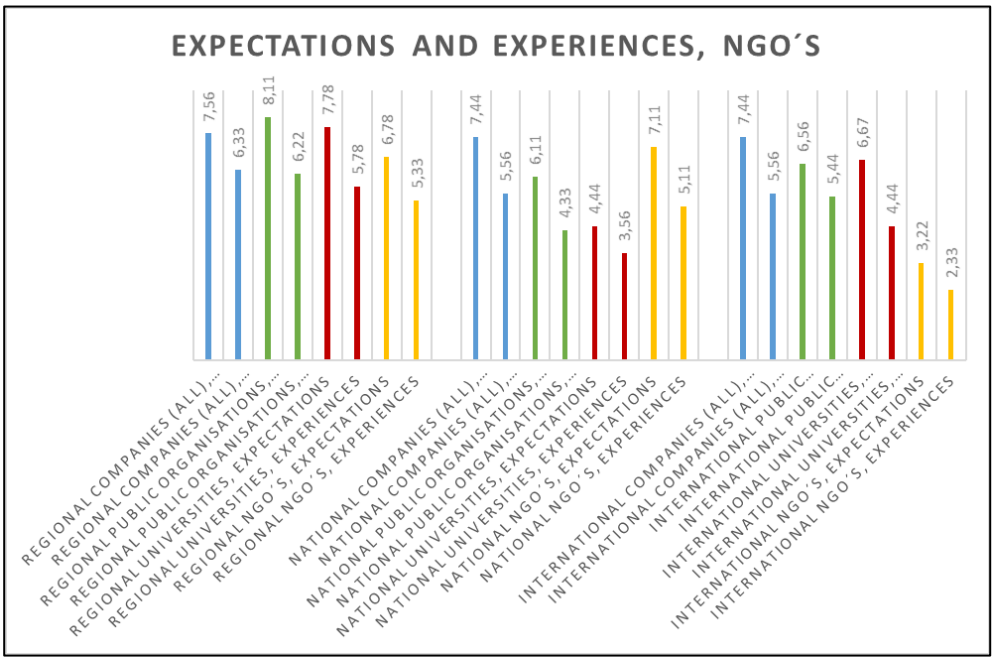
NGOs have high, almost equal expectations towards companies, public organizations and universities on regional level. It starts to vary when moving to national and international level, but still – companies are very important. Experience shows that cooperation with companies is most effective for long term business. It is easy to cooperate in the region due to logistics but sometimes when moving towards national/international it is easier to establish link with international companies. They however tend to treat R&D as sales channel. NGOs are also eager to cooperate with universities but there is a problem of trust – that's why it is also easier for them sometimes to launch projects with foreign universities rather than national ones. (ibid)

Figure 3.4. Quadruple helix co-operation: expectations and experiences in the relationships towards innovation partners, energy specialization









There are no gaps among innovation cooperation between Pomorskie companies, and only small gaps towards national companies (Tables 3.7. and 3.8.), since energy companies act rather locally and nationally, and the en-

ergy specialization seems to be a stable system. The largest gaps in innovation cooperation of Pomorskie *companies* seem to be towards international companies (2,67), which means that Pomorskie energy companies are somewhat frustrated in innovation cooperation with the international companies.

The largest gaps in innovation cooperation of *public organizations* are with national public organizations (2,59). The gap at national level can be explained at least to some extent with the current political influences. The gap at regional level in cooperation between public organizations is somewhat smaller (2,00) and the effect of too little communication between public organizations. Public organizations seem to have relatively large gaps towards regional, national and international universities. (Tables 3.7, 3.8 and 3.9)

Pomorskie *universities* in energy specialization seem to have much smaller gaps in their innovation cooperation with helix actors than universities in ICT specialization. The gaps among universities are distributed more equally, but there are large gaps only in cooperation towards regional and national NGOs. The problems with companies arise mostly from the fact, that companies want quick results, and in various fields of research, this cannot be achieved. Universities and companies have different priorities and, in most cases, companies cannot accept this. There are also issues like value for money since according to some interviewee's universities can be more expensive than competitive R&D companies. In addition, there is an issue on agility since some industries are so fast changing that universities do not have ability to keep up. Gaps in cooperation with public institutions arise mostly from the lack of tangible effects. There are mostly meetings, which lead to nothing in many cases. Gaps in cooperation with other universities arise from the lack of common project, lack of cooperation, and competition between various institutions of a very similar characteristics.

NGOs have very small gaps in cooperation with the helix actors at regional level. Gaps among NGOs mostly come in cooperation with national NGOs and international universities. In cooperation with universities effectiveness of inputs is one of the issues, since NGOs are seen to be more troublesome to achieve given goal, and therefore it is more costly to obtain for example business proposal thru their network of cooperation. In order to be a member of cluster you need to pay some king of a fee yearly or monthly to the cluster organization (NGO). Time is also an issue in competitiveness of companies since results are sometimes extended over longer period of time. Some interviewees even said that the cooperation is on a low level; high expectations, but little has materialized. There is a sentiment among NGOs that the environment for NGOs has worsened, mostly due to political reasons – a lot has happened since the current central government cast a shade of suspicion on renewable sources of energy, where most NGOs were very active in advocating for building wind and solar energy. (TECH-ACC 2020b)

Table 3.7 Gaps between helix actors in energy specialization in Pomorskie, **regional level**

From\to	Companies	Public sect	Univers	NGOs
Companies	0	1,00	1,23	1,00
Public sector	1,34	**2,0**	**2,24**	1,25
Universities	0,55	1,22	0,89	**2,00**
NGOs	0	1,0	1,23	1.0

Table 3.8 Gaps between helix actors in energy specialization in Pomorskie, **national level**

From Pomorskien \to national	companies	public organiza-tions	universities	NGOs
Companies	1,22	0,67	0,67	0,43
Public sector	1,25	**2,59**	**2,50**	1,37
Universities	0,77	1,66	0,87	**2,34**
NGOs	1,88	1,78	0,88	**2.00**

Table 3.9 Gaps between helix actors in energy specialization in Pomorskie, **international level**

From Pomorskien\to international	companies	public organi-zations	universities	NGOs
Companies	**2,67**	0,76	0,38	0,45
Public sector	**2,25**	1,50	**2,59**	0,50
Universities	0,78	0,44	1,22	0,33
NGOs	1,88	1,12	**2,33**	0,89

The figure 3.5 combines the importance of and gaps in a relationship between Pomorskie energy companies to regional, national (outside Pomorskie region) and international universities. We can observe that the nearer the university the more important innovation partner it is for the energy companies. The gaps are smaller in the relations between Pomorskie energy companies and national and international universities than in their relations towards regional universities, but this is because the expectations are higher towards regional universities.

The energy specialization in Pomorskie region is very diverse, this sector contains a very large number of actors, like renewable energy sources (RES), energy management, energy storage, energy effectiveness, smart home and city, alternative fuels, hardware and software, building materials, strategic planning, resources, region and national security, etc. It is difficult to coordinate all those subsectors and to create successful way to communicate with so many partners. Energy sector is again capital intensive so cooperation is highly needed. There is also a problem of the influence of the public player – the state which effectively owns the two major

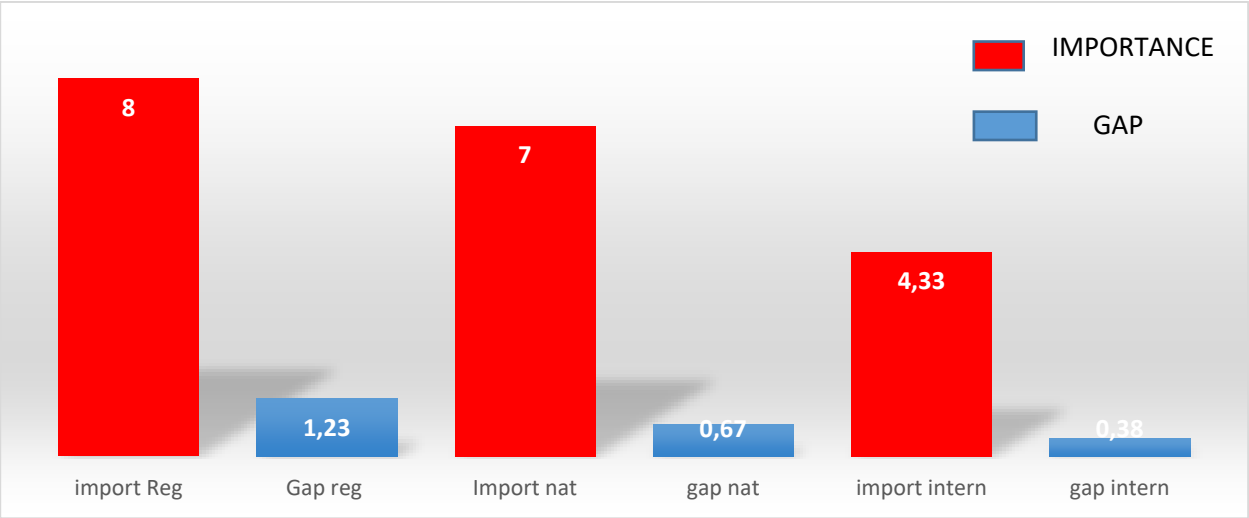


Figure 3.5. Company-university relations in Pomorskien energy specialization across spatial levels

companies in the Pomorskie region but the strategies and fields of interests like current investment strategies are controlled in Warsaw; they are planned locally, but approved by the supervisory board members designated by the ministries. There is also a visible problem with trust and relations because the authorities from the local self-government and managers appointed in the two largest companies are from two opposing parties. There is also a problem of changing directions in strategic matters depending on who currently runs the country – there are different views and approaches towards RES, coal, smart metering hence local investment strategies and focus on innovations are changing and the self-government has very little influence on it. Because of legal regulations and the nature of the energy sector – natural monopoly in some cases – some of the activities can only be undertaken by a certain energy group and medium and small companies have no influence on the market. The local authorities, through the smart specialization and the council of this particular specialization are trying to animate and motivate the cooperation between large companies and local small and medium enterprises together with local universities and NGOs. (TECH-ACC 2020b)

The key regional players in the energy specialization are strongly tied into their national knowledge exchange networks, reflecting the fact that the energy system is organized at the national level. Their ability to drive an eco-effective technologies specialization in Pomorskie depends critically on decisions of national state actors on how much to invest in the transition to renewable energies and where to make these investments. The overall challenge for the regional smart specialization is to achieve substantial growth to arrive at a critical mass of local SMEs and start-ups in renewable energies. The key players could have more knowledge connections and more efforts could be placed in seeking to support their development. (OECD 2019: 79-80). To strengthen regional knowledge exchange could contribute to development of a distinct regional specialization. Smart specialization is a long-term process and the idea is to reach competitive advantage in the long term. (ibid 85)

3.4 Summary and comparison of cases

Comparing to the two specializations in the light of connectivity analysis, we can conclude that the expectations towards innovation cooperation with helix actors are generally higher for ICT companies, public organizations and universities than for respective actors in energy specialization. High expectations especially in important relations are driver of change in the innovation network. Helix actors in ICT specialization show high gaps in their innovation cooperation, and the gaps are clearly higher than the respective gaps in energy specialization. Especially big difference in gaps can be noticed in the cooperation of Pomorskie universities with companies, public organizations and universities: ICT shows very high gaps, but energy specialization relatively low gaps. Pomorskie companies and universities of energy specialization are quite happy to cooperate with their innovation partners, except the Pomorskie companies with international companies. Helix actors in both ICT and energy specializations value the innovation cooperation with NGOs as less important than with other helix actors. However, there is a potential to develop the cooperation with NGOs and other helix actors, since for instance cluster organizations are important as intermediators and knowledge transfer between the partners.

ICT specialization seems to be somewhat more dynamic and integrated than energy specialization. This is mainly due to the fact that the local cluster and the whole local network of academia especially the Gdańsk University of Technology (GUT) and companies – both local, founded by graduates of the GUT and international, where graduates of the GUT started their careers as programmers or managerial staff – were well organized even before the whole process of entrepreneurial discovery and smart specialization. This is also a sector, where no public or state-owned enterprises hinder the process of development or waste time and effort and resources on divergent strategies or plans. The local ICT industry if a very vibrant one and full of young, dedicated entrepreneurs who are expanding not only outside of the Pomorskie region, but also outside of Poland with more and more confidence. The region has also some success stories like the first Polish web portal – Wirtualna Polska (founded in mid-1990') and Ivona Software which developed cutting edge speech synthesizer acquired by Amazon in 2013 which later became the Amazon's Alexa. (TECH-ACC 2020a)

Energy specialization is a more stable system. The large companies because of their size are having problems with innovations so they are eager to cooperate with small and agile innovators with the benefit for both. It is great to test innovations in energy specialization, but this specialization likes stability and security.

According to the OECD (2019:82) policy recommendation a main priority for Pomorskie is to "build connections amongst actors – within and across smart specializations and internal and external to the region – for the purpose of strengthening knowledge exchange and collective actions." One way to create more connectivity is open innovation platforms, which are to some extent used in ICT, but not in energy specialization. According to the OECD (2019) more open innovation would strengthen ICT specialization by diversifying the actors and participants in the innovation value chain and the potential sources of knowledge diffusion and acquisition. In energy specialization open innovation would mean greater collaboration between large firms and HEIs. (OECD 2019: 69). We look more the open research platforms in chapter 5. Next chapter compares the ICT and energy specialization with other LARS cases regard to their innovation potential combining the dimensions of importance and gaps.

4 Pomorskie ICT and energy innovation networks compared to other LARS cases

Connectivity analysis which is used in this report reveals the institutional and structural obstacles which *prevents the innovation potential from being realised*. The innovation potential is hiding behind the gaps and flaws of regional institutional networks and arrangements which blocks Smart Specialization decision making unleashing the economic potential.

The connectivity between companies, universities, public organizations, and NGOs is a precondition for well-functioning systems of innovation (observed as high levels of expectations and experiences between and within helices). The connectivity depends on the structure of the innovation network, which is measured as importance of the partners for 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.

In order to discover the innovation potentials, we have first summarised the different dimensions of importance (importance of different QH actors at different spatial levels for the respondents) in the interview data with the help of factor analysis and 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 centralised the network is. For instance, companies with well-connected relations to other companies, universities, public organizations, and NGOs (high IMPORTANCE) have higher expectations and better experiences in their innovation networks than companies in fragmented regions, where relations to universities, public institutions, and NGOs are weaker. Figure 4.1 presents the comparison of LARS cases; the cases in Oppland (Norway) and Hamburg have a low importance and fragmented networks, whereas Latvia and Lithuania (BIO) have a high importance meaning more integrated networks. Compared to the other LARS cases, the Pomorskie specializations show average importance or network integration, however, the networks of the ICT specialization is more integrated than that of the energy specialization.

The deviations of connectivity across the regions can be the space where one can search for good practices and where 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. The well-connected companies, public organization, universities, and NGOs may be a source of good practices.

Important relations are at the core of networks of innovation. In a stable system, it would be expected that important relations also are characterized by high expectations and equally matching, good experiences. Here, gaps between expectations and experiences are expected to be low, or close to 0. In other, less important relations in stable systems, gaps might be higher. In other words, in a stable system, the correlation between expectations and importance is high. In a dynamic system, it would be expected that there are tensions in important relations. These tensions will be visible as gaps between expectations and experiences. It would be expected that

gaps increase with increasing expectations. The gap is the urgency driving innovation. Expectations in important relations are likely to go down.

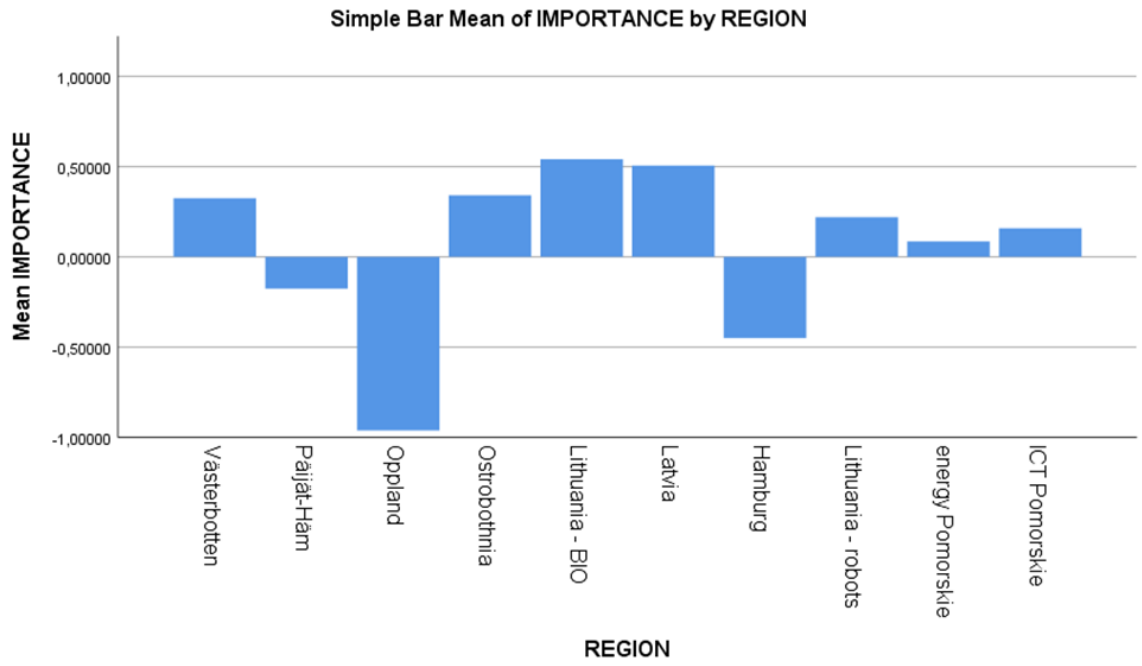


Figure 4.1. Mean IMPORTANCE of innovation partners across regions

In the previous section we counted the gaps between helices for Pomorskie ICT and energy specializations (tables 3.3, 3.4 and 3.5 for ICT and tables 3.7, 3.8 and 3.9 for energy) from all of the data across all spatial scales, and we noticed that the gaps were larger between helices of ICT that between energy specialization. We also noticed for both Pomorskie cases that the gaps in relation to regional helix actors were smaller than to national and international one.

The figure 4.2 examines questions on innovation networks towards companies and public organizations (see appendix 1) but includes the answers of all respondents representing different helices. When comparing the gaps between Pomorskie ICT and energy specializations (see appendices 2 and 3), we can notice that the gaps of ICT specialization in this dimension are generally smaller than the gaps in energy specialization.

The answers of the respondents to the innovation network questions were the basis when building the indicator GAP, which is a new variable created with the help of factor analysis summarising the differences between expectation and experience of relationships of respondents towards 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 in indicator GAP means that the relationship needs more attention, and should possibly be bridged. Some relations are important with high expectations and

equally high experiences (close to 10), and some are less important with low expectations and experiences (close to 0). Lithuania (Bio) and Latvia have the highest gaps, but in this dimension also Pomorskie energy specialization shows high gaps. Västerbotten, Päijät-Häme, Oppland show small gaps, and Ostrobothnia, Hamburg, Lithuania (robotics) and Pomorskie ICT show intermediate gaps.

Large GAPs might signal missing relations or relations with disruptive institutional actors who might block progress. It is also important to know, for instance, whether the GAPs are big or low towards relationships with important stakeholders. It might be more crucial to have a big GAP towards important stakeholders than towards less important ones. This means that there is a correlation between the importance of stakeholders and features of its relationship like 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 deep GAP or missing relation. This might be indicative of "sleeping giants", important actors who do not bother to engage (Mariussen et al., 2019). Regions with high GAPS and high-level IMPORTANCE have the innovation potential. They might go through dynamic change and need good practices from other regions.

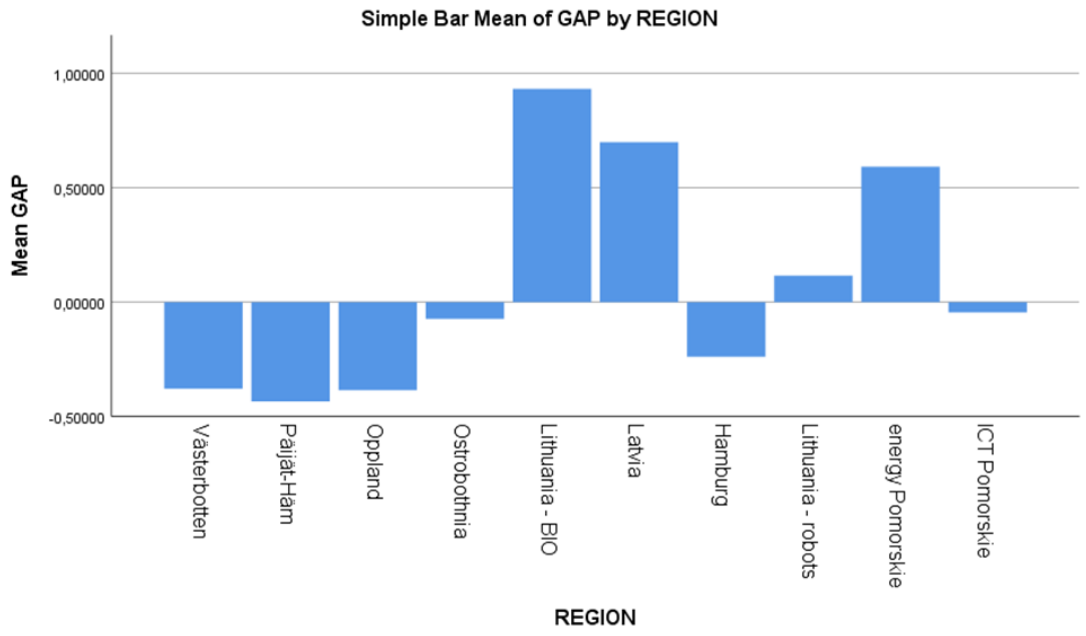


Figure 4.2. Mean GAP in innovation networks (towards companies and public organisations) across regions

We will use three typologies (see table 4.1):

1. Well-functioning systems of innovation. Regions with strong or medium strong networks (high importance) and small or average gaps. The innovation network is regarded as important, and actors are working closely together. Examples are Västerbotten (Sweden), Päijät-Häme (Fin), Lithuanian robotics and Pomorskie ICT.

2. High innovation potential. Regions with strong networks and big gaps. These regions have a potential for improving the way their innovation system works, by closing the gaps. Examples are Lithuania (BIO), Latvia and Pomorskie energy.

3. Fragmented systems of innovation. This is regions where the innovation network is regarded as less important. Innovation is taking place inside firms or institutions. Here, the gap may be large or small, but since the system is not important, the innovation potential is low. Examples are Oppland and Hamburg.

Table 4.1 innovation potential measured with the factors IMPORTANCE and GAP in innovation network across regions

IMPORTANCE \GAPS	*Large*	*Intermediate*	*Small*
High	Lithuania (BIO) Latvia	Ostrobothnia	Västerbotten
Intermediate	Pomorskie Energy	Lithuania (Robotics) Pomorskie ICT	Päijät-Häme
Low		Hamburg	Oppland

We can describe innovation potential across the cases also building new factors on the existing factors of importance and gaps being the basis in the figures 4.1 and 4.2. We used the calculated IMPORTANCE and GAPS for each of the three spatial levels, regional, national and international, as input to an SPSS factor analysis, which came up with two factors: innovation potential and strong network. The correlation between the input variables and the two new factors are shown in the component matrix below (Table 4.2).

Table 4.2. Component matrix innovation potential and the strength of the network

Component Matrix[a]

	Component	
	innovation potential	strong network
regional importance	,617	,513
national importance	,631	,615
international importance	,451	,649
gap in international innovation networks	,657	-,306
gap in national innovation networks	,739	-,546
gap in regional innovation network	,679	-,578

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

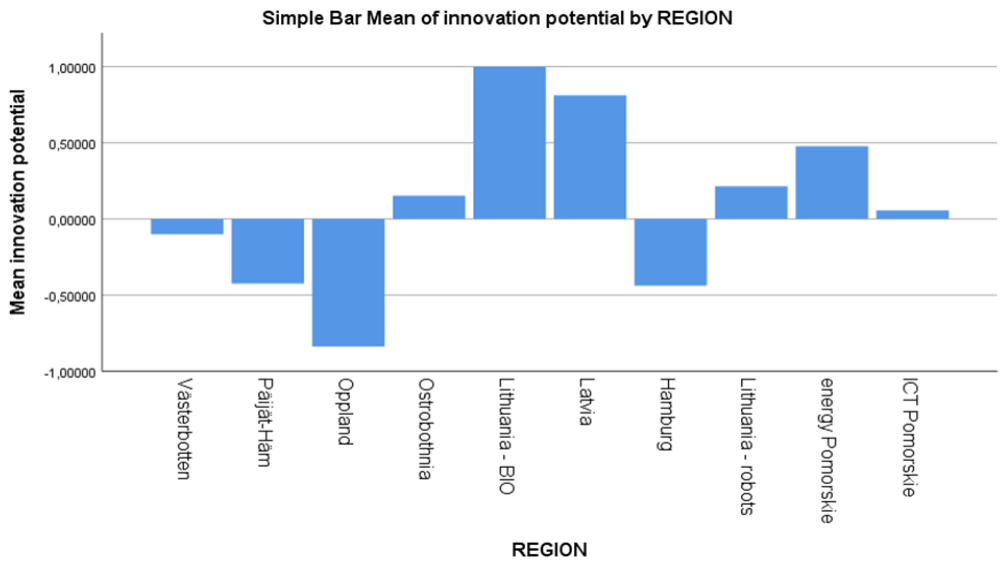


Figure 4.3. Innovation potential across regions

The figure 4.3 shows the innovation potential factor by region. We can observe that Lithuania (BIO), Latvia and Pomorskie energy have high innovation potential, Pomorskie ICT, Lithuania (robotics) and Ostrobotnia the average, and Västerbotten, Päijät-Häme, Oppland and Hamburg small innovation potential.

The figure 4.4 shows network strength (high importance and low gaps) by region. Regions with high score on this indicator have innovation networks which are strong and stable, with small gaps. Measured in this way, Västerbotten, Ostrobothnia, Päijät-Häme and Pomorskie ICT has a high score. Oppland, Hamburg, Pomorskie energy have a low score, when Lithuania (Bio), Latvia and Lithuania (robotics) show an average score.

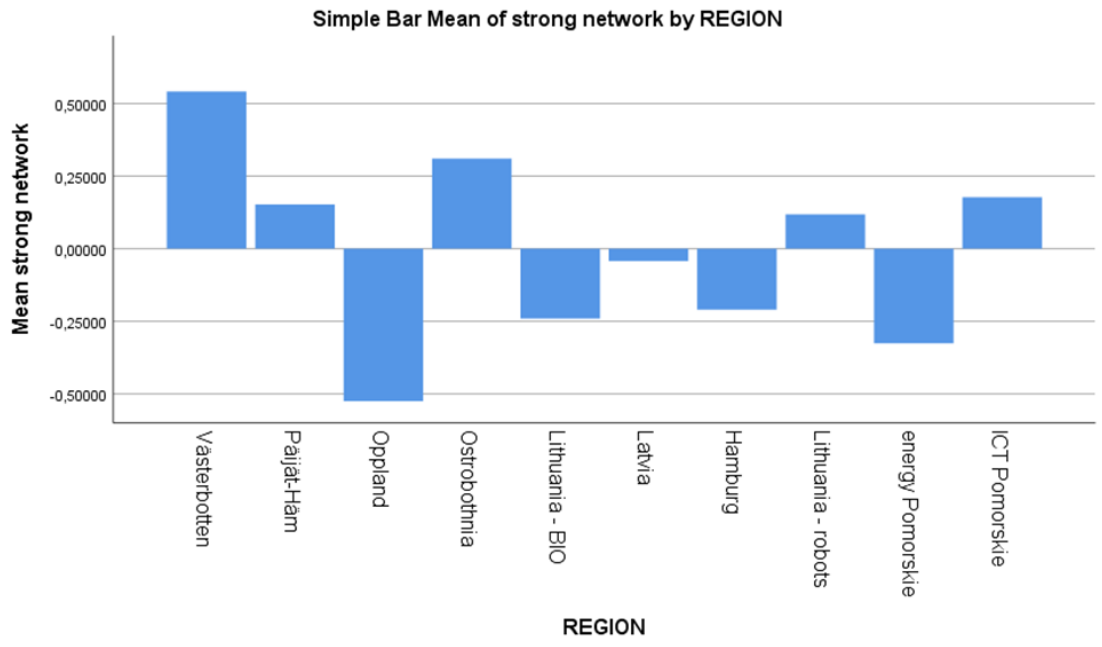


Figure 4.4. Strength of the innovation networks across regions

We can conclude that compared to other LARS cases, Pomorskie ICT has a strong innovation network. Pomorskie energy innovation network has an innovation potential.

5 The LARS strategy of innovation

LARS strategy of innovation was implemented by the 8 full partners and the selected specializations: circular economy in Hamburg, metal industry in Latvia, bioeconomy in Lithuania (Lithuanian institute of agrarian economy), robotics in Lithuania (Lithuanian Innovation centre), wood cluster in Oppland (Norway), energy technology in Ostrobothnia (Fin), grain cluster in Päijät-Häme (Fin), and bioeconomy in Västerbotten (Sweden). Each region identified the good practices and developments challenges of connectivity of helices in their selected specializations based on the gap analysis and on the findings of the focus group meetings with the relevant stakeholders. At least one good practice in connectivity/cooperation of helix actors was then chosen for more thorough analysis. In the analysis, the concern was on the actors and description of the good practice, the story behind the good practice, as well as the factors that can lead to failure and the factors that can lead to success. The story of the good practice was written and presented to the other partner regions. The good practices from other regions were then matched with development challenges in the own region of LARS partners in the focus group meetings of relevant stakeholders. (see figure 5.1) The selected good practice (from other region) was then evaluated and benchmarked in the transnational learning seminar by the regional stakeholders, and finally a plan to implement the good practice (from other region) as a pilot was prepared by the project partners. Through transnational

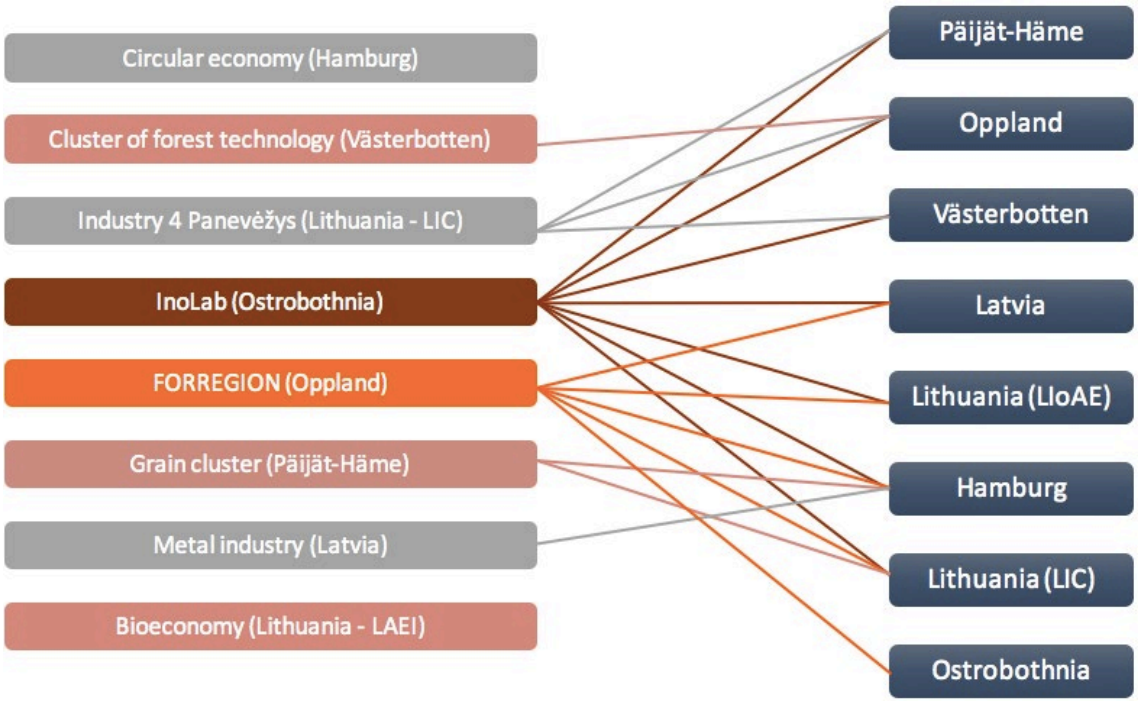


Figure 5.1. LARS good practices

Learning Seminars with stakeholders, each region could identify and select at least one good practice from other LARS regions that can help them to overcome the gaps they have. The figure 5.1 shows the good practices and their matches.

The attempts to use good practices to learn in LARS regions depend on the structure of the regional network and the ability of partnerships to make decisions. The structure of the innovation network can be integrated or fragmented depending on the importance of the partners of the respondents in the survey. The more important the helix partners are for the respondents, the more integrated the network. The weak or fragmented network has only few connections between partners (in LARS project that was the case of region Oppland, Norway) or is controlled by dominant stakeholders (LARS case Hamburg). In a complex structure like Pomorskien ICT specialization the structure is characterized by self-organising autonomous interrelations, in which there is high integration (importance), but also high gaps (between expectation and experience) in innovation cooperation between helix actors.

The policy making capacity of the partnerships in the regions depends on in what degree the partners are able to agree on common goals, and make common co-creation. In the static system the actors are not able to make decisions. There might be also frozen conflicts and rivalry between strong stakeholders. Here, a backward-looking perspective is dominating. Leading actors decide upon the course of action, others are marginalized. Fragmented regions are characterized by lack of leadership. There is a general low level of expectations of other stakeholders or networks of innovation in the region, and experiences from attempts to cooperate were moderate. In a more dynamic system, the actors search for new entrepreneurial discoveries together.

The most popular good practice is research platform from Ostrobothnia region, a university-driven practice that was selected as benchmarking for all partners. This initiative consists of different platforms to lower boundaries for companies, NGOs, public organisations and civil society to contact universities. This policy based on good relations among helix actors allows to open doors for cross-sectoral collaboration and it is considered powerful to close regions' gap, since new discoveries can often be found through cross-sectoral approach, it lowers the organizational barriers and opens doors for wider society and it allows for implementing the open-science concept, a rising trend in the global research field.

The open research platforms have been established to response multidisciplinary to the grand challenges of our society like climate change or digitalization, to have more impact of the university in the society and economy, and to create more connectivity between helix actors. There are in many universities' similar efforts and especially efforts to contribute to the innovation activities, but at the university of Vaasa the research platforms have been made as essential components or the organizational structure (see figure 5.2.).

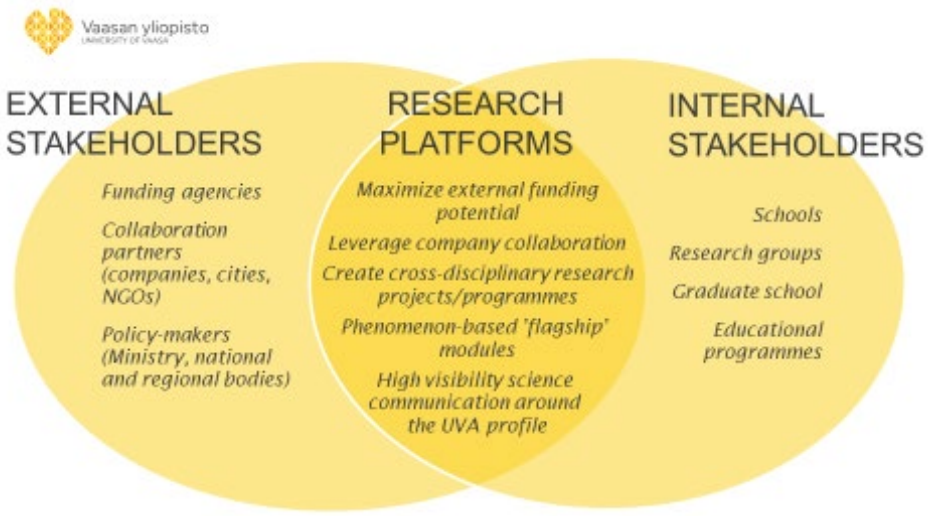


Figure 5.2. Research platforms between university's internal and external stakeholders

Forregion in Oppland is another popular good practice and five partners (Latvia, Lithuania – LAEI, Hamburg, Lithuania – LIC and Ostrobothnia) selected it as a possible initiative to overcome their gaps. It is public organization-driven practice that promotes research-based innovation and collaboration with researchers and scientists for businesses (mostly SMEs) with little or no research and development experience, increasing their internal capacity of innovation. Forregion allows the interaction between research and scientific institutions and business (SME and bigger companies), and public organisations act as intermediaries, providing support (financial and knowledge) to push innovations, involving the helixes' actors.

Industry 4 Panevėžys (Lithuania, LIC) is a company and NGO-driven initiative that incorporates different activities aimed at the development of the Industry 4.0 in the region of Panevėžys and it establishes a platform where experts from various fields discuss and present important regional trends, helping regions and sub-regions to transform and be more innovative with basis in their strengths. This practice allows lower collaboration boundaries between different stakeholders, including business, education, science and public sector representatives in order to foster the innovative ideas generation, knowledge sharing and ensure the continuous flow of the investment in the region. Some regions believe Industry 4 Panevėžys, as a benchmark, can teach how to start the transformation of the regional strategy in whole innovation ecosystem: starting from primary schools and informal learning and continuing with the R&D institutions that develops solutions for local companies.

Grain cluster (Päijät-Häme) was selected by two regions as a good practice that can bridge their gaps. This is a company-driven practice that connects industry companies and universities, research institutes and NGOs, fostering circular economy for more efficient and innovative use of resources.

From Päijät-Häme's conclusions, the practices presented did not bring much debate from the stakeholder's side. Based on earlier experiences on EU joint projects, expectations were not very high. In principle collaboration and

exchanging information interested them but the benefits that are expected must be concrete enough. Companies' representatives did not have much to say or comment for transnational benchmarking. They expect that intermediary organisations, like regional development company and universities, will bring and apply good practices to the region as appropriate, focused on the needs of the company as much as possible. Regional development company (agency) who coordinates cluster cooperation in Päijät-Häme wants to learn more from other cluster models. Grain Cluster companies discussed about expanding the group and necessity of "out of the box thinking" and reorganization and a more formal, focused approach. In Grain Cluster board meeting, representatives wanted a presentation and suggestions about the possibilities of how to develop cluster further. For Päijät-Häme, challenge is that regional universities do not offer the core knowledge that grain business needs, and it was asked, whether an idea of Open innovation platform can create possibilities to build new kind of research collaboration? Cooperation with universities is one of the important ways to fund innovations and research. Now grain cluster companies cooperate with national actors rather than regional that means less funding and expertise to Päijät-Häme region. New cooperation models are needed especially between educational institutes and universities and companies. If the collaboration between universities and companies would be more intense, more funding could be directed to the region.

Oppland region concluded that better triple-helix connectivity is important for future development. It is very important to showcase the importance and relevance for the SME to involve in R&D. Public sector must identify targeted instruments and measures to bridge the gap between the businesses and R&D institutions.

The focus group meetings conducted among quadruple helix actors (enterprises, research institutes, public institutions and NGOs) in Panevezys County, Lithuania indicated that cooperation among those partners is crucial and that is the reason why Panevezys region developed its own regional strategy to facilitate the cooperation among all innovation actors. However, regional development strategy raises a lot of challenges and it is very important to select priority areas where changes are needed the most and create the roadmap how to deal with those challenges. The participants that took part in the focus group meetings in Lithuania (LIC) indicated a number of barriers (gaps) that hamper or even make it almost impossible to establish regional value chains. The most important one was identified between business entities and other quadruple helix actors mainly public institutions (ministries and municipalities) and universities. The latter provide just a few R&D services or the quality of these services is unsatisfactory. Also, business entities would like to increase the prestige of local universities cause today very few graduates choose to stay in Panevezys county for their bachelor degree. In addition, business owners expressed their opinion that public organizations must direct more resources to create an entrepreneurial and cooperative culture among all innovation actors.

In Lithuania (LIC), all these problems and needs related to quadruple helix collaboration mentioned by the participants were taken into consideration, in response to these gaps several good practices suggested by LARS project partners were presented. Local stakeholders gain in their "entrepreneurial opportunities" from the ICT emphasized the most important features in those practices and admitted that learning from other regions could help to overcome existing gaps. The main focus will be put on the discovery of main regional development agency functions and facilitation of local research institutes.

Overall Latvia concluded that the approach chosen for the project and especially the idea of transnational learning seminars works very well. Transnational learning seminars provide an opportunity not only to discuss the good practice in this region but to tell about the good practices from other regions. In such a way it was possible

to make some initial benchmarking. If there wouldn`t be any good practices from partner countries to speak about, the concept of Latvia's good practice wouldn't be sufficient. During transnational learning seminar, Latvian stakeholders could understand that they can take and adopt some elements from every good practice and it is only up to them – how do they use them in Latvia and its regions. If the good practice in the sending regions works well it doesn't mean that the same result will be in the receiving region. If the story behind the good practice, including factors for success and failure, have not been described adequately, most probably even the best practice will face failure. Also, one important conclusion appeared in the learning seminar – in this case, there needs to be someone in public administration to motivate, and to push forward the evaluation, translation and implementation of the good practice. It doesn't definitely mean that the public sector should be the driver, but the question of who needs to be the real driver is still debatable, but it definitely means that the public sector should support new ideas and activities because otherwise, it will be hard to implement them.

In Lithuania (LAEI) region, results of focus group meetings confirmed that using of Quadruple helix model with involvement of 4 types of stakeholders (private sector, public sector, universities and research institutes and NGO's) are good tool for improvement of gaps that are identified in selected areas for RIS3 implementation within partner regions in LARS project: in bioeconomy (biogas) sector. The biggest challenge (gap) for Lithuania was identified between public institutions (ministries that are responsible for bioeconomy sector in Lithuania) with other stakeholders of Quadruple helix. Continuous work of the LARS project with public institutions (Ministry of Agriculture, Ministry of Energy and Ministry of Environment of the Republic of Lithuania) helped to get positive results and to make these institutions more open for work and discussions with other actors of this helix and this was confirmed at the Focus group meeting when representatives of the ministries reflected to the process on bioeconomy (biogas) in Lithuania and shared their vision. For Lithuania (LAEI), transnational learning of good practices identified by the LARS project partners play an important role for potential improvements in selected area by pilot actions implementations. For Lithuanian case the focus will be based on policy recommendation aiming to close collaboration gaps for smart specialization development by including the necessary measures into the regional development programme for Lithuania for 2021-2027 to support smart specialization in circular and bioeconomy.

The HORIZON 2020 project FORCE was identified as a good practice in Hamburg. The project helped to intensify the regional connectivity for the circular economy. The project is an example and a first step to improve the still fragmented regional innovation network. Examples and other good practices from other regions in the project helped to develop a plan how to further improve the regional connectivity and bridge the existing gaps in the innovation network. As next steps, the involved research institutions will reach out to other universities working with circular economy. To intensify, the cooperation between research institutions it is planned to develop a knowledge platform for circular economy. This platform should help to join forces for more research, projects and funding. Stakeholders from all other helices shall be involved and attracted step by step in the following years.

In Västerbotten, transnational learning was a good way to get new ideas how other regions have been working to accelerate their innovation development. To be successful it is important that the actors have time to go though the good practices and that they make it based on their own issues so it can be transferable in the region Västerbotten and contribute its development. It was difficult to get the actors to define one good practise to be committed to, which can be explained by the various interests which the stakeholders represent. From Region

Västerbottens perspective, it's very important to join forces with the different processes that is ongoing and strengthen the dialog among stakeholder. This way, the input with the LARS-perspective can get the most value.

For Ostrobothnia's conclusions, all of the presented good practises were considered to be relevant and useful approaches to regional development. Stakeholders were interested to learn more about the good practises and project team has decided to focus on FORREGION in the next phase. Some of the identified good practises were similar to existing activities in the region, despite having different types of actors and industries as basis. Overall, the learning seminar was a very positive experience, as several stakeholders were present and there was great discussion happening around the good practises, as well as general development challenges in the region.

The table 5.1. presents a summary of the good practices identified, analysed, benchmarked and translated in LARS project which got most interest of other partners. They could possibly be useful in Pomorskie specializations ICT and Energy. There are many proactive public organisations, universities and other helix actors in Pomorskie region. The universities have had proactive role in the emergence and development of ICT specialization in Pomorskie, and there are already existing platforms in Pomorskie. However, we think that the ideas and elements of the good practice of Ostrobothnia (Finland) like the open innovation platform could contribute to embed the large firms and universities also in Pomorskie. The good practice Oppland (Norway) professional public sector driven knowledge brokering between universities and SMBs with low R&D skills can integrate SMBs into wider systems of innovations and research institutes. The good practice from Lithuanian robotics sector is municipality creating NGO to promote the global position of the ecosystem has strong support from decision makers who concentrate their resources and entrepreneurial capacities into the area of Industry 4.0 ecosystem. Päijät-Häme (Finland) good practice is public sector-company driven cluster and NGO as cluster organization which aim to climb in value chain through NGO-company interactions based on local raw material, grain.

The main impact in LARS project might be that the learning capability by regional stakeholders have increased when reflecting first their own regional innovation ecosystem with the help of simple indicators like gap index, and then searching and evaluating and benchmarking the connectivity related good practices of other regions.

Table 5.1 LARS good practices possible relevant for Pomorskien ICT and Energy specializations

Relations	LARS good practices, scores	Characteristics	What can this practice deliver?
Universities and companies	Ostrobothnia (7) UNIVERSITY OPEN RESEARCH PLATFORMS	Open innovation platform between Universities and companies (labs)	Embedding large firms and universities in the region "*InnoLab in Ostrobothnia shows how open doors policy in Universities could create new networking opportunities for all innovation actors and spark new project ideas in the specific fields*."
Public sector, Universities and SMBs	Oppland (5) FORREGION	Professional public sector driven knowledge brokering between universities and SMBs with low R&D skills	Integrating SMBs into wider systems of innovation, including universities/ institutes *..learn how public organizations can be more active … as intermediaries to connect companies with little or no R&D capacity with universities or other research and science institutions to push innovations.*
Municipality creating NGO to promote the global position of the ecosystem	Lithuania-LIC (3) Industry 4.0 ecosystem industrial robotics and automation	*their goal is to concentrate their resources, policy, entrepreneurial and innovation capacity into development of this strategic area.*	*Panevezys has the main strength – support from decision makers that could lead to the future success of newly established regional development agency*.
Public sector-company-driven cluster (NGO)	Päijät-Häme (2) "*The world's most innovative grain cluster and ecosystem*"	Strengthening ties between companies and cluster organizations (NGOs)	Climbing in the value chain through NGO-company interaction based on a local raw material, grain

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Appendix 1 Questionnaire

A partner is any organization, which is crucial for your organisation's work, which you are in contact with more or less regularly from time to time. Relations to partners may be formalized through contracts and/ or they may result from mutual understanding. Partners may in various degrees share the same or mutually supporting objectives. Partners are important to the innovation activities of your organisation.

We will make a distinction between four types of possible partners:

- **Companies**, such as service providers, suppliers and customers.
- **Public organisations**, such as municipalities, ministries, public agencies, and international institutions (EU, UN, etc.).
- **Universities**, which perform research, education, and knowledge dissemination**.** These also include universities of applied sciences and other higher education and research institutes, which may be also privatively owned.
- **Non-governmental organisations (NGOs)**, which are usually non-profit interest organisations and operate on issues regarding business, environment, social security, public policy, education (chambers of commerce, farmer´s union, forest owners association, business associations, cluster organisations etc.) There are also international NGO´s, such as Committee of the Regions, European Cluster Collaboration Platform, etc.

Question regarding cooperation with companies

How important are companies as innovation partners for your organisation:

How important are companies as innovation partners for your organisation:	Scale: 0, 1-10
at the regional level	
at the national level	
at the international level	

b) Cooperative activities with companies

Aspect of cooperation	Regional cooperation		National cooperation		International cooperation	
	Expectations	Experi-ences	Expectations	Experiences	Expecta-tions	Experiences
Cooperation regarding production network(logistics, parts, services) *Concrete cooperation on a daily basis (process innovations)*						
Cooperation regarding innovation network(design, testing, marketing) *Work surrounding the products/services/research (product innovations)*						
Cooperation regarding future ventures (events, learning seminars) *Work relating to long-term exploration of business opportunities*						

Value/meaning: 10-9 Very high expectations, 8-7 High expectations, 6-5 Average expectations, 4-3 Low expectations, 2-1 Very low expectations, 0 = no expectations

10-9 Very good experiences, 8-7 Good experiences, 6-5 Average experiences, 4-3 Bad experiences, 2-1 Very bad experiences, 0 = no experiences

Cooperation here refers to activities in which both sides are genuinely interacting with one another. For example we do not consider purchasing a product, or granting assistance to be cooperation if there is not some sort of dialogue between the actors (for example planning, mutual project, etc.)

Expectations = what the cooperation should be in ideal situation/what you want it to be.

Experiences = the cooperation in practice.

Question regarding cooperation with public organisations

How important are public organisations as innovation partners for your organisation:

How important are public organisations as innovation partners for your organisation:	Scale: 0, 1-10
at the regional level	
at the national level	
at the international level	

Cooperative activities with public organisations

Aspect of cooperation	Regionalcooperation		National cooperation		International cooperation	
	Expectations	Experiences	Expectations	Experiences	Expectations	Experiences
Cooperation in regional development (infrastructure, logistics, land-use) *Concrete cooperation*						
Cooperation regarding innovation network (business development, employment affairs, advice) *Work surrounding the products/services/research*						
Cooperation regarding future ventures (events, education, knowledge/export-oriented activities) *Cooperation in developing innovative/inspiring environment*						

Value/meaning: 10-9 Very high expectations, 8-7 High expectations, 6-5 Average expectations, 4-3 Low expectations, 2-1 Very low expectations, 0 = no expectations

10-9 Very good experiences, 8-7 Good experiences, 6-5 Average experiences, 4-3 Bad experiences, 2-1 Very bad experiences, 0 = no experiences

Cooperation here refers to activities in which both sides are genuinely interacting with one another. For example we do not consider purchasing a product, or granting assistance to be cooperation if there is not some sort of dialogue between the actors (for example planning, mutual project, etc.)

Expectations = what the cooperation should be in ideal situation/what you want it to be.

Experiences = the cooperation in practice.

Question regarding cooperation with universities

How important are universities as innovation partners for your organisation:

How important are universities as innovation partners for your organisation:	Scale: 0, 1-10
at the regional level	
at the national level	

at the international level	

Cooperative activities with universities

Aspect of cooperation	Regional cooperation		National cooperation		Internationalcoopera-tion	
	Expecta-tions	Experiences	Expecta-tions	Experiences	Expecta-tions	Experiences
Cooperation in educa-tion(mutual courses, visit-ing lecturers, student pro-jects) *Concrete cooperation*						
Cooperation in develop-ment(testing, common projects) *Work surrounding the products/services/re-search*						
Cooperation in re-search(analytics, new so-lutions & concepts) *Work relating to long-term exploration of oppor-tunities*						

Value/meaning: 10-9 Very high expectations, 8-7 High expectations, 6-5 Average expectations, 4-3 Low expecta-tions, 2-1 Very low expectations, 0 = no expectations

10-9 Very good experiences, 8-7 Good experiences, 6-5 Average experiences, 4-3 Bad experiences, 2-1 Very bad ex-periences, 0 = no experiences

Cooperation here refers to activities in which both sides are genuinely interacting with one another. For example we do not consider purchasing a product, or granting assistance to be cooperation if there is not some sort of dialogue between the actors (for example planning, mutual project, etc.)

Expectations = what the cooperation should be in ideal situation/what you want it to be.

Experiences = the cooperation in practice.

***Non-governmental organisations (NGOs)**, are usually non-profit interest organisations and operate on issues regarding business, environment, social security, public policy, education (chambers of commerce, farmer´s union, forest owners as-sociation, business associations, cluster organisations etc.) There are also international NGO´s, such as Committee of the Regions, European Cluster Collaboration Platform, etc.*

Question regarding cooperation with NGOs

How important are NGOs as innovation partners for your organisation:

How important are NGOs as innovation partners for your organisation:	Scale: 0, 1-10
at the regional level	
at the national level	
at the international level	

Cooperative activities with NGOs

Aspect of cooperation	**Regional cooperation**		**National cooperation**		**Internationalcooperation**	
	Expectations	Experiences	Expectations	Experiences	Expectations	Experiences
Cooperation in regional development (land-use, logistics, environmental consultation, etc.) *Concrete cooperation*						
Cooperation in product/service development(consumer testing, etc.) *Work surrounding the products/services/research*						
Cooperation regarding future ventures (Common events, etc.) *Work relating to long-term exploration of opportunities*						

Value/meaning: 10-9 Very high expectations, 8-7 High expectations, 6-5 Average expectations, 4-3 Low expectations, 2-1 Very low expectations, 0 = no expectations

10-9 Very good experiences, 8-7 Good experiences, 6-5 Average experiences, 4-3 Bad experiences, 2-1 Very bad experiences, 0 = no experiences

Cooperation here refers to activities in which both sides are genuinely interacting with one another. For example we do not consider purchasing a product, or granting assistance to be cooperation if there is not some sort of dialogue between the actors (for example planning, mutual project, etc.)

Expectations = what the cooperation should be in ideal situation/what you want it to be.

Experiences = the cooperation in practice.

Appendix 2 The gaps in ICT specialization network in Pomorskie

				Companies	Universities	Public organisations	NGO´s
Questions			Data type	all	all	all	all
Companies	Cooperation regarding production network	regional level, gap (0, 1-10)	gaps	1,67	2,33	2,33	1,25
		national level, gap (0, 1-10)	gaps	1,67	2,33	1,33	2,00
		international level, gap (0, 1-10)	gaps	0,67	0,00	2,67	1,50
	Cooperation regarding innovation network	regional level, gap (0, 1-10)	gaps	1,00	1,33	1,00	0,75
		national level, gap (0, 1-10)	gaps	0,67	3,00	1,33	-0,25
		international level, gap (0, 1-10)	gaps	0,00	0,67	3,67	0,75
	Cooperation regarding future ventures	regional level, gap (0, 1-10)	gaps	0,67	1,00	1,33	0,50
		national level, gap (0, 1-10)	gaps	0,67	1,67	1,00	0,75
		international level, gap (0, 1-10)	gaps	0,67	1,33	1,67	0,25
Public sector	Cooperation in regional development	regional level, gap (0, 1-10)	gaps	2,67	0,67	2,33	0,25
		national level, gap (0, 1-10)	gaps	3,33	2,00	3,00	0,00
		international level, gap (0, 1-10)	gaps	0,33	0,33	2,00	0,00
	Cooperation regarding innovation network	regional level, gap (0, 1-10)	gaps	3,33	2,00	2,67	1,00
		national level, gap (0, 1-10)	gaps	1,00	4,00	4,00	1,00
		international level, gap (0, 1-10)	gaps	0,00	3,67	1,67	0,25
	Cooperation regarding future ventures	regional level, gap (0, 1-10)	gaps	2,00	1,00	2,33	0,00
		national level, gap (0, 1-10)	gaps	4,67	2,00	1,67	0,75
		international level, gap (0, 1-10)	gaps	0,00	0,67	1,33	1,00
Universities	Cooperation in education	regional level, gap (0, 1-10)	gaps	2,67	3,67	2,00	0,00
		national level, gap (0, 1-10)	gaps	4,33	4,33	5,33	2,25
		international level, gap (0, 1-10)	gaps	5,67	2,00	4,33	1,00
	Cooperation in development	regional level, gap (0, 1-10)	gaps	3,00	5,33	0,33	0,50
		national level, gap (0, 1-10)	gaps	4,00	5,33	0,00	1,50
		international level, gap (0, 1-10)	gaps	6,67	3,67	0,00	2,00
	Cooperation in research	regional level, gap (0, 1-10)	gaps	5,33	4,67	1,00	0,00
		national level, gap (0, 1-10)	gaps	4,67	6,00	1,00	1,00
		international level, gap (0, 1-10)	gaps	6,67	3,33	2,67	0,75
NGOs	Cooperation in regional development	regional level, gap (0, 1-10)	gaps	1,33	1,67	3,00	1,25
		national level, gap (0, 1-10)	gaps	0,00	2,33	2,00	0,25
		international level, gap (0, 1-10)	gaps	0,00	2,00	0,00	1,75
	Cooperation in product/service development	regional level, gap (0, 1-10)	gaps	1,00	1,00	0,00	1,25
		national level, gap (0, 1-10)	gaps	1,00	1,00	0,00	1,25
		international level, gap (0, 1-10)	gaps	0,00	0,33	0,00	1,00
	Cooperation regarding future ventures	regional level, gap (0, 1-10)	gaps	1,00	2,00	1,67	1,00
		national level, gap (0, 1-10)	gaps	1,33	2,33	1,67	1,75
		international level, gap (0, 1-10)	gaps	3,00	1,67	0,33	2,25

Appendix 3 The gaps in energy specialization network in Pomorskie

				Companies	Universities	Public organisations	NGO´s
Questions			Data type	all	all	all	all
Companies	Cooperation regarding production network	regional level, gap (0, 1-10)	gaps	0,00	-0,67	2,00	1,00
		national level, gap (0, 1-10)	gaps	1,67	-0,33	0,50	1,00
		international level, gap (0, 1-	gaps	2,00	0,33	2,75	3,00
	Cooperation regarding innovation network	regional level, gap (0, 1-10)	gaps	0,33	2,00	3,50	2,00
		national level, gap (0, 1-10)	gaps	1,00	2,00	2,50	2,00
		international level, gap (0, 1-	gaps	3,33	1,67	2,50	1,67
	Cooperation regarding future ventures	regional level, gap (0, 1-10)	gaps	-0,33	0,33	1,50	0,67
		national level, gap (0, 1-10)	gaps	1,00	0,33	0,75	2,67
		international level, gap (0, 1-	gaps	2,67	0,33	1,50	1,00
Public sector	Cooperation in regional development	regional level, gap (0, 1-10)	gaps	1,67	0,67	1,75	1,33
		national level, gap (0, 1-10)	gaps	1,00	2,33	3,50	0,67
		international level, gap (0, 1-	gaps	1,33	-0,33	2,25	0,67
	Cooperation regarding innovation network	regional level, gap (0, 1-10)	gaps	1,00	1,00	2,50	2,67
		national level, gap (0, 1-10)	gaps	0,67	2,00	2,50	1,33
		international level, gap (0, 1-	gaps	0,67	1,00	1,25	0,33
	Cooperation regarding future ventures	regional level, gap (0, 1-10)	gaps	0,33	2,00	1,75	1,67
		national level, gap (0, 1-10)	gaps	0,33	2,67	1,75	3,33
		international level, gap (0, 1-	gaps	0,33	0,67	1,00	2,33
Universities	Cooperation in education	regional level, gap (0, 1-10)	gaps	0,67	0,00	2,50	1,00
		national level, gap (0, 1-10)	gaps	0,33	0,00	2,50	1,00
		international level, gap (0, 1-	gaps	0,67	0,33	3,00	2,67
	Cooperation in development	regional level, gap (0, 1-10)	gaps	1,33	0,33	1,50	2,67
		national level, gap (0, 1-10)	gaps	0,33	0,33	2,50	1,67
		international level, gap (0, 1-10)	gaps	1,00	1,33	2,25	2,00
	Cooperation in research	regional level, gap (0, 1-10)	gaps	1,67	2,33	1,50	2,33
		national level, gap (0, 1-10)	gaps	1,33	2,33	2,50	0,00
		international level, gap (0, 1-10)	gaps	-0,67	2,00	2,50	2,00
NGOs	Cooperation in regional development	regional level, gap (0, 1-10)	gaps	0,67	1,67	1,50	1,67
		national level, gap (0, 1-10)	gaps	0,33	2,33	1,50	2,33
		international level, gap (0, 1-10)	gaps	1,00	0,67	0,50	1,00
	Cooperation in product/service development	regional level, gap (0, 1-10)	gaps	0,33	2,33	1,25	1,67
		national level, gap (0, 1-10)	gaps	0,67	2,67	1,25	1,67
		international level, gap (0, 1-10)	gaps	0,00	0,00	0,50	0,67
	Cooperation regarding future ventures	regional level, gap (0, 1-10)	gaps	2,00	2,00	1,00	1,00
		national level, gap (0, 1-10)	gaps	0,00	2,00	0,75	2,00
		international level, gap (0, 1-10)	gaps	0,33	0,33	0,50	1,00