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Unused potential for Smart Specialization development through collaboration: Lithuanian case

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Abstract: Smart Specialization in this research is addressed to the use of collaboration as a tool for increasing efficiency of investment in entrepreneurship, research and innovation in a service-driven post-industrial economic system. This study provides evidence that collaboration potential is used only partly during the implementation of Smart Specialization strategy. The research illustrates given thesis by the evaluation of collaboration in Lithuanian biogas sector, which is listed among the priorities of Lithuania's Smart Specialization strategy till 2020, using structured interviews. The main aim of this empirical research is to assess the will to collaborate in order to enhance the development of Smart Specialization and identify unused collaboration potential among all Quadruple Helix model counterparts in the biogas sector. Empirical findings show that collaboration in the Smart Specialization development has a big potential. However, this potential is used only partly because of lack of knowledge and available business infrastructure for this task and the passive role in collaboration processes of government institutions. Research findings suggest that current situation should be changed by supporting measures for business and NGOs with the aim to encourage collaborative initiatives for Smart Specialization. Research findings might serve as guidelines for policy makers, entrepreneurs, university and NGO managers.

Keywords: biogas; circular economy; post-industrial economic system; quadruple helix; service-driven economy

Smart Specialization as a concept developed in the previous decade (Foray et al. 2009; Foray 2012, 2014, 2015; Gianelle et al. 2016; McCann and Ortega-Argilés 2013) entails the new approach for increasing efficiency of investment in entrepreneurship, research and innovation. According to Foray and Goenaga (2013), Smart Specialization is a regional initiative seeking to explore and discover technological and market opportunities with the aim to establish a robust competitive advantage, upon which related development policies are conceptually based and implemented. This new policy approach refers to a process of priority setting in national and regional research and innovation strategies aiming to build "place-based" competitive advantages and help regions and countries develop an innovation-driven economic transformation agenda (Landabaso 2014).

Over the last decade, the concept of Smart Specialisation has been diffused at a surprisingly rapid pace among European regions and became an important tool in regional policy (European Commission 2014). The European Union has adopted Smart Specialization as flagship policy aimed at encouraging member states to enhance their innovativeness and competitiveness by focusing their endogenous potential in specific sectors and industries (Foray et al. 2009). All EU members were obligated to formulate Research and Innovation Strategies for Smart Specialization which will guide further research and development (R&D), and innovation system development in every member state.

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A large number of existing studies in the broader literature have examined a role of collaboration in post-industrial service-driven economic system. However, this topic remains very briefly addressed in the literature on Smart Specialization and many regions and countries are still trying to implement Smart Specialization strategies without any measures to encourage collaboration initiatives. In our opinion, the lack of collaboration activities becomes an important obstacle for success of Smart Specialization plans. Moreover, the differences between industrial and post-industrial economic systems should be taken in consideration.

In industrial economic system, creation and spread of innovations have been based on the initiative of firms limited by government regulations. This approach composed a basis for building the first national and regional innovation systems in most countries, where innovation policies were seen under systemic light. The concept of the Triple Helix initiated by Etzkowitz (1993) and Etzkowitz and Leydesdorff (1995), has extended the dyad of key players in the innovation process at macro level focusing on a growing triadic relationship between university, industry and government. The Triple Helix thesis says that the potential for innovation and economic development lies in a more prominent role for the university and in the hybridization of elements from university, industry and government to generate new institutional and social formats for the production, transfer and application of knowledge. However, the Triple Helix model is no longer enough for developing regional programmes or strategies for development in the context of Smart Specialisation. In the post-industrial service-driven economic system, entrepreneurs are shifting from traditional idea of value creation, where customers are seen as destroying the value which organisations create for them, to new value creation paradigm which views customers as active co-creators and co-innovators. It means that Smart Specialisation governance model should include customers as an equally important group of stakeholders because in post-industrial economy efficient innovation systems are more the result of collaborative strategies based on networking, rather than a set of individual initiatives which follow a linear R&D process from lab to the market.

The growing role of customers influenced the next step in developing the Triple Helix model. Quadruple Helix concept extends the Triple Helix model by presuming that society is a key actor in innovation processes along with academia, business, and government (Carayannis and Campbell 2009, 2010; Santonen et al. 2014). The concept of the Quadruple Helix also plays an important role in the context of transition from a linear development model to a circular economy integrating customers as key actors' group in the circular flow of resources at a macro level. The circular approach contrasts with a traditional linear model of production of take-make-use-dispose and an industrial system largely reliant on fossil fuels because of the aim of the business shifts from generating profits of sold artefacts, to generating profits from the flow of materials and products over time (Bakker et al. 2014).

According to Carayannis and Grigoroudis (2016), the Quadruple Helix approach is suitable for developing Smart Specialization strategies, and there is an urgent need to reconsider measures to keep the momentum generated in the original initiative and demonstrate the value of this exercise. However, this theory lacks empirical validation. This study aims to fill literature gap on the role of collaboration in Smart Specialization development by providing evidence that a will for collaboration among the four groups of Quadruple Helix model is big, but collaboration potential during the implementation of Smart Specialization strategy in most cases is used only partly. The research illustrates this thesis by evaluation of collaboration in Lithuanian biogas sector which development is a key priority of Lithuanian Smart Specialization strategy 2020, titled "Energy and Fuel Production from Biomass or Waste, Waste Treatment, Storage and Disposal". Biogas is already produced in Lithuania for more than 20 years. Production of biogas starts being promoted since the year 2011 after the Law on Renewable Energy of the Republic of Lithuania. In January 2013 first winners of the first biogas auction fixed electricity purchase tariff with an approved quota of 18 MW (Megawatt). However further biogas production promotion was stopped. There were 36 operating biogas plants in Lithuania in 2018: agricultural waste (14) 13.3 MW; landfill waste (9); sewage sludge (8) and biowaste and industrial waste (5). In total, 36 power plants in Lithuania provide the capacity of 9.481 MWth (Megawatt thermal) and 30.218 MWel (Megawatt electric). In the agricultural sector, biogas plants count up to a decade. At the same time, the agricultural sector is the main biogas producer in Lithuania (61.7%) (Statistics Lithuania 2018). Biogas production from agricultural, landfill and sewage sludge waste in 2016 exceeded 67.6 million m^3 in total, whereas annual natural gas consumption in Lithuania exceeds around 2.3 billion m^3. Production

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of biogas in the year 2017 reached only 4.3% of all produced energy in Lithuania m^3.

Despite rapid development of the biogas sector, Lithuania is still remaining in the back among biogas producers in the EU and, there are reasons behind. Therefore the development of biogas production from agricultural waste and residues has been identified among major priorities in Lithuania's Smart Specialization strategy till 2020 (2014). However, collaboration as an important tool in the post-industrial economy has not been taken into account during the strategy formulation and in the action plan for implementation. Therefore it becomes vitally important to investigate the collaboration process as phenomena and measure unused collaboration potential for the development of biogas production in Lithuania as obstacle for the Smart Specialization strategy implementation.

The biogas sector is chosen as representative of activities where circular and service-driven approaches to the development of an economic system are of core importance. The findings of the research hold particular limitations, related to the selected research subject, because it explores the situation in one country and in one Smart Specialization area – biogas production. The limitations of the present study naturally include need for empirical investigations in other countries and areas of Smart Specialization.

MATERIAL AND METHODS

The research consisted of several stages. Different methods at each stage were applied to validate the results:

1. Mapping of stakeholders in the biogas sector in Lithuania;
2. Interviews with selected stakeholders;
3. Data analysis (descriptive statistics);
4. Focus group meeting (validation of results; in-depth analysis of factors).

Stage 1. Creation of stakeholders map for biogas sector in Lithuania

Quadruple Helix approach was used to identify four key groups of stakeholders in the biogas sector in Lithuania:

– Business (producers of biogas);
– Government (ministries dealing with Smart Specialization in the biogas sector);
– Academia (universities and research institutes dealing with energetics, agriculture and rural development);
– Society as customers (NGOs dealing with local government issues and associations of farmers and rural communities).

Stakeholder mapping was developed according to Mitchell's et al. (1997) methodology, referring to stakeholder salience model which was adapted to macro-level analysis. Stakeholders were selected using measures based on 3 criteria: power, urgency and legitimacy of each stakeholder to influence the development of Smart Specialization in the biogas sector in Lithuania. Results of stakeholder mapping have been used for selection of most relevant interviewees.

Stage 2. Interviews with selected stakeholders

The aim of the interviews was to map innovation network in biogas sector to find out the bottleneck of the functioning of the network. This was done by mapping the Quadruple Helix connectivity between the stakeholders with the help of connectivity analysis in which the expectations and experiences of respondents towards its innovation partners in different helices were measured. This connectivity analysis regarding innovation networks has been developed by the University of Vaasa (Virkkala et al. 2014, 2017) in cooperation with Regional Council of Ostrobothnia. Connectivity means that three sets of variables: importance, expectations and experiences are correlated. Collaboration in the survey refers to activities in which both sides are genuinely interacting with one another. Collaborative relations may be formalised through contracts and/or they may result from mutual understanding. A structured questionnaire was used for the interviews aiming to evaluate the collaboration of all stakeholder groups from Quadruple Helix model involved into the circle of biogas production, distribution, consumption, and regulation (Table 1).

Interviews took place in May–September 2018. At least 3 respondents had been interviewed from each Quadruple Helix model component. In total, 13 interviews had been made with appropriate representatives: 4 with business, 3 with government, 3 with academia and 3 with NGOs.

Stage 3. Data analysis

Data received via interviews was analysed aiming to answer the following research questions:

– Do stakeholders value collaboration in the process of Smart Specialization development?

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Table 1. Assessed aspects of collaboration among groups of Quadruple Helix

Assessed area	Unused potential measured as the mismatch between expectations and experience
Expectations and experiences in	national collaboration international collaboration
Collaboration with	business government academia NGOs
Collaboration for	regional development (infrastructure, logistics, land-use) innovations in business development, employment affairs future ventures (events, education, knowledge/export-oriented activities)

Source: created by authors

– How big is a mismatch between expectations and actual collaboration practise?
– Does symmetry exist between evaluations of collaborating groups of actors on the unused potential for collaboration?

Stage 4. Focus group meeting

Verification of analysed data was done in a form of focus group meeting organised as a part of the EU INTERREG "Baltic Sea region programme 2014–2020" project "LARS – Learning among Regions on Smart Specialisation". The meeting was organised as a structured dialogue on collaboration analysis concerning problems in connectivity between the four Quadruple Helix groups and possible good practices. There were 13 participants in a focus group representing all Quadruple Helix model groups.

RESULTS AND DISCUSSION

Collaboration relations and its importance

The first research question "Do stakeholders value collaboration in the process of Smart Specialization development?" aimed to measure the role of collaboration between all actors of Quadruple Helix model. The role of innovation partners was measured by interviewees using number scale from 0 to 10, where 0 means non-existence of innovation partners, and 10 – vitally important innovation partners. Averages were calculated within every group of Quadruple Helix model actors.

For business, most important innovation partnerships are from other companies, national government institutions and science (average given points varies from 8.3 to 9.5). However, the role of collaboration with NGOs was assessed as less important: at the national level, it counted 7.3 and at international level 5.8 points. Least important innovation partners for business are found international government institutions (5.0).

Ministries stated high importance of innovation partners among other ministries at national (9.7) and international (9.3) levels, also academia and NGOs at the national level (both actors were given 9.0 points). However, Lithuanian ministries stated business at national level is less than medium importance innovation partner (4.3). The non-existence of ministries' international innovation partners was found in collaboration with companies, academia and NGOs (0 points).

The lower collaboration role was stated by academia and NGOs. For academia, all Quadruple Helix model groups were very important both at national and international level (average given points vary from 8.3 to 9.3), except international government institutions (4.7) and NGOs (2.7). NGOs stated greater that medium importance of innovation partners from other NGOs (8.3), government institutions (7.7), academia (7.7) and business (6.0) at national level, whereas innovation partners at international level were found least important from all Quadruple Helix parties (average given points vary from 2.3 to 3.3).

The amounts of innovation partners insignificantly vary among Lithuanian Quadruple Helix model actors both at national and international levels. Most of biogas sector actors keep collaborative relations for innovation with up to 20 actors both at national and international level. Hence, particular observations are important. At the national level, there are no collaborative relations for innovations in the biogas sector between academia and NGOs. Whereas at the international level situation is even worse: non-existence of innovation partners was found between business

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and NGOs, as well as no partners were found between academia and NGOs.

The stated importance of collaboration in the biogas sector elucidates particular significant insights, especially for policy makers. First, non-existence or very limited amounts of innovation partners signalise about the limited conditions of the particular actor to innovate and prosper, and this is considered to be a barrier for Smart Specialization development in Lithuania. Weak collaborative relationship is especially evident in the case of NGOs, both at national and international levels since non-existence of innovation partners are limiting their role in economic development. Hence, Lithuanian NGOs are still developing due to the young democracy, so they have time to mature and increase their role in fostering innovations as customers.

Research results also reveal that Lithuanian government institutions' role is extremely limited with regard to collaboration for innovation. This signalise inability to acquire new knowledge about the ongoing situation in the country and around the world, developing innovative practises and transform all of this to serve the public interest – people and society, which is the primary government mission. Therefore, according to the interviewees, the greatest amount of barriers in Lithuania exist within the government institutions in the form of confusing legislation, various surplus requirements and restrictions, which continuously block Smart Specialization breakthrough.

Very limited amount of innovation partners, in general, are found at an international level among almost all Quadruple Helix parties. These findings demonstrate that international collaboration as a driver for innovation is still rarely used in Lithuania and tools are on demand to move the situation forward.

Evaluation of unused and asymmetric collaboration potential among Quadruple Helix actors

The second research question "How big is a mismatch between expectations and actual collaboration?" aimed to measure the unused collaboration potential. Interviewees valued collaboration by giving particular value between 0 and 10 (0 means non-existence of a gap or perfect collaboration with regard to expectations and experiences, and 10 means totally unused potential of collaboration). Unused collaboration potential was defined as a mismatch between expectations and actual collaboration practise. According to the overall Lithuanian interview data, collaboration potential was operationalised into several intervals:

i) very strong collaboration potential between expectations and the actual situation was considered to be with values (9–10);
ii) strong collaboration potential was described with given values (6–8);
iii) medium collaboration potential was considered with values (3–5);
iv) existence of weak collaboration potential was recognised with values (1–2) and;
v) non-existence of collaboration potential was defined as (0).

Average values were calculated within every group of Quadruple Helix actors. All gathered results were aggregated into above-listed intervals and interpreted following the described logic.

It was found, that there exist significant differences among expectations and actual collaboration activities both at national and international levels. The gap between expectations and actual collaboration demonstrate the unused potential for collaboration between groups of Quadruple Helix model actors. Table 2 elaborated as matrix shows unused potential according evaluation of Quadruple Helix model group mentioned in line towards it's collaboration with group mentioned in column.

The findings show that more unused opportunities are at national level and the efforts should be focused on development of local collaborative initiatives. At national level the biggest unused potential for collaboration was found in collaboration between NGOs with academia (7.8) and between academic institutions (7.7). At international level the biggest unused potential for collaboration was found in collaboration between academia with government (6.1), and between NGOs with government (5.4). Alongside, it is important to state, that from the government side there is no will to collaborate for innovation with the rest of Quadruple Helix actors at international level. This situation demonstrates the particular closeness of Lithuanian government institutions due to its role in fostering innovations through international collaboration.

Summarised research findings regarding the answers to the third research question "Does symmetry exist between evaluations of collaborating groups of actors on the unused potential of collaboration?" demonstrate different attitudes towards collaboration among several groups of Quadruple Helix model actors both at national and international levels (Table 2). The main collaboration asymmetry at the

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Table 2. Unused collaboration potential among Quadruple Helix model actors

Unused collaboration potential (scale from 0 to 10)	Business	Government	Academia	NGOs
National level				
Business	2.1	2.6	1.8	1.8
Government	2.1	0.0	1.8	2.4
Academia	2.1	1.0	**7.7***	3.8
NGOs	5.3	6.6	**7.8***	0.0
International level				
Business	0.0	0.3	1.3	1.5
Government	0.0	0.0	0.0	0.0
Academia	3.3	**6.1***	4.7	3.9
NGOs	5.0	**5.4***	4.7	0.0

*the biggest unused collaboration potential for innovations in biogas

Data source: own calculations according to research results

national level was found among evaluations of NGOs and the rest of actors. NGOs highlight the greatest unused potential to collaborate with business (5.3), but according the opinion of representatives of business unused potential of business in collaboration with NGOs is only 1.6, i.e. more than 3 times smaller. Also, NGOs see big unused potential for collaboration with government (6.6) , counting almost 3 times higher expectations compared to expressed from the government side (2.4). The significant unused potential was also observed by NGOs towards collaboration with academia (7.8), however asymmetry in evaluations of the unused potential for collaboration in this pair of relations is less, academia evaluated it as 3.8, i.e. the evaluation differs more than 2 times . This research finding shows that other groups of Quadruple Helix model, especially business and government, lacks knowledge on collaboration opportunities with NGOs. At international level summarised research results on unused collaboration potential asymmetry are less impressive. Warning asymmetric evaluations were observed between the two pairs of actors. Academia highlights more than 2 times bigger unused potential for collaboration with business (3.3) than vice versa (1.3). Even greater unused potential to collaborate was issued by NGOs towards business (5.0), but business evaluate unused potential only as 1.5, which is more than 3 times bigger compared to the business side. Such research findings also signalise that business lacks knowledge on collaboration opportunities with NGOs and academia on international level.

CONCLUSION

The case of collaboration for Smart Specialization in biogas, which is listed among the priorities of Lithuanian Smart specialization strategy (2014), shows that collaboration still has a huge unused potential as a driver of Smart Specialization. Empirical findings confirmed the thesis of Carayannis and Grigoroudis (2016) that Quadruple Helix approach is suitable for developing Smart Specialization strategies since stakeholders understand the importance of collaboration among all four groups of actors and declare a will to collaborate at national and international levels. However, the empirical research opens a huge mismatch between expectations and actual collaboration.

The research results suggest that collaboration for Smart Specialization in biogas is performing greatest difficulties because of the passive role in collaboration processes of government institutions. Also integration of the fourth counterpart of Quadruple Helix model – customers represented by NGOs – into the process of Smart Specialization as co-innovators goes slowly because business lacks knowledge how to involve customers and available business infrastructure for this task implementation.

The research findings demonstrate that potential of such powerful tool for regional development as collaboration is used only partly and suggest that the situation should be changed. Since expectations are much greater from all Quadruple Helix model actors than actual collaboration practise governmental programme with support measures for business and NGOs

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are needed for encouraging collaborative initiatives in Smart Specialization. The design of such support measures should be based on further in-depth research aiming to explain the key reasons for the huge unused potential of collaboration more precise.

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