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THE INNOVATIVE PROCESS IN THE BALTIC SEA REGION

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In order to maintain its global competitiveness in the future, the Baltic Sea region (BSR) needs to preserve and improve its technological capability and innovativeness. This article focuses on innovations in the Baltic Sea region, particularly on external innovation drivers and innovation environments in the BSR and individual countries within the region. Firstly, some definitions of innovations, innovation drivers, and characteristics of a favourable innovation environment are presented. Secondly, the current condition of innovation environments in the BSR is described and the innovation performances of Baltic countries are compared. Finally, the research aims to conclude, as well as to analyse, the future innovation development of the BSR. The research material for this desk study is collected from various sources, including journal articles, statistics, media, research reports, and other publications.

Key words: Baltic Sea region, competitiveness, innovation, innovation environment, innovation drivers, education, R&D, innovation capacity, innovation performance

Introduction

The economic, political and strategic significance of the Baltic Sea region[1] has been constantly growing, and simultaneously the region itself has grown more prosperous. The Baltic Sea countries have intense import and export relations with each other, and the trade within the region is of great significance for the BSR countries. The Baltic Sea region is also an important centre of economic power in Europe — for instance, the EU member states in the region account for some 30 % of the EU's GDP. The EU has also acknowled-

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[1] In this article, the Baltic Sea region is defined to include the nine countries surrounding the Baltic Sea, i.e. Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden.

ged the significance of the BSR and adopted a Strategy for the Baltic Sea Region — the first EU strategy for a macro-region — aiming to facilitate the development of the region. However, to maintain its global competitiveness in the future, the Baltic Sea region needs to preserve and improve its technological capability and innovativeness.

Innovation and a fruitful innovation environment

Nowadays innovation is regarded as a central component of the knowledge economy and essential in meeting the challenges of the global economy. According to OECD [13, p. 46], *an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.* Nordic Innovation[2] [11] defines innovation as *a new or improved process, service, product or organization that creates economic or other public value. And Innovation is important for both private and public sectors.*

In general, innovation drivers can be both technology push and market pull. In the former case, the initiative for innovation arises from research and invention. In the latter case, the main driver behind innovation is market demand, expressing user needs [10]. Innovations come from a variety of sources, of which the most common are new demands by customers, demographic changes, new technologies, new organisations and business models, and entrepreneurs [11]. For an innovation to succeed, it is important that it will respond to the needs of customers — simply to make an invention is not enough.

Innovation drivers can also be divided into *internal* and *external* factors. The internal factors comprise the companies' capabilities and processes within them to create and commercialise new technology. In the last resort, it is the companies that introduce innovations. However, external innovation drivers i. e. a favourable environment for innovation is equally significant. Large differences exist between countries' innovative capabilities and outputs, which are mainly explained by national circumstances. Location is, indeed, very important for innovation. Different locations can also foster innovations in varied fields [15, p. 28—29].

According to Porter and Stern [15, p. 29], *national innovation capacity* affects the vitality of innovation in a location. They define national innovative capacity as *a country's potential — as both a political and economic entity — to produce a stream of commercially relevant innovations. It is not simply the realized level of innovation but also reflects the fundamental conditions, investments and policy choices that create the environment for innovation in particular location*.

The common innovation infrastructure comprises basic conditions for innovation throughout a nation. These innovation-supporting factors include

[2] Nordic Innovation is a Nordic institution working to promote cross-border trade and innovation, working under the auspices of the Nordic Council of Ministers.

human and financial resources devoted to advances in science and technology, the level of technological sophistication of the economy, and public policies related to innovative activity, such as protection of intellectual property, tax-based incentives for innovation, and the economy's openness for trade and investment. A strong common innovation infrastructure requires long-term political and economic commitment from a nation [15, p. 29].

Innovations emerge from cooperation between different actors — universities and public research institutes, private enterprises and the people within them — in a fruitful innovation environment. According to OECD [12, p. 7—10], a key to the innovative process is the flow of technology and information among these actors producing, distributing and applying various kinds of knowledge. The complex network of linkages between these actors can take a form of e. g. joint research, personnel exchange, or cross-patenting. These relationships among the actors produce innovation and technical progress and determine to a large extent the innovative performance of a country.

According to the Global Competitiveness Report 2011—2012 [7, p. 8], an environment that is conducive to innovative activity requires support from both public and private sectors. The high-quality education and scientific research institutions, sufficient investment in research and development (R&D), particularly by the private sector, extensive research collaboration between universities and industry, and the protection of intellectual property are important elements of a favourable innovation environment. According to Finland's Ministry of Employment and the Economy [6], a favourable innovation environment requires e. g. a high-quality research and education system, a viable labour market, and a society in which conditions such as intellectual property rights, business and market legislation and social institutions are functioning and reliable. In addition to these systemic conditions of an innovation environment, other factors such as close location of different actors and direct interaction between them promote the creation of functional innovation networks and innovation development. Indeed, in many cases, local poles of excellence which include both companies and research organisations have proved to be very innovative. Furthermore, the diversity of actors in an innovation network can result in unexpected and revolutionary innovations.

Hautamäki [8, p. 71] notes that although innovations require knowledge basis and institutional framework, these alone are not enough to produce innovations. Creativity, inspiration and stimulation are important components of an innovation environment, and structures can sometimes even become an obstacle to innovation.

This article concentrates on external innovation drivers and the innovation environments in the Baltic Sea region and individual countries within the region. The region has a variety of factors in common that facilitate its competitiveness and innovative capability, such as open societies, advanced university networks producing highly educated people, and competitive business environments. The innovation infrastructure is one of the region's strengths. The characteristics of the innovation environments in the Baltic Sea region countries will be discussed next.

Innovation environments in the Baltic Sea countries

Education is one of the keys to an innovation-oriented society. Education produces for example entrepreneurial, managerial, scientific, mathematical and foreign-language skills, which all play important role in innovative human resources [2]. As shown in Figure 1, the BSR countries have strong potential in well educated people — in all countries (excluding Russia on which the data is not available) the share of population that has completed at least upper secondary education is above the EU 27 average.

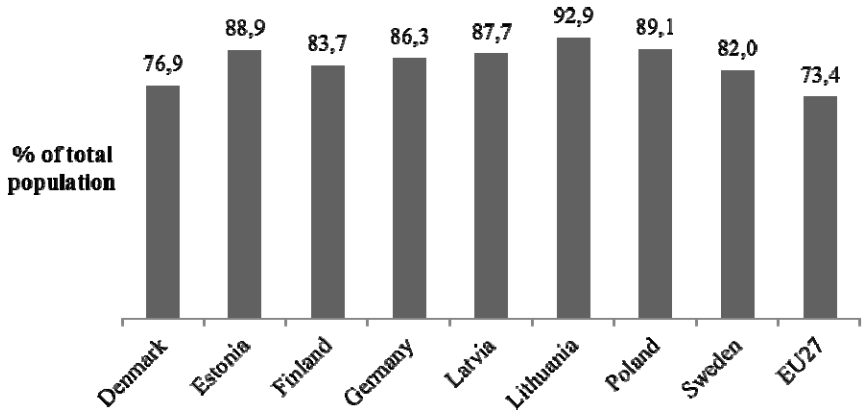


Fig. 1. Population between 25—64 having completed at least upper secondary education in the BSR countries[3], 2011 [4]

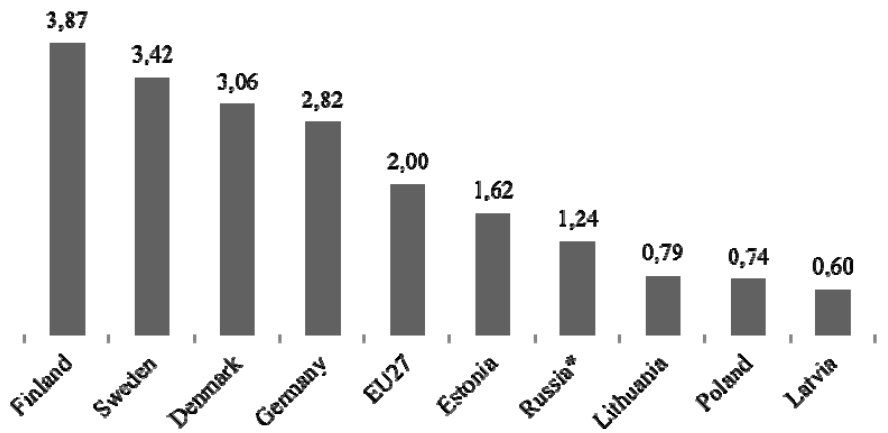
The number of students in tertiary education is also high in the BSR countries. The doctoral graduates are very important when it comes to research and innovation as they are trained to conduct research and to create and diffuse new scientific knowledge. In general, the number of doctoral graduates has been growing in the BSR countries during the last decade, partly because the increasing share of women in doctoral programmes. However, what happens after the doctoral graduation i. e. the career choices of doctorate holders is equally important as the number of graduates. Indeed, an economy's innovation capacity is affected by its ability to draw human resources into research as they are the basis for creating new knowledge and advancing economic activity. Although one may assume that researchers are mainly employed by higher education and government sectors, business enterprise sector is an important employer of researchers for instance in Finland, Denmark, and Sweden [14, p. 68—74]. This also reflects the significant role of the business sector in these countries' national research and development (R&D) systems.

[3] Data for Russia are not available.

Innovations emerge from research and expertise which require not only educated and qualified human resources but also investments in research and development activities. Indeed, it is essential for the countries' competitiveness that even in the light of the current economic situation public and private sectors resist pressures to cut back on the R&D spending [7, p. 8].

High-level basic research is an important source of new scientific knowledge and it creates a foundation for innovation activity [8, p. 54]. Basic research is mostly conducted in universities and other public research institutes, for which public funding is essential. In general, the governments also invest in basic research although the modes of funding vary from institutional to project-based, reflecting the countries' research systems [14, p. 78].

The proportion of GDP spent on research and development is an important indicator of an economy's relative degree of investment in generating new knowledge [14, p. 76]. As shown in Figure 2, R&D expenditure as a percentage of GDP varies in the BSR countries.



*Data for Russia from 2009

Fig. 2. R&D expenditure as a percentage of GDP in the BSR countries, 2010

Sources: [4, 5].

As the Figure 2 indicates, in Denmark, Finland and Sweden the share of R&D expenditure in GDP is more than 3% which is one of the five headline targets of the European Union's growth strategy "Europe 2020". On the other hand, in Latvia, Lithuania and Poland the share is well below 1%.

Business sector is a major performer of R&D in several BSR countries. A breakdown of R&D funding by sectors indicates that business enterprises contribute the majority of the funding in Denmark, Finland, Germany and Sweden, and in Estonia the half of it (Table 1).

Table 1

R&D expenditure by sector of performance in the BSR countries, 2010 (EUR million) [4]

Country	All sectors	Business Enterprise sector	Government sector	Higher education sector	Private non-profit sector
Denmark	7 208	4 909	151	2 117	31
Estonia	232	116	25	89	3
Finland	6 971	4 854	645	1 425	47
Germany	69 810	46 980	10 230	12 600	n/a
Latvia	109	40	25	43	n/a
Lithuania	219	64	39	117	n/a
Poland	2 608	694	936	970	7
Sweden	11 870	8 160	578	3 127	4
EU27	245 673	151 126	32 602	59 509	2 436

Data for Russia are not available.

The interplay between public and private sectors in the funding and performance of R&D is often complex. Governments can for instance finance business R&D activities directly via grants, loans or procurement, or indirectly via tax incentives. For example in Russia, a large share of the business R&D is government-financed. Similarly, business sector participates in the funding of R&D activities in universities and government research institutes. The share of business-funded R&D in the higher education and government sectors is rather high for instance in Russia and Germany [14, p. 39; 90—91]. Business R&D funding is important for innovation and economic growth, and the countries in which the business enterprise sector actively participates in the innovation process are also leaders with regard to their innovation performances. In the BSR countries, the innovation systems differ: whereas in Denmark, Finland, Germany and Sweden the business sector actively participates in innovation process, in Latvia, Lithuania, Poland and Russia — and to a lesser extent in Estonia — the role of the private sector still remains limited.

Europe has traditionally been regarded as good in producing original ideas, i. e. inventions but not that strong in bringing them to market [2]. Thus, instead of only relying on a research-centred approach, market oriented innovation development and commercialisation of innovations is needed, which requires cooperation between public and private sectors.

Qualified labour force and investments in R&D are not the only preconditions for innovation activity. A climate that encourages innovation, creativity and a certain level of risk-taking is an important part of a successful in-

novation system. National innovation policies play an important role in countries' innovation environments and public policies related to innovation activity can create important incentives for innovation. Several governments of the BSR countries have also established their own national innovation agencies to boost innovation. Some examples of such agencies include Vinnova in Sweden; Tekes in Finland; Danish Agency for Science, Technology and Innovation in Denmark; MITA in Lithuania; ASI in Russia.

Protection of intellectual property is one of the important elements encouraging innovation. Intellectual property rights and particularly patents are an important link between innovation, inventions and the marketplace. Through a patent application an invention becomes public, and simultaneously protected. One indicator for a country's inventive activity is the number of patents. It also shows a country's capacity to exploit knowledge and translate it into potential economic gains [3]. According to the World Intellectual Property Organization (WIPO), Germany, Sweden and Finland were all among the top 15 countries in the world in 2010 regarding the number of international patent applications under WIPO's Patent Cooperation Treaty — Germany ranked number three, Sweden number ten and Finland number 13 [18].

The economy's openness for trade and investment also encourages innovation, as does the level of technological sophistication of the economy [15, p. 29]. Particularly the information and communications technology (ICT) is an important enabler of innovation. The ICT sector is very R&D intensive, and the effective use of ICT increases labour productivity, as well as effectiveness and competitiveness of firms [1]. In general, ICT is among the BSR's strengths.

Comparison of the Baltic Sea countries' innovation performances

Countries' innovation performances are usually compared by way of various international indicators. The Innovation Union Scoreboard 2011 divides the EU member states into four performance groups according to their average innovation performance. The performance groups are called *Innovation leaders*, *Innovations followers*, *Moderate innovators*, and *Modest innovators*. The Innovation leaders -group includes only four countries which are all located in the Baltic Sea region — Denmark, Finland, Germany and Sweden. Their innovation performance is well above the EU27 average [9, p. 3—8].

Estonia belongs to the second performance group Innovation followers, being close to the EU27 average, whereas Poland belongs to the third group Moderate innovators. Latvia and Lithuania fall into the category Modest innovators which means that their performance is significantly below the EU27 average. The innovation performance of Russia is also compared to the EU27 average. According to the Innovation Union Scoreboard 2011, the overall performance of the EU27 is better than Russia. Russia's performance is better only in tertiary education [9, p. 3—8; 19—20].

Innovation leaders share several strengths in their national research and innovation systems, such as active business participation and the collabora-

tion between public and private sectors. Innovation indicators related to firm activities, for instance business R&D funding, are among their strengths. They also have functioning relations between scientific research institutions and enterprises, as well as succeed in the commercialisation of scientific knowledge, which is shown for example in the number of patents [9, p. 3—8].

Table 2 presents the Knowledge Economy Indexes (KEI) of the BSR countries which can be used to measure and compare the innovation environments of the countries. KEI takes into account whether the environment is conducive for knowledge to be used effectively for economic development and presents various elements that play key roles in an innovation-encouraging environment.

Table 2

Knowledge Economy Index (KEI) of the BSR countries, 2012 [17]

Country	KEI	Economic Incentive Regime	Innovation	Education	ICT	World ranking in 2012	Change in rank from 2000
Sweden	9,43	9,58	9,74	8,92	9,49	1	0
Finland	9,33	9,65	9,66	8,77	9,22	2	6
Denmark	9,16	9,63	9,49	8,63	8,88	3	0
Germany	8,90	9,10	9,11	8,20	9,17	8	7
Estonia	8,40	8,81	7,75	8,60	8,44	19	7
Lithuania	7,80	8,15	6,82	8,64	7,59	32	2
Latvia	7,41	8,21	6,56	7,73	7,16	37	0
Poland	7,41	8,01	7,16	7,76	6,70	38	– 3
Russia	5,78	2,23	6,93	6,79	7,16	55	9

The index is based on four key pillars of the knowledge economy: *Economic Incentive Regime*; *Innovation*; *Education*; and *ICT*. The first pillar, Economic Incentive Regime, takes into account the degree of economic freedom, the regulatory quality of an economy, and the rule of law in a society. The second pillar, Innovation, measures the inputs into the innovation system, such as royalty and license fees payments and receipts, granted patents, and scientific and technical journal articles. The third pillar, Education, is based on adult literacy rate, as well as secondary and tertiary education enrolment rates. Finally, the fourth pillar, ICT, measures the penetration and usage of telephones, computers and Internet [16]. The BSR countries Sweden, Finland and Denmark are the three world leaders according to the index. Germany ranks the fourth among the Baltic Sea countries. The results are similar to the Innovation Union Scoreboard 2011.

Indeed, when comparing the innovation capacities and performances of the Baltic Sea countries, four countries that usually stand out are Denmark,

Finland, Germany and Sweden. Other countries in the region — Estonia, Latvia, Lithuania, Poland and Russia seem to still have more to develop. Denmark, Finland and Sweden are considered to be among innovation leaders also at the global scale. Indeed, a disparity between eastern-western / northern-southern parts of the BSR is still visible when comparing the countries' innovation capacities and performances. However, the proximity of knowledge intensive economies of the BSR, such as Finland and Sweden, can benefit the three Baltic States, Russia and Poland. The transfer of knowledge and information within the BSR can help the countries to reinforce their innovation capacities in the future.

Research world is increasingly international and networking across national and institutional borders is common. Increasing scientific specialisation and intensifying cross-border collaboration is considered to facilitate innovation. For instance, according to OECD the indicators for international scientific collaboration and patent applications correlate positively across countries. In general, small countries engage more in international collaboration. Some factors, such as geographical and cultural proximity can facilitate the collaboration although the widespread use of English and information and communication technologies have made international scientific collaboration easier [14, p. 46—49]. Nonetheless, the Baltic Sea countries can benefit from their cultural and geographical proximity as facilitators of cross-border collaboration across the region.

Concluding remarks

A capability to innovate is essential for a country's competitiveness in a knowledge-based global economy. Innovations are also a key to a nation's development and regeneration. Furthermore, in the face of growing global challenges, innovations can contribute to solving or mitigating them in a sustainable yet profitable way. Indeed, innovations are important for the Baltic Sea region to maintain its competitiveness in the future, to develop into even more prosperous region, as well as to even out differences in economic well-being and improve the quality of life of the region's inhabitants.

A favorable innovation environment requires, among others, educated people, investments in R&D, collaboration between public and private sectors, functioning society and a certain degree of creativity and risk-taking for innovations to emerge. The historical development has led the BSR countries to varying paths, and they are at different levels with regard to their innovation capacities and performances. Still, they all hold great potential for innovation development in the future as they share several factors which are important for a fruitful innovation environment. Moreover, the Baltic Sea region as a whole has many of these characteristics, such as advanced universities producing educated people and high-level scientific research, open societies with functioning institutions and legislation, finance and support for R&D both in public and private sectors, and competitive private enterprises. Thus, although the countries in the region differ, they could translate these differences into strengths and complement each other with their varying capabilities.

Some sectors in the Baltic Sea region hold particular potential for innovation development. The region in general appears to be specialised in some technological fields, such as biotechnology and particularly pharmaceuticals, as well as ICT. Furthermore, sustainable innovations could arise as a special focus area in the BSR in the future. Climate change and energy are priorities of both Europe 2020 and the EU Strategy for the Baltic Sea Region[4]. The environmental issues are particularly important for the Baltic Sea countries, as the Baltic Sea is one of the world's most polluted seas whose main challenges derive from the conditions of the maritime environment. Thus it would seem that a clear demand for innovations related to sustainable development exists in the BSR to solve these challenges. Furthermore, many BSR-based companies have advanced technological skills and capacities to produce sustainable innovations, and common specialisations could create synergy advances for the whole region.

The Baltic Sea region is rather small in a global scale. However, it could be turned to the region's advantage as the region as a whole can benefit from the geographical proximity for example with regard to transfer of knowledge and information. Close location and direct interaction between different actors can facilitate networking and collaboration. Due to the current economic situation the countries in the region face some challenges which could affect innovation development as well, for example funding of R&D. Despite of that, investing in R&D and innovation development is important because innovation success stories can attract more capital, educated people and new companies to the region in the future. Still, realising the full innovation potential of the BSR would require the development of a common vision and identity of the region, as well as increasing the collaboration in practice not only at national level but also between actors at lower levels, such as various innovation clusters.

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