Study of Co-Operation between Entrepeurship and Scientific Infrastructure in Baltic Sea Region

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CONTENT

1. LIST OF ABBREVIATIONS

BSR – Baltic Sea Region

DTI - Danish Technological Institute

DTU – Danish Technical University

EK – European Commission

ERAF –European Regional Development Fund

ES – European Union

GEMS – German Engineering Materials Science Centre.

IKT – Information Communication technologies

UCPH- University of Copenhagen

LIAA - Investment and Development Agency of Latvia

LU – University of Latvia

SME – Small and medium size enterprise

OECD – Organisation for Economic Co-operation and Development

AAU - Aalborg University

AU - Aarhus University

R&D - Research and Development

PPP – Public Private Partnership

TTU – Tallin Technical University

TUT –Tampere University of Technology

TU – Tartu University

VU – Vilnius University

2. LIST OF CHARTS, FIGURES AND TABLES

3. METHODOLOGY

The main objective of the research „Study of Co-Operation between Entrepeurship and Scientific Infrastructure in Baltic Sea Region" is the analysis of the enterprise demand and scientific infrastructures in the Baltic Sea Region (hereinafter BSR). It means that in the existing public scientific research centres located in each of the eight countries involved in the research – Denmark, Estonia, Latvia, Lithuania, Poland, Finland, Germany and Sweden - will be examined. Their research interests responds to at least to one of the fields included in the project "Science Link" – agriculture and food science, chemicals and their manufacturing, construction and natural sciences, environment and energy, household goods and personal hygiene, life science and biotechnologies, material science, and nanotechnologies. The business demand analysis is created by using a variety of publicly available data, for example, in the project "Science Link" home page found and within the framework announced two tender results on the enterprises` interest to participate in this project.

The results are examined in the context with other data which illustrate the interest of various industries on the scientific infrastructure and collaboration with it, as well as the enterprise investment in research which can manifest as self- financed and monitored research development. Also, the answers obtained by the entrepreneurs, entrepreneurial organizations, state institutions and scientists have been used during the research, where they characterize the industry and scientists` collaboration in their own countries.

Each of the informative materials or information sources characterize the industry's interest in one of the sectors examined in the research, its development, potential innovations and readiness to participate in their creation and implementation themselves. It will also appear which fields of entrepreneurship are the most willing towards the collaboration, interest, and participation in science.

Based on the publicly available information on a number of scientific publications, the research establishment budget, and the number of employees, as well as collaboration with the industry, the authors of the research have selected at least five centres from every state, on which a more detailed description is provided. Each review contains the smallest structural units of the relevant research institutions, if any, and the main research interests are listed. Applying this methodology the search describes both, the primary research sectors in each country individually, as well as the research centres of particular countries are mentioned, i.e., the universities, their scientific centres, institutes and laboratories which operate in the fields mentioned by the "Science Link". The methods used in the research are already partially outlined. First of all, these are publicly available data collected on the internet, for example, on the work of a university or characteristic elements of some entrepreneurship

field. The used data may be, for example, summarized statistics of international institutions, states or some organizations. Secondly, those are responses and data obtained from the institutions of all eight countries. During the study, the questionnaires on experience of industry and science collaboration within all eight countries were sent to more than 110 research centres, official bodies, entrepreneurs and chambers of commerce and industries. In the case of Germany, the information was sent to several regions in the Northern part of the country. Importantly, the questions for each of the addressee groups were different. For example, some questions were addressed to the state institutions, other – to companies which have had collaboration with research institutes, because both contact groups have separate roles in the collaboration of scientific institutions. Thus, the answers on practical collaboration between the industry and science were obtained. Thirdly, the offered data by the "Science Link" project were used in the research, i.e., already mentioned tender results on readiness to participate in the project, which also illustrate the field interest on potential innovations created by the science. In many cases, the necessary data were not available, such as on the research centre budgets, thus the study, possibly, does not fully reflect the collaboration and potential between the entrepreneurship and scientific infrastructure. During the research there were 13 responding institutions from 133 governmental establishments, with a corporation experience PA, scientific institutions and entrepreneurial organizations. The study examines the situation in eight EU Member States located at the Baltic Sea. The scientific institution can be located in any region of the country included in the research. Exceptions to the case are Germany and Poland. There have been six Northern regions examined in Germany: Berlin, Brandenburg up to Berlin, Hamburg, Mecklenburg - Vorpommern ,Schleswig – Holstein and Lower Saxony.[1]

The study begins with an explanation of abbreviations, graphics, illustration and lists of tables, as well as the methodology section setting out the objectives and methods of the study, as well as the outline of its contents. The fifth chapter analyses the scientific infrastructure in the BSR in the scale of the EU, presuming the amount of financial resources allocated to the collaboration of the scientific infrastructure and industry within the 7th Framework Programme (hereinafter FP7) of the EU, as a criteria. Also the input and the established priorities are being analyzed in every BSR country. The sixth chapter deals with scientific institutions in each of the countries studied. The seventh chapter deals with research institutions in each of the countries included in the research.

[1] http://www.scanbalt.org/the+region/northern+germany Information on the administrative division of Germany

Therefore, there are eight subdivisions in the research - each of which deals with the examination of scientific infrastructure and a number of its centres in one of the BSR countries.

Each Research Centre is described in accordance with the "Science Link" targets-for example, when listing some university structural units - centres, faculties - only those are mentioned whose fields correspond to the interests of the "Science Link". If there are also arts or social sciences within the interest scope of the university, they are not marked among its research interests. If there are many centres, departments and areas at the university which correspond to the project "Science Link" setting, then the university is indicated as the "main institution"; for example, Aarhus University (AU) in Denmark. In other cases, some specific institute can be the primary one, and the "parent organization" is not mentioned, for example, the Institute of Solid State Physics (at the University of Latvia). The seventh chapter examines the industry demand and interests in research: which industry areas are the most interested to collaborate with scientists, and how has the industry participated in the scientific research so far.

The fifth, sixth and seventh chapters have an introduction, which outlines the issues examined in the section and its subsections, as well as the summary where the conclusions are compiled. The research concludes with a conclusion part which is the eighth chapter, where the mutual correspondence of the scientific infrastructure supply and industry demand is examined, as well as the recommendations to the industry and scientific institutions to enhance mutual cooperation.

The main objective of the study is as follows: To investigate the business and applied science environment in BSR countries, identifying the potential fields and possible new users which would require a significant infrastructure of investigation in the region and its area.

Within the framework of the study it will be established, which areas in the BSR scientific infrastructure are represented the most and developed in the project "Science Link", well as the recommendations will be provided for the improvement of communication between the industry and research institutions in the BSR.

4. RESEARCH INFRASTRUCTURE AND THE EUROPEAN UNION

According to the EU Commission the term “Research infrastructure” means – “facilities, resources and related services used by the scientific community to conduct top-level research in their respective fields, ranging from social sciences to astronomy, genomics to nanotechnologies. Types of infrastructure presence 1. „single-sited” - when all the resources required for the research are concentrated in a particular place; 2. distributed - when all the resources required for the research are located in varios areas as a distributed network of resources; 3. it can exist "virtually", for example, is the service is provided electronically. Examples include singular large-scale research installations, collections, special habitats, libraries, databases, biological archives, clean rooms, integrated arrays of small research installations, high-capacity/ high speed communication networks, highly distributed capacity and capability computing facilities, data infrastructure, research vessels, satellite and aircraft observation facilities, coastal observatories, telescopes, synchrotrons and accelerators, networks or computing facilities, as well as infrastructural centres of competence which provide a service for the wider research community based on an assembly of techniques and know-how”.[2]

The underlying goal and strategy of building large scale research infrastructures is to leverage synergy effects and bring resources together to integrate existing research infrastructures and construct new ones. Such structures play an important role in bringing together different stakeholders to be able to tackle the advanced challenges faced by the nowadays society. Furthermore, adequate research infrastructures are essential in promoting and supporting technological innovation and fostering development. Also, such model allows creating new environment in which all researchers have access to unique scientific facilities regardless to their specialization or geographical location in the world.

Dr. Marc Thiry (Engineering Materials Science Centre (GEMS)) explains that "[...] a great scientific infrastructure means more cooperation between the institutions, and it may not be the only one laboratory. Whereas science equipment tends to be expensive and complicated, then they can only be built through cooperation.

In addition, a large infrastructure includes a variety of science and interests.[3] Vilnius University Institute of Material Science and Applied Research showed that in relation to the institution, the scientific

[2] European Commision official web-page on Research Infrastructures; Accessed: 25.02.2013; Available at: http://ec.EURopa.the EU/research/infrastructures/index_en.cfm?pg=what

[3] Technical University of Denmark computerized response format

meaning of the infrastructure around the working space 500-1000 square meters in size, equipment and technology in five to 10 million EUR, a collective that works at 300-500 doctoral degrees obtained employees and approximately 20 million EUR budget.[4] The University Tartu Professor Marco Kirm as a modern scientific infrastructure features mentions scale and international provision of services to the public, outside of a research institution.[5] Also, there is a view that at the modern scientific infrastructure should have at least 1,000 employees.[6]

There are already several intergovernmental research infrastructures established in the EU, the most common ones are CERN (European Laboratory for Particle Physics), ESO (European Southern Observatory), ESRF (European Synchrotron Radiation Facility), EMBL (the European Molecular Biology Laboratory) and ILL (The Institute Laue-Langevin).

It is contrived to invest more than 100 billion euro in the development of various fields of the EU science infrastructure until 2020. It is considered to be necessary 10 to 15 billions euro yearly for the maintenance.

Europe`s research infrastructure is a unique asset that needs to be leveraged through an extensive collaboration, sufficient financial resource allocation and smart specialization to compete globally with the US, China and India, and other countries.

[4] VU Materials Science and Applied Research Institute of computerized response format

[5] The University of Tartu - computerized response format

[6] Tartu Science Park - computerized response format

5. SCIENCE INFRASTRUCTURE IN THE BALTIC SEA REGION

This chapter examines the activity and participation of each country in the European 7th Framework Programme (FP7). In its projects mostly the researchers from small countries and research institutions, which gain more new opportunities from this programme than the researchers who work in bigger scientific infrastructures. Also, the state investments in R&D have been examined The objective of the programme is to create the European Research Space in which the knowledge and technologies can be trans located freely and mobile within the frameworks of a coordinated research activities and particular policy. At the moment at least 3% of the GDP are invested by the BSR Nordic countries and Germany, thus recognizing the R&D field to be economically significant. Finally, the priorities of each BSR country have been examined, and the collaboration level between the state, enterprises and science has been outlined. In a part of the countries, for example in Sweden and Denmark, the state science priorities are not defined as strictly as, for example, in Baltic states. The BSR countries are mostly trying to focus on the development of different technologies, natural sciences.

5.1. Collaboration in R&D in BSR

As a basis for assessing the collaboration activity among the researchers in the BSR, data from participation in the 7th European Framework Programme(FP7) were collected. The Framework Programme was chosen for its important role due to its share size, multiple research areas and offered support instruments. In addition, it significantly supports and facilitates collaborative research projects and

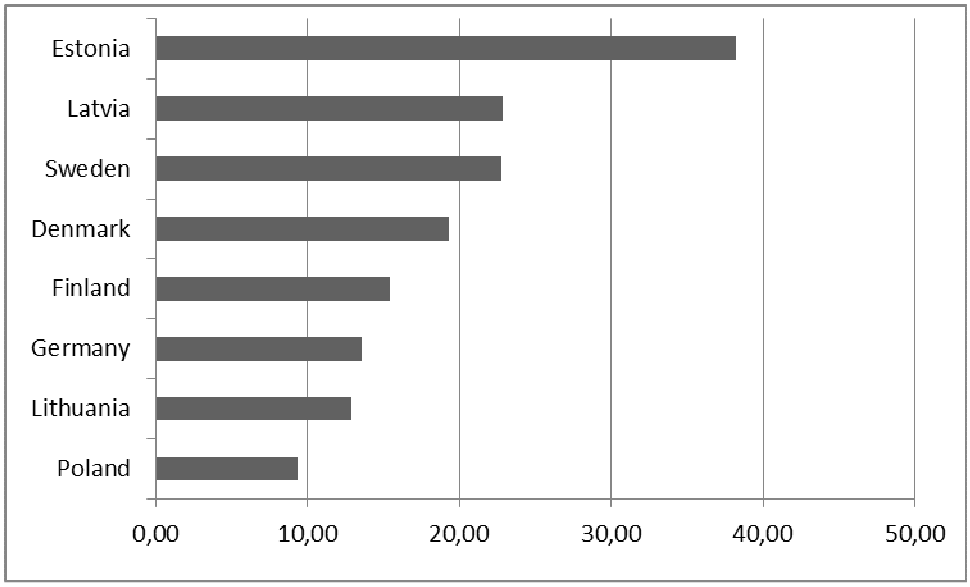


Figure 1 Number of participations(1) in FP7(2) per thousand researchers (FTE)

Source: DG Research and Innovation, Innovation Union Competitiveness Report 2011
Notes: (1) A participating institution or firm is counted as many times as it is funded in different projects.
(2) FP7 covers only the years 2007-2009.

networking among the agencies, mobility of researchers.

It can be seen from the chart above that Estonia, Latvia and Sweden are the countries collaborating the most, and leveraging the benefits and instruments provided by the Seventh Framework Programme(FP7). It can be said that smaller countries with less resources and specialized knowledge can share their competence and be a part of the large EU or worldwide research projects gaining new experience and sharing their own knowledge. As well as the fact that for smaller countries FP7 funding plays a bigger role compared to countries such as Germany or Finland.

Furthermore, if we look at the scientific cooperation within the whole EU, the cooperation takes place

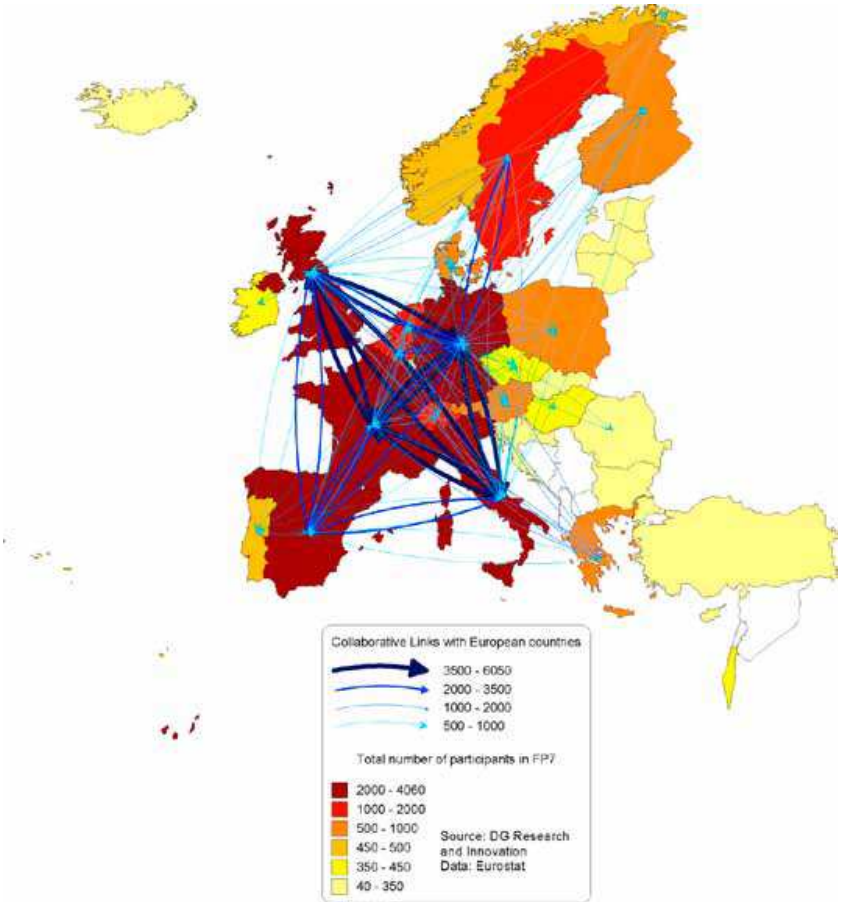


Figure 2 FP7 collaborative links between European countries

Note: A collaborative link between two countries iscounted each time participants from two countries participating in a FP7 collaborative Project.

mainly among the four big countries, i.e. Germany, France, Italy and the UK. Moreover, this map clearly shows that the collaboration among the BSR countries is minimal, and therefore should be significantly improved.

5.2. Financial resource allocation for R&D in the BSR

To be able to compete globally it is necessary for the EU that all member states continue to invest in research and development to meet the set goal of the EU 2020 strategy, where 3 % of countries` total GDP need to be invested in the R&D activities. To see the current status of overall investment in the R&D in Baltic Sea Region, data from Eurostat have been collected and analysed.

As can be seen from the chart below, Finland, Sweden and Denmark are the countries investing the most resources in research and development. Germany, which is slightly lagging behind only by several

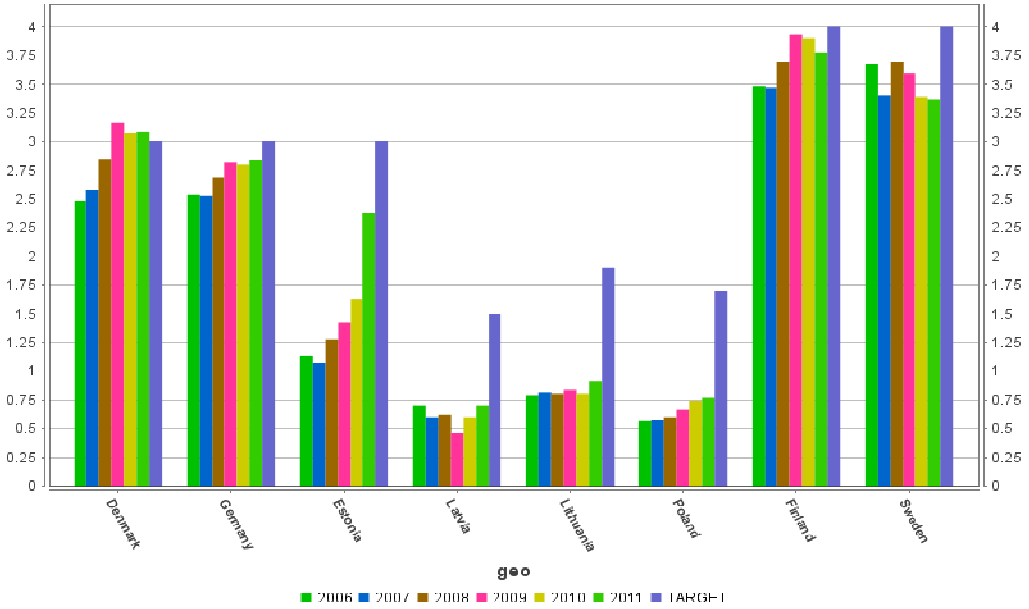


Figure 3 Gross domestic expenditure on R&D (% of GDP) Source: Eurostat

percentage points, is fourth. It is clear that these countries acknowledge the importance of research and development, and its role in sustainable and long term development. It can be clearly seen that these countries already meet the EU 2020 strategy set goal.

Estonia has showed a significant growth in R&D investment in the past 3 years. Country has almost doubled their in investment from 1,3 % in 2008 to 2,4 % in 2011 of the GDP showing the country`s commitment to achieve the goal of the EU 2020 strategy.

The three countries that are slightly behind in the BSR are Lithuania, Latvia and Poland, where in 2011 Lithuania invested 0,9 %, Latvia 0,7 %, Poland 0,77 %. However, these countries have a lower target set for 2020 and they are showing their commitment to achieve it. In the 1st graph the chapter "objective" reflects a part of the GDP what is planned by every BJR country to be achieved PA. The only country

reaching the exceeding the objective by 2010 was Denmark. It is believed to be due to the plan approved in 2005 which provided determined investments in both governmental and private sectors.

5.3. Specialization areas in the BSR countries

It has been emphasized in the EU 2020 strategy that sustainable growth of the region is critical for future development. Therefore it is necessary to utilize resources efficiently and leverage key knowledge and competences within the each member state. All countries in the EU have developed the planning documents and policies to set a roadmap for defining each specialization areas to focus financial and human resources on. Further on a snapshot of each BSR country specialization areas will be defined.

Denmark[7]

In Denmark the private sector is the main R&D performer, and in 2008 it accounted for 70 % of the total R&D activity. The main public research performers are concentrated in the university system. The majority of universities have a broad range of faculties and specializations. In 2007 additional 15 government research institutes were merged in order to strengthen research quality and reduce the fragmentation of the research system.

[7] Erawatch country report Denmark, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/dk/report_0005

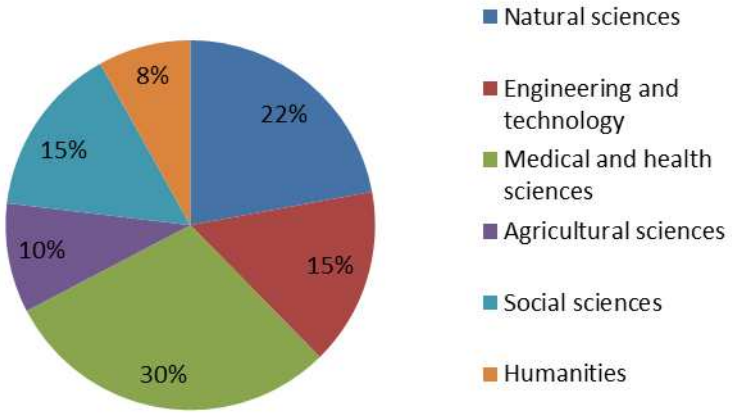


Figure 4 Total intramural R&D expenditure (GERD) by public sector and fields of science in Denmark in 2010. Source: Eurostat

However, through the assessment of policies and strategic documents it has not been identified that specific research and development specialization areas are defined by the government, but it can be seen from the expenditures that emphases are put on natural sciences and medical and health sciences.

Estonia[8]

The innovation system in Estonia was developed in the beginning of the 21st century, and has been continuing to evolve to currently become an innovation follower. Smart allocation of resources and flexibility to global changes has allowed achieving significant progress in moving towards a knowledge intensive economy. Currently the innovation and the R&D system is financed from three main sources, i.e. national financing, structural funds and private funding. Currently there are no public-private partnerships set up to foster the R&D and innovation development. As mentioned earlier, Estonia invested more than 2% of GDP in R&D and innovation in 2011, these resources are allocated to three main strategic areas, i.e.:

- Biotechnology;
- Material technology;
- Information and communication technology.

[8] Erawatch country report Estonia, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/ee/report_0006

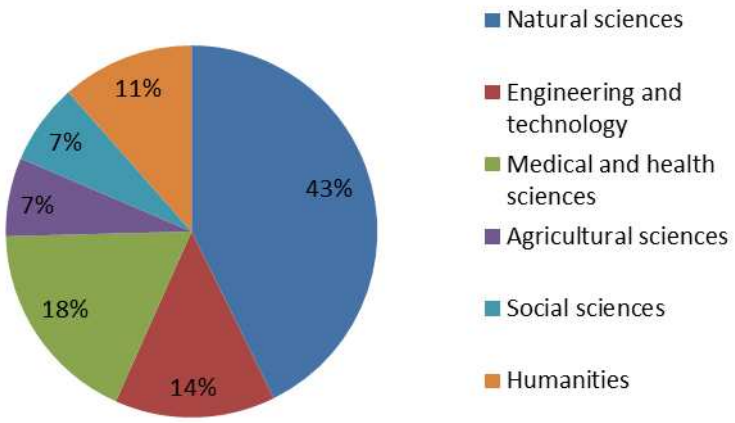


Figure 5 Total intramural R&D expenditure (GERD) by public sector and fields of science in Estonia in 2010. Source: Eurostat

These areas are selected to improve existing technologies, develop new ones, and overall have a significant effect on the countries` growth. As can be seen from the chart below that 75 % of all public money is targeted towards the three strategic areas, indicating that the set policies and strategies are actually implemented and followed.

Latvia[9]

The national innovation system in Latvia in comparison to other countries is mainly driven by the governmental sector, and private investment in the R&D is very low. There is basically no cooperation between the public research institutes, universities and enterprises. The current policy mix is aiming to solve these issues and stimulate the collaboration between the private and public sectors to drive innovation and become a more knowledge intensive economy. It is regulated by the Law on Research Activity meaning, hat the government needs to define a set of research priorities every four years that would serve as a basis for financial resources allocation. For period 2010 – 2013 the following priorities have been approved:

- Energy and the environment;
- Innovative materials and technologies;
- National identity;
- Public health;
- Sustainable use of the local resources.

[9] Erawatch country report Latvia, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/lv/report_0005

The data analysed from *the Eurostat* show that most resources are invested in natural sciences, engineering and technology, and agriculture sciences. It is hard to track the correlation between financial resources allocation and set policy documents, mainly because the strategic priorities are very broadly and vaguely defined.

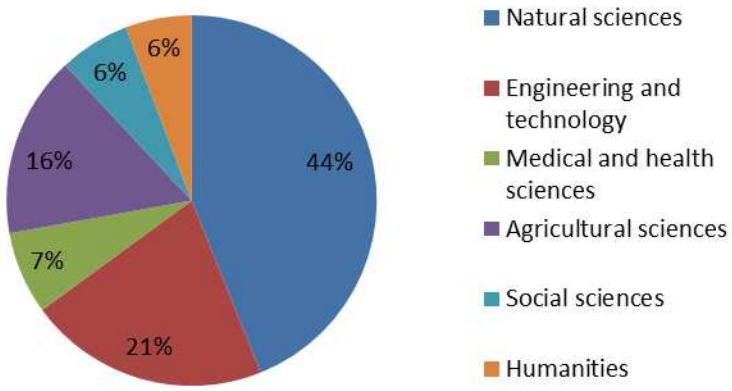


Figure 6 Total intramural R&D expenditure (GERD) by public sector and fields of science in Latvia in 2010. Source: Eurostat

Lithuania[10]

In order to maximize the country`s investment in the field of R&D and innovation the government drafted a resolution in 2008 to establish five integrated centres ('valleys') of science, studies and business. The aim is to consolidate the potential of scientific research, studies and knowledge intensive business. It is planned that such structuration will drive significantly the movement of Lithuania towards more knowledge based economy, improve the overall conditions for research in biomedicine, physical sciences and technologies, as well as enable cooperation between academic research institutions and industry. It is planned that EUR 300 m will be used to strengthen the five leading research infrastructures specifically, which will result in creation of valleys focusing on different specialization areas:

- "Sauletekis" valley – located in Vilnius and specialize in laser technologies and material science;
- "Santara" valley – located in Vilnius and specializes in biomedical research;
- "Santaka" valley – located in Kaunas and specializes in material science, chemistry and mechatronics;

[10] Erawatch country report Lithuania, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/lt/report_0006

- "Nemunas" – located in Kaunas region and specializes in agro-science;
- Integrated Marine Science and Industry centre in Klaipeda region.

Analyses of the government financial resource allocation to different fields of science show that 50 % of the budget is allocated to the natural sciences, engineering and technology. The rest of the resources are spread out quite evenly, indicating the focus on the valley strategy.

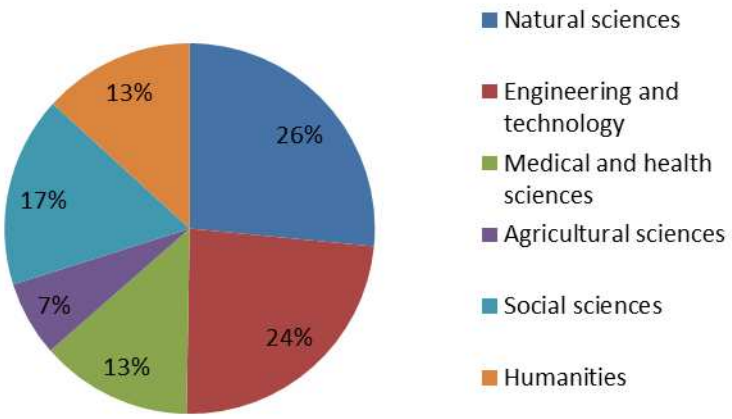


Figure 7 Total intramural R&D expenditure (GERD) by public sector and fields of science in Lithuania in 2010. Source: Eurostat

Poland[11]

Up to now the investments of Poland in R&D have been quite moderate taking into account that it is one of the biggest countries in the EU. However, the country has taken significant steps towards reforming their R&D landscape. The government introduced five new legal acts in 2010 that will be used as a framework for the development of the knowledge base in the country both, in the private and public sectors. Poland is one of the countries where the budget for science is not prioritised towards specific research areas, and hinders the predictability and long term planning of research investments. However, currently the implementation of *Build upon Knowledge* reform is focusing to develop specific multiannual research programmes and strategic areas. In 2010 the government announced the programme (National Programme for the Development of Humanities), which was the first long term thematic funding in public research policy. The five research priorities are:

- Society and security;
- Accelerated and sustainable socio-economic development;

[11] Erawatch country report Poland, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/pl/report_0007

- Health, energy and infrastructure;
- Modern technologies for the economy;
- Agriculture and environment.

Although the government has identified five research priorities, the resource allocation shows a slightly different picture, where it is dominated mainly by natural science, engineering and technology scientific fields (66 % of all expenditure on R&D). This might indicate that policy documents have just a slight impact on resource allocation.

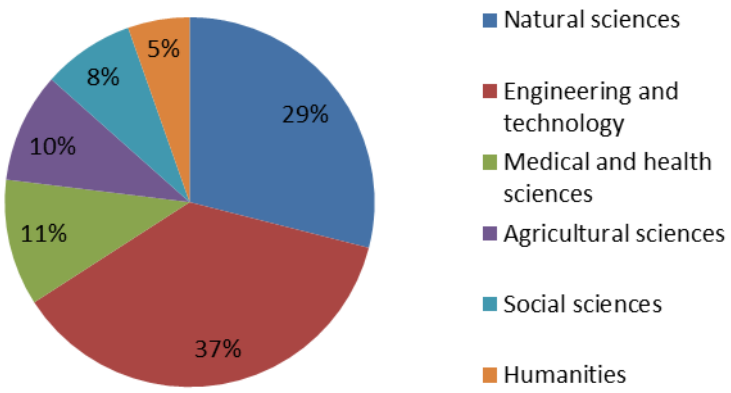


Figure 8 Total intramural R&D expenditure (GERD) by public sector and fields of science in Poland in 2010. Source: Eurostat

Finland[12]

Research, innovation and general education policies are experiencing a rapid change to face the challenges of globalisation, ageing, environment and public health. Finland has been restructuring their research and higher education strategy to focus more on internationalization, i.e. broader university and R&D collaborations worldwide. The approach of knowledge triangle has been very well established in Finland, and practically supports the interconnection among education, research and innovation. Overall Finland has significant confidence in their R&D activities. Financial (EUR 7.2 b in 2011) and human resources are allocated to develop all the necessary policies to foster and support further evolvement of knowledge based economy. One of the Finnish innovation systems` funding body *Tekes* has identified the six focus areas:

[12] Erawatch country report Finland, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/fi/report_0005

- Natural resources and sustainable economy
- Intelligent environments
- Vitality of people
- Business in global value networks
- Value creation based on service solutions and intangible assets
- Renewing services and production by digital means.

In total *Tekes* grants EUR 600 m annually, out of which 50 % are allocated to non-specific areas and the other above-mentioned focused areas. It is not specified how the finances are allocated to specific focus areas. However, it is clear that the funding is used for overall innovation system support and development. Additionally, Finland has developed six strategic centres to support science, technology and innovation. The centres are Forest Cluster, Information and communication industry and services, Metal products and mechanical engineering, Energy and the environment, Built environment innovations and Health and well-being.

As can be seen from the chart below, most of the government funding is spread out over different scientific fields, therefore clearly supporting the set forth innovation and R&D policies.

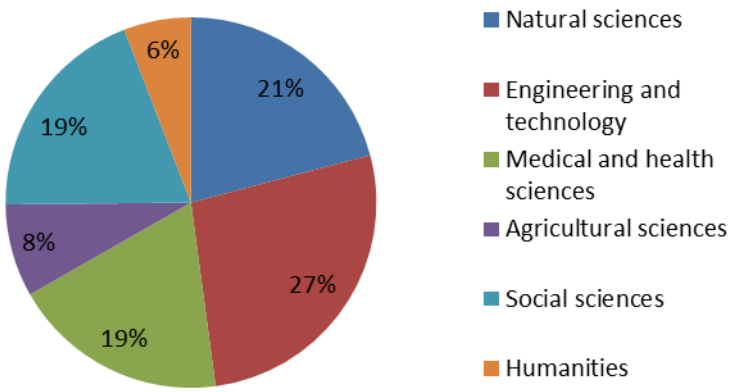


Figure 9 Total intramural R&D expenditure (GERD) by public sector and fields of science in Finland in 2010. Source: Eurostat

Germany[13]

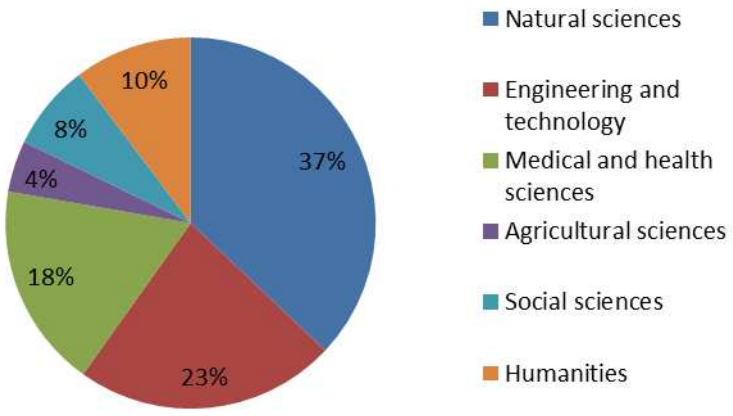
The country has the largest research system in the EU and it is mainly driven by the private sector, which performed two-thirds of the total R&D activity. To stimulate a further development of country and innovation, the policy plays the major role; therefore, it has introduced a High-Tech Strategy to make the country a pioneering force in solving global challenges. The strategy sets forth five major priorities:

- Climate change and energy;
- Health and nutrition;
- Mobility;
- Security;
- Communication.

Within the each priority the scientific, technological and social objectives are defined over a period of ten to fifteen years. Additionally the R&D&I policy has defined key the following priorities:

- Keeping pace with the global technology trends;
- Providing funding for public and private R&D and keeping research excellence at the top international level
- Maintenance and further improvement of the industry-science link;
- Investing in education to strengthen the education sector and to provide a qualified labour.

All the priorities set forth have remained stable since their implementation allowing companies and research organizations to pursue long-term oriented goals.



[13] Erawatch country report Germany, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/de/report_0009

Figure 10 Total intramural R&D expenditure (GERD) by public sector and fields of science in Germany in 2010. Source: Eurostat

Sweden[14]

Currently the policy mix in Sweden promotes private investment in R&D, apart from fostering private investment the government has invested in strategic research areas EUR 121 m on a yearly basis. The strategic investments aim is twofold: firstly, to build a number of world class research environments in research areas that have been specifically selected due to their strong strategic importance for society development, secondly, to raise the research quality, improve conditions for commercialization, encourage cross disciplinary scientific approaches and increase opportunities for the system to use the EU funding more efficiently.

Overall Sweden has identified 20 strategic research areas. It can be seen that the areas where the funding is allocated mostly, are clearly related to society well-being, development and security. Apart from the other BSR countries`, the data in relation to government expenditures on different scientific fields of performance were available only for higher education sector, and in 2009.

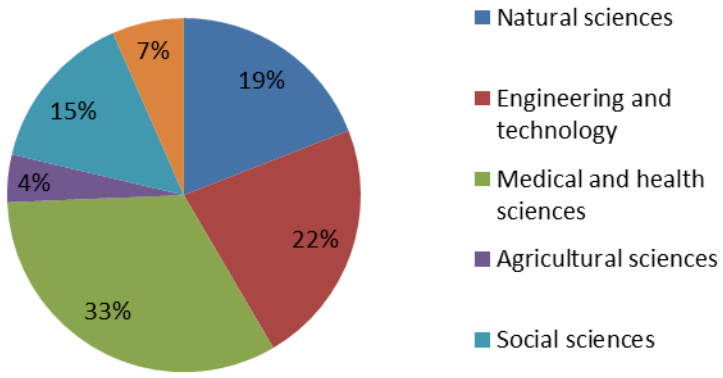


Figure 11 Total intramural R&D expenditure (GERD) by Higher education sector and fields of science in Sweden in 2009. Source: Eurostat

SUMMARY

The BSR is less active on the whole EU background, because with the exception of Germany, it does not fit into the "Big Four" – France, Italy, the United Kingdom and Germany. If Sweden, Finland and Denmark

[14]Erawatch country report Sweden, 2011; Available at: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/countries/se/report_0006

have a certain level of cooperation with the four mentioned scientific super powers, the Baltics and Poland do significantly less.

Typically, the Nordic countries and Germany see science as a sector by developing, which, one can get income and enhance the national prosperity. Thus, the private institutions have a big importance, the same as and their willingness to invest in the R&D and defining strategic targets in science, state or any organisation, choosing the primary field. This choice can be largely done, basing on the calculations about the financial convenience of the chosen area. On the one hand, such approach can be observed less in Baltics and Poland, on the other hand, Lithuania and Poland invest considerably to develop the R&D. Also, there is the Science and Technology Park in Tartu, Estonia, which is working on the implementation of technological innovations.

6. LARGE SCALE INFRASTRUCTURE IN THE BSR

The purpose of this chapter is to identify leading research centres in each of the BSR countries - Denmark, Estonia, Latvia, Lithuania, Poland, Finland, Germany and Sweden. Germany focuses on one certain regions: Hamburg, Mecklenburg - Vorpormern, Schleswig-Holstein, Berlin and Brandenburg. Research centres are selected in accordance to three criteria: the budget of the establishment, the number of publications and the number of employees. At least five centres are selected from each country. Information about the research centres is summarized in accordance with the requirements of the first and second tender under the project "Science-Link". One of the objectives of the research is to define the specialization of the research centres and compliance of their offered services with the “Science Link” tender results. The scientific infrastructures located in the Nordic countries and Germany are greater and also more diverse in the offer to the industry.Sometimes among the collaboration partners of the research centres of these countries, global enterprises – the leaders in their filed- can be found. It is essentially,that unlike the Baltic and Poland research centres, they sometimes have people whose job is to attract, and agree with the potentional industrial partner about collaboration, while in Baltics and Poland usually a little or not at all even theoretical cooperation with industry is mentioned. In other words, the research centres located in Denmark, Finlang Germany and Sweden express a bigger interest, readiness and ability to satisfy even a very large industry tender. Another characteristics – the Nordic states` research centres are more oriented towards the development of advanced technologies – ICT (Information and communication technologies), biotechnology.

6.1. Denmark

Among the BSR countries Denmark distinguishes with its science centres` intense addressing of different new technologies, for example, biotechnologies, nanotechnologies, and their use in different fields. In comparison with other region countries, the research centres in Denmark have a bigger budget, institutions of higher education where a part of the research centres is located, and which take a high place in the world rankings of university quality assessment. Besides, the Danish research centres have a large cooperation with the industry, which they want to develop further on. This fact can be proven by the contacts of the structural units or employees found on the home pages of the research centres testify, their duty is to conclude agreements with the enterprises on industrial collaboration, as well as the university announcements and stimuli to get in touch with them. Thus, the research centres make no secret of the fact that the research itself can largely take place only in cooperation with the industry – with its support and interest. One of the most well-known life science, pharmacy and biotechnology research institution groups "Medicon Valley" is located exactly in Eastern Denmark, as well as Western Sweden.

The Technical University of Denmark[15] [16]

Research interests: nanotechnology, chemistry, food science, physics, different types of engineering.

Atructural units: Chemical and Biochemical Department, Department of Department, Department of Civil Engineering, Department of Electrical Engineering, Department of Environment, the National Food Institute, Department of Photon Engineering, Department of Micro and Nanotechnologies, Department of Physics.

Budget (2011): 568,9 million EUR

Publications (2011): no information available

Personnel: 1684

Industrial cooperation: The Technical University of Denmark (DTU) indicates that it is ready to cooperate with companies, for example, giving them advice, launching a joint, new business, creating innovations and helping to improve the qualifications of employees.

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[15] http://www.dtu.dk/English.aspx DTU website

[16] http://www.dtu.dk/upload/english/about_dtu/dtu_in_profile/131185%20dtu_2012_uk_web.pdf DTU 2010 Annual report

In addition, also real examples of collaboration have been mentioned in different types of engineering, environmental and resource usage in the field and other sectors. In collaboration with one of the of Denmark administrative region governance, the DTU researchers have sought biological and chemical methods of cleaning to protect groundwater.

The Danish Technological Institute[17] [18]

Research interests: construction, chemistry and biotechnologies, energy, transport and logistics, environment, food technologies, industrial production, microtechnologies.

Structural units: Department of Building, Denmark Institute of meat research, Departments of life sciences, Departments of materials.

Budget (2011): 131,6 million EUR

Publications: no information available

Personnel (2010): 959 employees

Industrial cooperation: There is collaboration with enterprises in every operation sphere of the DTI – food technologies, environment. The institute is a non-profit organization with its goal of promoting the technology-based knowledge in the business of Danish and international business. The institute create new technologies itself and tries to implement them in society, as well as offer advice and do laboratory researches. Similarly to other Danish research establishments also DTI emphasizes that it has already had joint projects with entrepreneurs.

The University of Copenhagen[19]

Research interests: Environment sciences, including environment chemistry, genetics, microbiology, biochemistry, biomolecular sciences, citology, neurobiology, bionano science, chemical biology, food science, forest, biomass and bioenergy, nanobio science and biophysics, a.o.

Structural units: Department of Biology, Department of Chemistry, Department of Food Science, Niels Bohr Institute, Department of Plants and Environmental Sciences, Department of Food and Resource economy Nono Science Centre, a.o.

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[17] http://www.dti.dk/ DTI website

[18] http://www.dti.dk/annual-report-2011/32150 DTI 2011 Annual report

[19] http://www.ku.dk/english/ Copenhagen University home page

Budget (2011): 1 046 billion EUR

Publications (2010): 8188

Personnel: no information available

Industrial cooperation: The University of Copenhagen similarly to the Danish universities collaborate with both, the enterprises and other universities or research centres. The fields included in the project "Science Link" have been examined in the Faculty*of Science*), where all the mentioned departments and other structural units can be found. The University of Copenhagen points out that it is ready for industrial cooperation, giving an example of the food science, where there are more than 40 scientific and industrial partners in the project „Pathogen Combat for Safe Food", including the enterprises from Denmark „Bactoforce", Ltd., Cyprus - „Pittas Dairy Industry", Germany – „Biomax Informatics AG" , a.o.

The University of Aalborg[20] [21]

Research interests: chemistry, chemicals, biotechnologies, energy, physics, nanotechnologies, electronics, civil engineering.

Departments: the fields included in the project "Science Link" are found under the supervision of the Faculty of Engineering and Science. They are examined by more than 10 different departments: Department of Biotechnology, Department of Chemistry and Environmental Engineering, Department Civil Engineering, the Department of Electronic Systems, Department of Energy Technology, Department of Physics and Nanotechnologies, a.o.

Budget (2011): 318 million EUR

Publications (2011): 3714

Personnel: 2850

[20] http://www.en.aau.dk/ Aalborg University home page

[21] http://www.okonomi.aau.dk/digitalAssets/51/51948_--r2011-eng-10--udkast-af-20--juli-2012---komprimeret.pdf Aalborg University report 2011

Industrial cooperation: the University of Aalborg (OU) highlights that in recent years the cooperation with industry has increased. This is reflected by the increase in revenue from this collaboration in comparison with 2010 and 2011, by 13%, reaching approximately 58 million EUR.

Also, the OU calls the entrepreneurs to cooperate in various ways: to let the students collaborate with the industry, write their dissertation, offer advice and implement joint projects. Like other Danish study centres, also OU illustrates the real examples of collaboration, including the jointly implemented energy project"EnergyVision.dk" or the project "BioMed Community" which is implemented by the collaboration among many companies and institutions in biomedical engineering. The aim of the latter of these projects is to create new companies in this field, which would also strengthen the existing fields by the collaboration.

Aarhus University[22] [23]

Research interests: nanotechnologies, neurology - brain activity, microbiology, biogenesis and metabolism, material science, environment and energy, food science and agriculture, bioscience, computer science, agroecology, chemistry, engineering, environmental science, molecular biology and genetics.

Structural units: the Interdisciplinary Centre of Nanoresearch, DNA Nanotechnology Centre, Centre of Geomicrobiology, Centre for Materials Crystallography, , the Danish Centre for Environment and Energy, the Danish Centre for Food and Agriculture, the International Centre for Research in Organic Food Systems, etc.

Budžets (2011): 783 millions EUR

Publications: No information available

Personnel: 5970 (total amount of employees)

Budget (2011): 783 million EUR

Publication: no information available

Personnel: 5970 (the total number of employees)

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[22] http://www.au.dk/en/ Aarhus University home page

[23] http://www.au.dk/en/about/profile/publications/ Informative materials and 2011 report on AU

Industrial cooperation: AU has a large collaboration with the industry, which it is trying to highlight in its website, thus encouraging the enterprises to collaborate with the AU even more.

AU is mostly oriented towards the technical and natural sciences, as shown by both, the interests of departments and research centres and the listed examples of industrial cooperation.

For example, there has been collaboration with the with food producer "Arla Foods" in the research of milk content. Similarly to other Danish universities, AU stresses its interest in collaboration pointing out that it is a significant field in the operation of the university. Also, there are many well-known companies among the collaboration partners of the AU, including “Santaris Pharma”, “IceRobotics” a.o.

Statens Serum Institute[24]

Research interests: epidemiology, diagnosis, vaccination

Department: Clinical Biochemistry and Immunology Department, the Department of Epidemiological research, Microbiology and Infection Control Departments, etc.

Budget: 27, 08 million EUR

Publications: no information available

Personnel: no information available

Industrial cooperation: the Institute is willing to collaborate with biotechnology and pharmaceutical companies. The Institute stresses that, it is ready to engage both, with the licensing of new products, and the introduction of new technologies, as well as to participate in the new programs.

6.2. Estonia

Estimating, which of the project ”Science Link” listed fields the Estonian Universities and research centres

the most attention is paid, computer sciencem ICT, engineering fields move forward. Less, but also noticable fields are forestry, chemistry and physics.

There are areas which are researched little by the Estonian universities, such as nanotechnology. At the same time, the Estonian universities have pursued an active co-operation both in the academic and in several cases, industrial fields.

Estonian University of Life Sciences [25] [26]

[24] http://www.ssi.dk/English.aspx the Statens Serum Institute home page

Research interests: forestry, agriculture, environment, energy, engineering, ergonomics, agricultural engineering

Structural units: The Institute of Forestry and Agricultural Engineering, the Institute of Agricultural and Environmental Sciences, College of Technology, Institute of Technology

Budget (2010): 23.88 million EUR

Publications (2012): no information available

Personnel: 961 (academic and administrative -396-565)

Industrial collaboration: the Estonian University of Life Sciences is collaborating with other research centres, and participating in various international projects. There is no information on industrial cooperation, however.

The Tallinn University of Technology [27]

Research interests: civil engineering, electrical engineering, ICT, chemistry and biotechnology, environment, mathematics and physics, materials science and technologies, mechanical and instrument engineering.

Structural units: the Faculty of Civil Engineering, Faculty of Chemical and Material Technology, Faculty of IT, Faculty of Transport and Mechanical Engineering, Faculty of Natural Sciences.

Budget: 76.5 million EUR (around 26 million EUR for projects)

Publications (2012): 1830

Personnel: 2136

Industrial cooperation: The Tallinn University of Technology (TUT) is ready to cooperate with companies in fields that correspond to its specifics. In 2012 The TUT concluded 321 contracts for different types of services or consulting for both, private and public sector, for EUR 8.1 million in total. TUT has also an extensive academic cooperation with the universities and research centres around the world, including the Silicon Valley in the U.S., China, Japan, South Korea, and many countries in Europe and elsewhere.

The Tallin University Institute of Informatics) [28]

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[25] https://www.emu.ee/en/ Estonian University of Life Sciences home page
[26] Ibid

[27] http://www.ttu.ee/en Tallinn University of Technology home page

Research interests: implementing new generation - e - learning methods, self-learning in hybrid environment, making a variety of pedagogical manufacturing applications and creation of other educational programs and methods in computer environment.

Budget and investments: no information available

Publications: no information available

Personnel: no information available

Industrial collaboration: academic cooperation with the scientific centres takes place from more than 20 countries. With the financial support of the Estonian State and the European Union funds, a number of projects have been created. The Projects and studies have mostly taken place in informatics or Computer Science. However, there is no indication, that the potential industry partners can cooperate with the Institute of Informatics.

Faculty of Science and Technology at the University of Tartu[29] [30]

Research interests: Inorganic chemistry, organic chemistry, environmental chemistry, material science, botany, bio-informatics, technologies of language, programming technologies, information security, material science, laser physics, plasma physics, theoretical physics, biophysics, environmental physics, environmental technologies, information technology, materials and chemistry technology

Structural units: Institute of Chemistry (149), Institute of Ecology and Earth Sciences, Institute of Molecular and Cell Biology, Institute of Physics, Institute of Technology (46), the Estonian Marine Institute, Science Education Centre (15)

Budget (2008): 27 million (the University of Tartu overall budget - 145, 9 million EUR – in 2012)

Publications: no information available

Personnel: Scientific personnel is known only in the Institute of Chemistry, Institute of Technology and Science Education Centre – 210 employees in total (in total in the university 3800 – in 2012)

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[28] http://www.tlu.ee/?LangID=2&CatID=3215 The Institute Informatics home page

[29] http://www.ut.ee/en The University of Tartuhome page

[30] http://www.lote.ut.ee/index.aw/set_lang_id=2 The University of Tartu Faculty of Science and Technology home page

Industrial collaboration: Faculties are involved in many projects outside Estonia, and they have cooperation with the research centres from other countries all around the world. Industrial cooperation is offered in accordance with the Institute's research interests.

Faculty of Mathematics and Computer Science at the University of Tartu[31] [32]

Research interests: language technologies, programming technology, information security,

Budget and investment: the total budget of the Tartu University - 145.9 millions EUR (2012).

Publications: No information available

Personnel (2012): in total at the university - 3800

Industrial collaboration: a wide academic cooperation with various research centres both, in Estonia and abroad. At the same time, the Institute is also involved in industrial cooperation, such as for example, the Institute of Computer Science, along with nine academic and three industrial partners has involved in cancer research. Overall, the Tartu University Institute offers collaboration in many areas: manufacturing household robots, health care. Among the business partners there is "Skype", "Zero Turnaround", "Cybernetica".

6.3. Latvia

The research centres of Latvia focus relatively more on physics, chemistry, energy, and other natural science study exploration. On the one hand, research centres, in comparison to the Nordic States, cooperate a little with the industrial partners, and the academic institutions can be found among the collaboration partners the most. It is possible that the research centres themselves do not report about it. For example, the University of Latvia, Institute of Solid State Physics recognizes that it does not have a collaboration with industrial, but only with research partners.[33] But on the other hand, the scientific infrastructure of Latvia is competitive in several narrower industries. For example, the University of Latvia (LU) Institute of Physics, the specific processes can be performed by the liquid metal technologies, one of the few in Europe, while in the Institute of Solid State Physics of the LU there is a set of equipment for

[31] http://www.ut.ee/en The University of Tartu home page

[32] http://www.ut.ee/en/research/research-university-tartu University of Tartu Faculty of Mathematics and Computer Science home page

[33] ISSP computerized response format

nanomaterials research, and so on.[34] However, not all of them correspond to the fields the project "Science Link" is interested in. The Latvian companies prevail among the industrial partners.

The Institute of Physical Energy[35] [36]

Research interests: regional energy sector analysis and optimization, energy conservation, energy and environmental researches, renewable energy resources, energy efficiency and fossil energy technologies, electrical appliances and machinery, a.o.

Structural units: Laboratory of energy resources, modern material and technology laboratory, Electromagnetic process modelling, Laboratory energy system analysis and optimization, Laboratory of energy resources, energy efficiency centre, electric power system simulation laboratory, a.o.

Budget and investments(2011): 2,8 million EUR

Publications (2011): 57

Personnel: no information available

Industrial collaboration: The Institute has participated in various international researches, but it has also had cooperation with Latvian companies such as LTD "GroGlas" and Ltd. "Ekogaze". For the potential collaboration partners the Institute offers services in energy research. At the same time, there has not been any cooperation with Latvian and foreign universities.

Institute of Electronics and Computer Science[37]

Research interests: computer science, communications, information, electronic technologies, innovative techniques of information, communication and signal processing technology, intelligent integrated data collection, processing and transmission systems.

Budget and investment: 1.5 million EUR

Publications (2011): 38

Personnel: 90

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[34] LIDA computerized response format

[35] http://www.innovation.lv/fei/The Institute of Physical Energetics home page

[36] http://www.innovation.lv/fei/Projects/FEI_gada_2011.pdf The Institute of Physical Energetics year 2011 report

[37] http://www.edi.lv/lv/aktualitates/ Ltd Electronics and Computer Science Website

Industrial cooperation: The Institute has an extensive collaboration with research centres in Latvia and in the world. For the potential industrial partners the institute offers services and research performance in the following areas: transformed time signal processing, image processing, and a variety of other services.

The Latvian Biomedical Research and Study Centre [38] [39]

Research interests: human technology, recombinant biotechnology, molecular virology, cancer research, infection disease epidemiology, molecular pharmacology, stem cells, structural biology.

Budget and investments: 2.5 million EUR

Publications (2011): 38

Personnel: 165 employees: 31 senior researcher, 27 researchers, 56 assistant researchers and 51 employees of technical and support personnel.

Industrial cooperation: There is a cooperation with the universities in the USA and Sweden. There has been a collaboration with the US company "ViroGen Corporation". Under the shelter of the institute a several enterprises operate: Ltd. "Genera", Ltd. ”ASLA Biotech" and Ltd. ”Cilmes šūnu tehnoloģijas". The institute performs most of its researches with the help of the capital of the EU funds. The institute offers cooperation in fundamental and applied research in molecular microbiology, vaccine development, cell biology, genomics and proteomics, cancer biology, immunology, structural biology, and other directions.

The Latvian Institute of Organic Synthesis[40]

Research interests: the construction of medicine substances, pharmacology and biology, clinical researches, new organic synthesis technology uses, analytical support.

Budget and investment: 7 million EUR

Publications: 8775 publications, owns 200 patents together with its partners

Personnel: 312

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[38] http://biomed.lu.lv/lv/ Latvian Biomedical Research and Study Centre website

[39] Ibid

[40] http://www.osi.lv/ Latvian Institute of Organic Synthesis home page

Industrial cooperation: works together with other research centres. It has partners in Italy. The institute largely performs its researches by the EU funds capital.

Institute of Solid State Physics [41]

Research interests: Electronic and ion processes in band gap materials with different degree of consistency in the structure; inorganic materials – monocrystal, pottery, glass, the surface of nanostructured surface layers for optics, electronics and renewable energy; multi-purpose, hybrid and organic materials for photovoltaic elements, solar battery coatings, hydrogen storage, fuel cells, light issuing diodes (LED, OLED), organic electronics and photonics; Scientific instruments, analytical devices and sensors for environmental monitoring; Vision science, new technologies for psycho-physical research and vision care technology.

Structural units: Department of Crystal and Optoelectric Materials, Department of Semiconductor Materials, Laboratory of Radioelectronic Engineering, Department of Photonics Materials, Department of Theoretical Physics and Computer Modeling, Department of Ferroelectrics, Laboratory of Radiation Physics

Budget and investment : (2011): 3.9 million EUR

Publications (2011) :143

Personnel : 153

Industrial cooperation: the Research Institute takes part more than only in conferences, and it has begun cooperation with other foreign centres. However, the Solid State Institute has also had collaboration partners: Ltd "GroGlas", Plc. ”Sidrabe”, Ltd. “AlarmLat "and Plc. “Latvijas Kuģniecība”,and other companies. The Institute has not indicated exactly, what kind of services it would be ready to be provided to the potential collaboration partners.

University of Latvia, Institute of Physics[42]

Research Interest: magnetohydrodynamics, liquid metals, electromagnetic fields, hydrodynamics, electrodynamics, semiconductor-crystal cultivation in the magnetic fields, and others.

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[41] http://www.cfi.lu.lv/ Latvian Institute of Solid State Physics website

[42] http://ipul.lv/main/index_lat.html?nav=About_lv The University of Latvia Institute of Physics home page

Budget and Investments: 996 000 euro

Publications: 60 publications since 1965, and since 2001 "Magnetohydrodynamics" magazine issued in English.

Personnel: the academic personnel of 60 persons

Industrial collaboration: the institute emphasizes the importance of research in fields such as metallurgy, cultivation of semiconductor-crystals, medicine and nano-technologies. The institute highlights its being as one of the world's leading centers in the magnetohydrodynamic field owning unique experimental liquid metal plants. The institute is being involved in various researches sponsored by the European Regional Development Fund.

The Institute of Mathematics and Informatics Institute (LU)[43]

Research interests: computer science mathematical basics, complex system design methods and tools, graph theory and visual information processing, semantic Web technologies, computer linguistics, bioinformatics, real-time systems, computer networks and "Grid" technologies, mathematical modelling in technique and the natural sciences, theoretical research of mathematical methods and development of the e-infrastructure.

Budget and investments (2011): 4,3 million EUR

Publications (2011): 155

Personnel: 200

Industrial cooperation: The Institute has an extensive collaboration in the Latvian and international scale. The Institute has implemented projects within the international frameworks, as well as in collaboration with other state universities. At the same time it holds experience in collaboration with many companies, commercializing the scientific work results. Among the partners there are such companies as LTD “ZZ Dats”, “Lattelecom Technology”, Ltd. “Datorikas institūts”, “Baltijas Datoru akadēmija”, Ltd. “Tieto Enator”,and many other companies operating in Latvia.

[43] http://www.lumii.lv/ The University of Latvia Institute of Mathematics and Computer Science (IMCS LU) home page

The Institute of Food safety, Animal health and Environment science [44]

Research interests: pathological, histological, clinically morphological and biochemical tests, zoo-genic tests, examinations of animal feed, milk, various secretions, bees.

Budget and investments (2011): 790 000 EUR

Publications (since 2003): 165

Personnel: 100, out of them 50 - scientific personnel

Industrial cooperation: cooperation with research centres abroad, such as ones in Kazakhstan. Similarly, the Institute participates in preparation of various conferences. Information on business cooperation, however, is not available.. However, the Institute offers to perform laboratory tests, and also tests a variety of materials.

The Institute of Polymer mechanics [45] [46]

Research interests: research of deformation processes, including long-term ones research, research materials, mechanical integrity, engineering applications of composite materials and construction, calculations of composite materials design, impact of the external environmental factors on the mechanical properties of the material, physical methods in structure research in material mechanics, the long-term characteristics prediction methods, non-destructive test methods , composite material technology researches.

Budget and investments: 1,8 millions EUR

Publications (2011): 20

Personnel: scientific- 38

Industrial cooperation: cooperation with foreign research centres and universities, structured composites are made for the Latvian companies Ltd. "Primekss" and "Baltic Instruments". The Institute of Polymer Mechanics offers collaboration with other companies within its scope.

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[44] http://www.bior.gov.lv/lv The Institute of Food safety, Animal health and Environment science

[45] http://www.pmi.lv/New/LvInstituteAbout.html The Institute of Polymer mechanics home page

[46] Ibid

6.4. Lithuania

Currently, the strongest centres of the fields listed in the project "Science Link", are located in the Kaunas Technical University and Vilnius Gediminas Technical University. Both educational institutions are exploring many areas of interest of the „Science Link". Other Lithuanian research centres have already more specific and narrow interests. Probably, in the next years the strongest scientific infrastructure and its the most successful collaboration could take place in the five science and business valleys.

Similarly to Latvia, also Lithuania has to inform more broadly on the successful collaboration of the scientists and enterprises, as a result of which a new product has entered the market, as it happened as the result of the VU Institute of Biotechnologies and ”Thermo Fisher Scientific”.

It is planned that a considerable number of scientists and entrepreneurs till combine the efforts and knowledge, thus developing knowledge based entrepreneurship, and a greater entering of the innovations created in Lithuania in domestic and international markets.It is possible that similarly to Latvia, also Lithuania needs to inform closer about their successful collaboration of scientists andentrepreneurs, as a result of which, a new product has entered the market, as it happened as a result of the cooperation of the Vilnius University Institute of Biotechnology and ”Thermo Fisher Scientific” .[47]

Centre for Physical Sciences and Technology

Research interests: chemical technologies, electrochemical materials, material structure, organic chemistry, environmental research, laser technologies, nanoengineering, electrical engineering, optoelectronics.

Structural units: Institute of Chemistry, Institute of Physics, Institute of Semiconductor Physics

Budget and investment: no information available

Publications: No information available

Personnel: No information available

Industrial cooperation: Cooperation with industry center is named as one of its goals. However, no example of industrial cooperation is not shown, and also more detailed information on the potentional research partners has been given.

Kaunas University of Technology

[47] Univerity of Vilnius computerized response

Research interests: Biomedical diagnostic and monitoring systems and technologies, the application of mathematical methods in engineering and business, energy systems and component efficiency and reliability of electronic systems and the development of fundamental technical framework for modeling and automation, efficient construction materials, structures and technology, transport systems development, environmental protection, biomechanical systems analysis and design, advanced technology development and research, material and structure strength and sustainability, nanotechnology, mechatronics and mikromechannism systems, food safety and quality.

Structural units: Biomedical Engineering Institute, Food Institute, Information Technology Development Institute, Institute of Architecture and Civil Engineerin, Institute for Energy Technology, Institute of Environmental Engineering, Institute of Material Science, Institute of Synthetic Chemistry, Institute of Technological Systems Diagnostics, Microsystems and Nanotechnology Research Center, Mechatronics Research, Study and Information Centre.

Budget (2012): 197,7 million EUR

Publications: no information available

Personnel (2012): overall 3480, 1043 of which – academics

Industrial collaboration: Similarly to the universities in Denmark and other countries, and within the scale of research centers, also the many structural units, for example, the institutes, research centres, of the Kaunas University of Technology, offer their services. For example, the Food Institute offers food chemical, microbiological and sensor analysis.

Several institutes have already informed that they have experience in industrial cooperation, for example, the Institute of Energy Technologies has collaborated with AB "Lietuvos Energia", while the Institute of Material Science is collaborating with the IBM Research Center. However, there are also institutes that have not indicated, that they ave had collaboration with the industry. Many institutes have academic collaboration partners.

The university also calls the entrepreneurs to use the laboratory services and indicates, that it is ready to give advice or help in many areas: chemical technoies, environmental protection, information technology and other previously mentioned areas.

The Lithuanian Energy Institute [48] [49]

[48] http://www.lei.lt/index.php?k=9&i=0 Lithuanian Power institute home page

Research interests: different kinds of energetics: renewable energy resources, hidrology, energy technologies.

Budget (2011): 7,3 million EUR

Publications (2011): 199

Personnel: 310

Industrial cooperation: large scale cooperation with foreign country scientific centers and official institutions, to a lesser extent with industry.

For example, a joint project was implemented with the Austrian enterprise „KWI Consultants GmBH" several years ago.

The Centre of Semiconductor Technology [50] [51]

Research interests: semi-conductor technologies, nanotechnologies, optoelectronic devices, electronic devices.

Budget: no information available

Publications: no information available

Personnel: 150 employees

Industrial cooperation: the institution will be available within the Vilnius University structure, and will be included in the „Sauletekis" valley. One of the goals of the center will be industrial cooperation and research result transformation in commecial products.

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[49] http://www.lmt.lt/download/1367/2011_kelrodis_lmtik-b5-en-spreads.pdf Information on Semiconductor technology centre

[50] http://portal.meril.eu/converis-esf/publicweb/research_infrastructure/2982 Information on Semiconductor technology centre

[51] http://www.lmt.lt/download/1367/2011_kelrodis_lmtik-b5-en-spreads.pdf Information on Semiconductor technology centre

Vilnius Gediminas Technical University [52]

Research interests: experimental and theoretical environment research and technology environment protection, research of building materials, structures and technologies, automatization, electonic engineering, information systems engineering, computer engineering, nanostructures, material structure research, biotechnological process research, biosignal analysis and identification, innovation management and introducing into industrial enterprises, modern material research, building material resistance.

Departments: Environmental engineering faculty, Faculty of Electronics, Fundamental science research, Faculty of Mechanics, Faculty of Civil Engineering Faculty of Transport Engineering.

Budget (2012): no information available

Publicationa: approximately 100 yearly

Personnel (2012): 930 scientific personnel members

Industrial cooperation: the university has more than 200 cooperation partners in Lithuania. However, none is mentioned. The university is involved in different international projects, cooperation with research centres in foreign countries.

6.5. Poland

In comparison with other BSR countries, the specific peculiarity of Poland is the fact that the new research centres are opening, or are planning to open in future. They, the same as the most state-of-the-art Poland research centre ”Cezamat”, orient themselves towards the research of the new technologies and materials. Simultaneously the attention is paid to different kinds of engineering, but the sciences like food science or household good development are less common.

Gdansk University of Technology [53]

Research interests: chemistry, different kinds of engineering.

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[52] http://www.vgtu.lt/en Vilnius Gediminas Technical University home page

[53] http://www.pg.gda.pl/en/ Gdansk University of Technology home page

Structural units: Faculty of Chemistry, Faculty of Electronics, Telecommunications and Information Technology, Faculty of Electric and Control Engineering, Faculty of Civil and Environment Engineering, Faculty of Mechanical Engineering

Budget: no information available

Publications: no information available

Personnel: 2600 employees, (including academic personnel – 1200 employees)

Industrial cooperation: 280 concluded cooperation agreements with foreign research centers, as well as the industrial partners. The university has created a special section – Knowledge and Business centre, the aim of which is to unite scientists and entrepreneurs for a common cooperation. The University emphasizes that it is ready to help medium and small scale enterprises, but is currently collaborating with the Pomeranian Business tips, the Pomeranian special economic zone, and other partners. Also, the students can practice in the leading Pomeranian companies. The University offers its advice to companies, such as new product introduction, joint projects, the protection of intellectual property, and other services.

Koszalinas Tehnoloģiskā Universitāte (Koszalin University of Technology)[54]

Research interests: Nanotechnology, mechatronics, materials science, physics, various types of engineering

Departments: Department of Civil and Environmental Engineering, Department of Electronics and Computer Science, Institute of Technology and Education

Budget: no information available

Publications: no information available

Personnel: no information available

Industrial cooperation: The science and technology park operates within the University, the aim of which is to develop R&D, i.e., to find the University partners particularly in a small and medium business, where the enterpreneurs would agree to implement joint projects. There are more than 10 different centres of competence, specializing in one of the fields, for example, the Information Science Centre, the Electronics Centre, the Environmental Cngineering centre, a.o.

[54] http://www.tu.koszalin.pl/eng/civil.html Koszalinas Tehnoloģiskās universitātes home page

Cracow Unversity of Technology[55]

Research Interests: chemical engineering and technologies, civil engineering, electrical and computer engineering, environmental engineering, physics, mechanical engineering.

Departments: The Faculty of Chemical Engineering and Technologies, The Faculty of Civil Engineering, The Faculty of Environmental Engineering, The Faculty of Physics, The Faculty of IT and Mathematics.

Budget and Investments: no information

Publications: no information

Personnel: overall 2173, of which 1121 the academical personnel and 952 other employees.

Industrial collaboration: The CUT does not mention any particular example of industrial collaboration. Meanwhile pointing out various occasions of possible cooperation. It would be a corporal objective fulfilling of a mutual project, or an provision of a service which the University has already experienced. The collaboration can be formed as student internship in a particular company in which a student obtains practical skills and knowledge and has the opportunity to do the research paper, involving the analysis and research activities. Likewise other research centers of Polland and BJR countries, CUT has academic partnership all over the world.

The Center for Advanced Materials and Technologies "Cezamat" [56]

Research interests: modern latest generation materials and high-tech research and development.

Participants: "Cezamat" is set up of eight research centres: the Physical Chemistry Institute of the Polish Academy of Sciences, the Physics Institute of the Polish Academy of Sciences, the Fundamental technology Institute of the Polish Academy of Sciences, the Technology Institute of Electronic materials, the High Voltage Institute of the Polish Academy of Sciences, the Warsaw Institute of Technology, the Warsaw University, the Technology Mlitary University.

Budget: no information available

Publications: no information available

Personnel: no information available

Industrial cooperation: the cooperation promotion with the industry to contribute to the Poland country and business development in high-tech field is set as one of the most important goals emphasized by

[55] http://www.en.pk.edu.pl/ Krakovas Universitātes mājas lapa

[56] http://www.cezamat.eu/index.php?lang=en "Cezamat" Centre for Advanced Materials and Technologies

„Cezamat”. This is the largest R&D project in the Poland history so far. „Cezamat” is ready to cooperate in accordance with its research interests.

The National Synchrotron Radiation Centre "Solaris" [57] [58]

Research interests: the research of light and high energy synchrotrons-electrons

Budget: 40 million EUR

Publications: no information available

Personnel: no information available

Industrial cooperation: It is expected that the Centre "Solaris" will start its work at the end of 2014. It is also expected that the construction of the center will be one of the largest construction projects in the last 10 years in Poland. Its construction is happening in a close co-operation with the MAX laboratory in Sweden. Other partners include the "Swiss light source", ELETTRA and ALBA. Is has not entered into partnership with the industry, however, it is planned that the centre will be able to provide services in such areas as chemicals, packaging production, life and many other areas. The center will also offer to perform product tests.

The University of Warmia and Mazury in Olsztyn[59]

Research interests: agriculture, engineering.

Structural units: The Faculty of Animals and Bioengineering, The Faculty of Environment Management and Agriculture, the Faculty of Technical Sciences, the Faculty of Environment Sciences, the Faculty of Biology and Biotechnology, the Faculty of Forest Sciences, the Centre of Renewable Energy Research, the Centre of Milk Technology research and development, Organic and Traditional Food Research Rentre.

Budget: no information available

Publications: no information available

Personnel: 3300 employees (2000 - the Academic Personnel)

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[57] http://www.wayforlight.eu/eng/synchrotrons/solaris.aspx Information on National Synchrotron radiation centre „Solaris"

[58] http://www.synchrotron.uj.edu.pl/aktualnosci?p_p_id=56_INSTANCE_Zo55&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-_3&p_p_col_pos=1&p_p_col_count=2&groupId=3863852&articleId=3894544 Information on National Synchrotron radiation centre „Solaris"

[59] http://www.uwm.edu.pl/en/ The University of Warmia and Mazury home page

Industrial cooperation: The University is engaged in the activity of five clusters: Cluster Ketrzyn, Ecoenergy Baltic cluster, Brewery cluster, Milk cluster and Varmia and Mazury cluster "Warmer Together".

The Warsaw University projectsCeNT II un CeNT III:

• *University of Warsaw Biological and Chemical Research Centre*[60]

• *„Centre of New Technologies Ochota University of Warsaw”* [61]

Research interests: The research interests of the new technology center 'Ochota' (hereinafter CeNT II) are biology, biotechnology, chemistry, physics, computer science, mathematics, environment protection and chemistry technologies, new materials.

The Biology and Chemistry Center (hereinafter CeNT III) has selected its target - the interdisciplinary joining of the two sectors – chemistry and biology. Thus, the centre will focus on following areas: biotechnologies, chemical and biotechnologies, environment monitoring, and technology protection, as well as pharmaceutical, medical and energy technologies.

Budget: EUR 70,55 million are invested in the CeNT III development and reorganization

Publications: no information available

Personnel: no information available

Industrial cooperation: the priority of the both centres is cooperation with the industry, therefore improving the economic

Warsaw University of Technology [62]

Research interests: Chemical technology, biotechnology, biomedical engineering, automation and robotics, electrical and computer engineering, chemicals and their processes, civil engineering, materials engineering, environmental engineering, mathematics, power engineering, biocybernetics, biomedical engineering, mechanics, transport.

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[60] http://www.cent3.uw.edu.pl/ The Warsaw University Biological and Chemical Research Centre (CENT III) home page

[61] http://www.cent.edu.pl/s,in_english,16.html Information on the New Technology Centre of the Warsaw University *OCHOTA*

[62] http://www.pw.edu.pl/engpw/Research/Research-Centres The Warsaw Institute of Technology home page

Structural units: Modern Material and Technology Centre „Cezamat", Functional Material Academic research centre, Energy Engineering and Environment Protection research centre, Sustainable Energy Systems Academic research centre. Several faculties: Faculty of Chemistry, Faculty of Electronic and Information Technology faculty, Faculty of Electric Engineering, Faculty of Physics, Faculty of Civil Engineering, Faculty of Mechatronics, etc.

Budget: no information available

Publications: unknown amount, scientific projects – 547, international projects based on agreements - 546, other international projects – 71, the EU supported projects – 62.

Personnel: almost 5000 employees (2503 - administrative personnel, 2486 - academic personnel).

Industrial cooperation: the Warsaw University of Technology cooperates with 180 foreign universities. It also implements the cooperation with NASA (*National Aeronautics and Space Administration) and such enterprises as* „Siemens AG", „PKN Orlen", „S.A.France Telecom", „FIAT", and others. The project Projekts „Cezamat" is so far the biggest R&D in the history of Poland.

West Pomeranian University of Technology Szczecin[63]

Research interests: biotechnologies, different kinds of enginering of, food science, environment.

Structural units: Faculty of Biotechnologies and Animal Housekeeping, Faculty of Civil Engineering and Architecture, Faculty of Electric Engineering, Faculty of Computer Science and Information Technology, Faculty of Environment Engineering ans Agriculture, Faculty of Bromatology and fishery, Faculty of Chemical Engineering.

Budget: no information available

Publications: no information available

Personnel: scientific personnel – 1100

Industrial cooperation: there has been a cooperation within the field of electrical engineering with such companies as kā „Moeller Electric", "Bernecker & Rainer Industrie - Elektronik GmbH", "Astor", "Tieto", "Bosh Rexroth" or "Oticon Production". The potentional cooperation in other areas is not mentioned, but the university emphasizes that the industrial cooperation allows it and its students to become more competitive in the labour market.

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63 http://www.zut.edu.pl/west-pomeranian-university-of-technology-szczecin/home/news/current-news.html The West Pomeranian University of Technology home page

6.6. Finland

In comparison with other BSR countries, the research institutions of Finland pay more attention to the following fields in the project „Science Link": communication, information technology and electronics, as well as forest industry. However, also other fields like biotechnology, bioengineering and building are acive. The same, the Finland research institutions are actively trying to attract industrial partners, but the cooperation partners` willingness to do business with enterprises is not so emphasized so obviously as it is in Denmark.

VTT Technical Research Centre of Finland [64]

Research interests: biochemical processes, business and innovation research, energy, management of industrial resources, microtechnologies and electronics, information and communication technologies, chemistry industry and environment.

Budget (2011): 278 million EUR

Publications: 1780; more than 1200 patents and their applications, 600 scientific publications

Personnel: 2818 employees

Industrial cooperation: the Research Centre offers the enterprises to increase their competitiveness. Within these areas there is biotechnology, pharmaceutics, bromatology, electronics, energy, real estate, building, machines and transport, logistics, forest industry, chemistry industry and environment. Overall the centre offered its services to 1290 companies, out of which 930 were domestic, but 360 – foreign companies.

The National Institute for health and welfare [65]

Research interests: offering social services, preention of sicknesses and social problems, improvement of eople`s health and well-being

Budget (2011): 118 million EUR

Publications: 1000 yearly

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[64] http://www.vtt.fi/?lang=en Finland VTT Technical Research centre home page

[65] http://www.thl.fi/en_US/web/en The Institute for National Health and Welfare home page

Personnel: 1200 employees

Industrial cooperation: the main goal of the Institute is to improve the health and well-being of the inhabitants, carrying out the sickness and social problem prevention. The Institute has its research partners in Finland and other places in the world. As to industrial cooperation, the Institute offers cooperation in forensic medicine and other areas.

MTT Agricultural Research Centre of Finland [66]

Research interests: biotechnologies and food science, cattle-breeding, economics.

Budget (2011): 56,7 million EUR

Publications: 850

Personnel: 1096

Industrial cooperation: the centre is involved in national and international reaserches, cooperating with the universities and research centres, and is also involved in the work of different international organizations. As to the industry, the centre offers its researches and services in food sciences and biotechnologies, and manufacturing of different agriculture machines, as well as their standardisation and certification. Also, it is possible to perform the crop tests.

The Finnish Forest Research Institute (METLA) [67]

Research interests: forest environment, its ecosystem and renovation, forest industry, social impact on forests.

Budget un investīcijas: 50,2 millions EUR

Publications: 635

Personnel: 370

Industrial cooperation: METLA is one of the biggest forest research Institutes in Europe, whose goal is economical, ecological and socially responsible forest managing.

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[66] https://portal.mtt.fi/portal/page/portal/mtt_en MTT Agricultural Research Centre of Finland home page

[67] http://www.metla.fi/index-en.html The Finnish Forest Research Institute home page

Thus, METLA is ready to share the information and knowledge on forest ecosystem, examine and cooperate in the field of technologies.

The University of Helsinki [68]

Research interests: Biopharmaceutics, Pharmacokinetics, Pharmaceutic technologies, food, forest, material and nature resources, computer science, information technology phisics, chemistry, biology, biotechnologies.

Structural units: Faculty of Chemistry, Faculty of Agriculture and Forest, Faculty of Natural Sciences, Faculty of Pharmaceutics, Drug Research centre, Metapopulation biology centre, Physics, chemistry, biology and meteorology atmosphere content and climate centre, Biotechnology Institute, Helsinki Information Institute of Technology, Helsinki Institute of Physics.

Budget and investments: (2011): 228,4 million EUR

Publications (2011): 6386 Publications (6056 scientific articles and 321 book)

Personnel: overall personnel – 8590, scientific personnel - 4820

Industrial cooperation: Helsinki University (HU) is involved in different research projects in Finland and foreign countries, and it holds strong connections with research centres in Finland, Europe and the world. In accordance with its scientific interests, the Helsinki University is ready to cooperate with the industry. For example, the Helsinki Information Technology Institute which is managed together with the University of Aalto, has cooperated with several famous leading companies in Finland and other countries: ”Nokia”, ”Ericsson” ”TeliaSonera”, ”Elisa Communications”, ”Alma Media”, ”Sanoma WSOY”, ”Finnish Broadcasting Corporation” un”Tieto Enator”.

Tampere University of Technology(TUT) [69]

Research interests: automation and engineering, chemistry and bioengineering, civil engineering, electrical engineering, electronics and communication engineering, computer science and microelectronics, industrial management, logistics, material science.

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[68] http://www.helsinki.fi/university/ The University of Helsinki home page

[69] http://www.tut.fi/en/ Tampere University of Technology home page

Structural units: Department of Automation and Engineering, Department of Chemistry, Department of Civil Engineering, Department of Electrical Engineering, Department of Electronics and Communications Engineering, Department of material science.

Budget (2011): 147,4 million EUR

Publications (2011): 2026

Personnel: no information available

Industrial cooperation: Tampere University of Technology (hereinafter TUT) cooperates with almost 1000 companies in Finland and other countries, and points out that it is ready to cooperate with the industry as to the specific orders and needs. It acknowledges microelectronics to be its priority. TUT has established also academic cooperation with the research institutions in Finland and other countries. TUT has published the industrial cooperation examples in its home page, the ones where it has taken part itself.

Turku Centre for Biotechnology[70]

Research interests: molecular cell biology, structural bioinformatics and systems biology, bioenergy, cancer, molecular immunology, molecular neuroscience.

Budget: 12,3 million EUR

Publications (2011): 61

Personnel (overall inTurku University): 3500 employees

Industrial cooperation: The Centre is one of the components of the University of Turku. There is no information on potential industrial cooperation of the Centre in the home page. However, in the University home page it is indicated that it offers advice to both, public and private sector.

6.7. Germany

In comparison with other BSR countries, there are several strong research centres in Germany which are specialized in, for example, biotechnology, material science and natural science researches, paying attention to very specific areas time to time. That is more typical to research

[70] http://www.btk.fi/home/main/ Turku Centre for Biotechnology home page

centre chains, for example, Fraunhofer institutes, where several branches work in the areas of "Science Link" project interests. It is a typically that strong infrastructures which maintain both, academic and research connections with other centres, are located outside the region centres, and are not members of big universities.

Braunschweig University of Technology[71]

Research interests: science, civil engineering, environmental science, mechanical engineering, electrical engineering, ICT in physics, biochemistry, biotechnology, bioinformatics, microbiology, genetics, food chemistry, organic chemistry, technical chemistry, pharmacology.

Structural units: Biochemistry, Biotechnology and Bioinformatics Institute, Institute of Genetics, Institute of Microbiology, Plant Biology Institute of Inorganic and Analytical Chemistry, Food Chemistry, Organic Chemistry, Physical and Theoretical Chemistry, Technical Chemistry, pharmacology, toxicology and clinical pharmacy institute of pharmaceutical Institute of Technology, Department of Mechanical engineering, Natural Sciences, Department of Architecture, Civil engineering and Environmental Sciences Department.

Budget: no information available

Publications: no information available

Personnel: no information available

Industrial cooperation: has a very wide scope of cooperation with different companies and organizations. Including the German Aerospace Center, as well as various institutes in Germany and Europe.

Helmholtz Research Centre for Materials and Energy in Zentrum Berlin [72]

Research interests: magnetism, functional materials, materials for solar batteries, solar energy

[71] https://www.tu-braunschweig.de/ Technical University of Braunschweig home page

[72] http://www.helmholtz-berlin.de/index_en.html Helmholtz Research Centre for Materials and Energy in Berlin

Budget: 110 million EUR

Publications (2011): 280

Personnel: 1100

Industrial cooperation: the Helmholtz Centre in Berlin is primarily focused on two major areas: firstly, it is a research reactor BER II which carries out experiments with neutrons, and synchotron radiation source BESSY II. The Helmholtz Centre in Berlin is one of the few places in the world for research, where the both kinds of research can be done within the one laboratory environment. The Center has a wide range of research collaborations with colleges and universities in Brandenburg, Berlin, Germany and at the international level.

The Centre offers material manufacturing and energy to the potentional partners. Depending on the business needs of the enterprise, the Centre can make lighter, more compact and other kind materials, as well as to place orders, where it is needed to use solar power or solar cells.

Georg-August-Universitat Gottingen[73]

Research interests: agriculture, biology, chemistry, forest science, forest ecology, physics, computer science.

Structural units: Faculty of Agricultural Sciences, Department of Chemistry, Forest Sciences and Forest Ecology, Faculty of Mathematics and datozinātnes Department of Physics, Faculty of Bernstein Center Göttingen computational neuroscience, and Nanospektroskopijas lāzeattēlveidošanas Centre, European Neuroscience Institute, animal production and technology research center in Göttingen olekulāro Life Sciences Center.

Budget(2010): 986 million

Publications: no information available

Personnel: 14,373, including academic and administrative staff

Industrial cooperation: industrial cooperation often takes place with the university's existing institutes and centers. University indicates that it is ready to work with small and medium

[73] https://www.uni-goettingen.de/en/1.html Gotingenes Universitātes mājas lapa

enterprises. University also has a dedicated business unit - Technology Transfer Office - who cares about the university and business cooperation.

The European Molecular Biology Laboratory [74]

Research interests: molecularbiology, structural biology, cell biology, biophysics genome biology

Budget (overall in centres, 2011): 171,33 millions EUR

Publications: 384, togerther with others 36 publications made

Personnel (overall in centres): 1304

Industrial cooperation (2011): one of the laboratory branches is located in Hamburg.

Research cooperation with different research centres in the world is emphasized, however, not industrial cooperation.

"European X-Ray Electron Laser Laboratory" [75]

Research interests: X-Ray Electron Laser accelerators

Budget un investīcijas (2011): 133 million EUR

Publications: no information available

Personnel: 250

Industrial cooperation: there are 12 countries involved in this project overall (Denmark, Greece, France, Italy, Russia, Poland, Slovakia, Spain, Switzerland, Hungary, Germany, Sweden) and more than 10 research centres located in these countries. The centre does not indicate specific offers meant for the industry. However, cooperation is maintained with the enterprises from several countries, for example, in building and engineering, manufacturing of chemicals, natural sciences and other branches.

Fraunhofer Institutes

• **Budget** (overall for the 66 institutes) : 1,6 billions EUR[76]

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[74] http://www.embl-hamburg.de/aboutus/index.html Information on European Molecular Biology Centre home page

[75] https://www.xfel.eu/ European X-Ray Electron Laser Laboratory home page

• **Publications**: no information available

• **Personnel** (overall for the 66 institutes): 22 000 (mostly engineers and scientists)

∞ Fraunhofer Institute for Applied Polymer Research in Podsdam[77]

Research interests: biopolymers, functional polymer systems, synthesis and polymer technologies

Industrial cooperation: offers cooperation in areas mentioned under the section „Research interests"

∞ Fraunhofer Institute for Wood Research in Braunschweig[78]

Research interests: materials research and chemistry, surface technology, structural engineering and construction.

Industrial cooperation: provides material for quality analysis

∞ Fraunhofer Institute for Biomedical Engineering[79]

Research interests: biomedical engineering, molecular and cellular biotechnology, biohybrid technologies, nanobiotechnology, ultrasound technology, environmental control systems, sensor technologies;

Industrial cooperation: offers cooperation in areas mentioned under the section "Research interests".

∞ Fraunhofer Research Institution for Polymeric Materials and Composites[80]

Research interests: polymers and their use in chemistry, physics, engineering and physics, optoelectronics, microelectronics, production of various materials, like reinforced fiber materials;

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[76] http://www.fraunhofer.de/en.html Fraunhofer Institute home page

[77] http://www.iap.fraunhofer.de/en/kontakt.html Fraunhofer Institute for Applied Polymer Research IAP in Potsdam home page

[78] http://www.wki.fraunhofer.de/ Fraunhofer Institute in Braunschweig home page

[79] http://www.ibmt.fraunhofer.de/en.html Fraunhofer Institute for Biomedical Engineering in Potsdam home page

[80] http://www.pyco.fraunhofer.de/en.html Research Institute for Polymeric Materials and Composites in Teltow home page

Industrial cooperation: offers cooperation in instrumentalization, information and communication technology, and aviation.

∞ Fraunhofer Institute for Reliability and Microintegration in Berlin[81]

Research interests: new technologies and their use in different fields;

Industrial cooperation: offers cooperation to enetrprises working in auto industry, health carem electronics, textile production, and other field industries.

∞ Microelectronics and Microsystems Technology institute in Itzehoe[82]

Research interests: microsystem technologies, information and communication technologies, biotechnical microsystems

Industrial cooperation: cooperation is offered to the enterprises which can hold useful knowledge corresponding to the competence of the institute.

∞ Fraunhofer Institute forToxicology and Experimental Medicine[83]

Research interests: toxicology and environmental science, pharmaceutical biotechnology, chemical risk prevention.

Industrial cooperation: Institute is offering assistance companies who are interested in medicine, environmental and chemical research.

Leibniz Institutes

• **Budget** (all 86 Leibniz institutes together in 2011): 1,5 billions EUR[84]

• **Publications:** no information available

• **Personnel** (all 86 Leibniz institutes together): 17 300 (8200 - scientific personnel)

∞ Leibniz Institute for Plasma Science and Technology in Greifswald[85]

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[81] http://www.izm.fraunhofer.de/en.html The Fraunhofer Institute for Reliability and Microintegration home page

[82] http://www.isit.fraunhofer.de/en.html *Microelectronics and Microsystems Technology institute in Itzehoe* home page

[83] http://www.item.fraunhofer.de/ Microelectronics and microsystem technology institute Itzeho home page

[84] http://www.research-in-germany.de/leibniz Leibniz Institutes` home page

Research interests: materials and their surfaces, environment and energy, biology and medicine, diagnostics and modelling;

Industrial cooperation: proposed cooperation in surface modeling of plasma and materials , plasma modeling and generation. Among the partners there are such enterprises as "Siemens", "OSRAM", and other industrial partners.

∞ Leibniz Institute DSMZ – german Collection of Microorganisms and Cell cultures[86]

Research interests: microbial taxonomy, bio standardization and quality assessment, biosafety and bio-security.

Industrial cooperation: offering assistance in accordance with their own research interests.

∞ Leibniz Institute for Molecular Pharmacology in Berlin[87]

Research interests: molecular physiology and cellular biology, structural biology, chemical biology;

Industrial cooperation: offers cooperation in accordance to its research interests.

∞ Leibniz Institute for Medicine and Bioscience[88]

Research interests: biophysics, **i**munobiophysics, bioanalytical chemistry, infection imunology, inflammation models, etc.

Industrial cooperation: no information available

∞ Ferdinand Braun Institute in Berlin[89]

Research interests: microwaves and optoelectronics;

Industrial cooperation: offers cooperation in five fields: development of microwaves, optoelectronics, material technology, process technology, science management.

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[85] http://www.inp-greifswald.de/web.nsf/index?OpenPage&Eintrag=19D6C24CD60E2B35C12573B0003C6F5F&Language=engThe Leibniz Institute for Plasma Science and Technology (INP Greifswald) home page

[86] http://www.dsmz.de/ Leibniz Institute for Molecular Pharmacology in Berlin home page

[87] http://www.fmp-berlin.info/home.html the Leibniz Institute Molecular Pharmacology in Berlinghome page

[88] http://www.fz-borstel.de/cms/en/science/about-us.html Medicine and Biosciences Leibniz Institute home page

[89] http://www.fbh-berlin.com/ Ferdinand-Braun Institute in Berlin home page

∞ Leibniz Institute for Catalysis in the University of Rostock[90]

Research interests: different catalysis projects

Industrial cooperation: no particular cooperation kinds are mentioned, large cooperation in different researches, but industrial cooperation is not mentioned.

∞ Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy[91]

Research interests: ultra-fast and nonlinear phenomenon: atoms, molecules and plasma, ultra-fast and nonlinear phenomenon: the condensed phase;

Industrial cooperation: listed research, not industrial kind of cooperation.

∞ Leibniz Institute for Applied Geophysics[92]

Research interests: groundwater system and hidroģeofizika, soil sediment systems, geothermal energy.

Industrial cooperation: cooperation atblstoši Institute research interests.

∞Paul Drude Institute for Solid State Electronics[93]

Research interests: hybrid structures of ferromagnets – semiconductors, optoelectronics, nanoanalytics, engineering of different materials, also in the level of atoms, etc.

Industrial cooperation: listed research, but not industrial kind of research

German Engineering Materials Science Centre [94]

Research interests: scientific and practical engineering, research of materials and photon-neitron interaction, environmentally friendly technologies.

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[90] http://www.catalysis.de/index.php Leibniz Institute for Catalysis (LIKAT Rostock) home page home page

[91] http://www.mbi-berlin.de/en/organization/divisions/c/ MAX BORN INSTITUTE for nonlinear Otics and Short Pulse Spectroscopy in Berlin home page

[92] http://www.liag-hannover.de/en/home.html Lietišķās ģeofizikas Leibnica institūta Hanoverē mājas lapa

[93] http://www.pdi-berlin.de/ Paul Drude Institute for Solid State Electronics home page

[94] http://www.hzg.de/central_departments/gems/about/index.html.en German Engineering Materials Science Centre home page

The Engineering material science centre is a part of the ”Helmholtz – Zentrum Geestacht” Materials Science Institute.

Structural units: structural research of new materials and structural research of macromolecules

Budget: 80 million EUR (overall)

Publications (2009): 70

Personnel: particulary in this centre – 60 persons, overall in material science research in the **Centre for** Materials and Coastal Research, where the Engineering material centre is located – 860 persons

Industrial cooperation: the centre has a large cooperation with enterprises in different fields: metal industry, chemistry industry, information and communication technology, production of alloys and other materials.

The German Syncgotron Research Centre [95] [96]

Research interests: X-Ray accelerators, research of different physics particles, photon research

Budget and investments: 192 million EUR

Publications (2011): more than 100

Personnel: approximately 200, excluding the researchers from other centres

Industrial cooperation: The centre is collaborating with the universities and research centres around the world in joint projects, such as "Zeus", "Olympus". At the same time, the Centre has a strong link with industrial partners, and it is offered or held in a number of areas: agriculture and bromatology, chemicals, construction and engineering, environment and energy, electronics and household goods, the natural sciences and biotechnology, material science, and nanotechnology. These are areas where it is possible to use the Synchotron technique. „Desy" Centre offers three types of cooperation: feasibility studies, short-term and long-term cooperation.

6.8. Sweden

The research centres of Sweden specialize in the research of new technologies and natural sciences. The centres are involved in a large, world scale research project, and cooperate actively with the industry where, similarly as in Denmark, are located large scale enterprises. Research centres are located mainly within the structures of universities, but there are also other examples.

European Spallation Source [97]

Research interests: neutron research, natural sciences, energy, environment technologies, fundamental physics.

Budget: creation of the centre – approximately 1,47 billion EUR

Publications: no information available

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[95] http://www.desy.de/ Vācijas Sinhotronās pētniecības centra home page

[96] http://photon-science.desy.de/ German Synchrotron Research centre home page

[97] http://europeanspallationsource.se/ European Spallation Source home page

Personnel: approximately 130 employees

Industrial cooperation: the operation of the research centre is provided by 17 European country cooperation, and there are 60 laboratories included. Sweden and Denmark have undertaken the he project management. Industrial cooperation is offered mostly to the enterprises which use neutron rays in their work, and operate in such fields as production, energy, electronics, polymers, health and natural sciences, as well as green energy.

KTH Royal Institute of Technology [98]

Research interests: the Institute has defined following strategically important fields that need to be developed: 1) energy, 2) information and communication technologies, 3) material science, 4) life science technologies, 5) transport; there are further divided respectively:

1) energy – batteries, biomass, carbon, wind energy, hydroenergy, nuclear energy, solar energy;

2) information and communication technologies – communication networks, wireless mobile systems and services, electonical system design;

3) material science – metalic materials, fibers and polymers, photonics and electronics applications, energy applications;

4) life science technologies – biomolecular means, biomaterials and mathematics, and calculation sciences, health infrastructure, medical devices, health science research;

5) transport – future transport systems, transport in the age of infromation, creation of innovative vehicles, holistic transport systems.

Structural units: Biotechnology school, Chemistry science and engineering school, Computer science and communication school, Electrical engineering school, Engineering science school, Information and communication technology school, Technology and health school.

Budget (2011): 443 million EUR

Publications: no information available

Personnel (2011): 4615 employees, scientific personnel - 839

[98] http://www.kth.se/en/forskning/forskningsplattformar KTH Royal Institute of Technology home page

Industrial cooperation: the Institute notes that it is willing to engage in industrial projects that correspond to its competence, and the cooperation between the Institute and the industry already takes place. However, the strategy of the Institute anticipates that the satisfaction of theresearch and business problems and needs will happen in accordance with the initiative of the enterprise, namely, the company will come, define the root of the problem and will ask the Institute to solve it. The Institute has joint research projects with other national research centres. The Institute, along with other research institutes, engineering companies and different leading technical universities have established a consort – the European Institute of innovation and technology, which, for example, cooperates with such companies as "Ericsson" and "TeliaSonera".

Lulea University of Technology[99]

Research interests: civil engineering, computer and electrical engineering, mechanical and material engineering, forest science, mining, and environmental science, technologies, renewable energy.

Structural units: Biomedical and physics engineering centre, high-quality steel centre, Lulea railway research centre, "Complab" laboratory, ”Swedish mining Blasting Research Centre" and the unit of Geodesy Department, Centre of automatic systems and technologies, ”North Woods centre”.

Budget: 160 million EUR

Publications: no information available

Personnel: 1600 employees (scientific personnel - 723)

Industrial cooperation: the university confirms its readiness to cooperate with enterprises, but does not provide any further information on this issue. However, the North Woods centre has been created by the Lulea Tehnology centre centrs together with the enterprises operating in timber industry. Also, in the work of Swedish blasting research centre exactly industry is mostly interested in.

[99] http://www.ltu.se/?l=en Lulea University of Technology home page

Max IV Laboratory [100]

Research interests: physics, chemistry, material science, geology, engineering, medicine, synchotron electrons.

Budget (2011): 23 million EUR

Publications: 240 yearly

Personnel: 140

Industrial cooperation: The laboratory of the University of Lund as one of its most important targets has set the cooperation with the industry. The Max IV laboratory offers cooperation in several sectors: research of biomolecule structure, polymer, nanomaterials, powders and nanomaterials, research in a small amount of liquid, crystal and amorphous materials, and other materials. One of the "Max IV" laboratory partners is named after the Danish company "Halldór Topsø", as well as various research centers, including the German "Helmholtz-Zentrum Berlin", the French synchotron radiation enterprise "SOLEIL".

BioBanking and Molecular Resource Infrastructure of Sweden [101] [102]

Research interests: natural science research, molecular analysis, storing of various data on biomaterials.

Budget (2010 - 2014): 20,6 million EUR

Publications (2011): 28

Personnel: 41

Industrial cooperation: the main objective of the Biobank is to provide the work of the national biobank. There is a cooperation with the Swedish medical training institutions, however, no particular cooperation with industrial partner is named.

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[100] https://www.maxlab.lu.se/about „Max IV" Laboratory home page

[101] http://bbmri.se/en/ BioBanking and Molecular Resource Infrastructure of Sweden home page

[102] http://www.vr.se/download/18.7257118313b299b0f27204/1357820119559/Interim+evaluation+of+11+national+research+nfrastructure+No10+2012.pdf Information on BioBanking and Molecular Resource Infrastructure of Sweden

Summary

The scientific infrastructures located in Denmark, Finland, Germany and Sweden are ready to take a larger-scale projects, while the Baltics – smaller, engaging in a joint research as a member. It is testified by the fact that the number of workers in scientific personnel, and in the institution's budget, which is larger in the Nordic countries and Germany. The example of Latvia shows that such progress has taken place already several years ago.

Poland has put forward several projects through the development of R&D, seeking to compete with the Nordic countries, because the interests of all countries are often quite similar – different types of technologies and innovation in other areas. Typically, in some countries the centres are located within the universities, for example, in Denmark. Yet elsewhere, they can operate independently, or be within the structure of another organization. Within the branches included in the project "Science Link" the biggest offer is about different kinds of the latest technologies, natural sciences, and life sciences. The offer is smaller from engineering, and even smaller from other branches.

7. INDUSTRY GOALS AND DEMAND FOR THE R&D

This chapter seeks to implement one of the major objectives of the study: to determine the industry's interest, and the amount of the funds invested in R&D. To accomplish that, the both are examined, earlier studies, examining both "Science Link" contest results of invitations to questions, which were sent electoronically by the authors of the research to the state institutions and enterprises. The results obtained in this chapter on the demand and interest of the industry in the conclusion part will be compared with data on the research centre tender, thus, identifying that the demand of the industry compliest with the tender of the research institutions.

The results of the "Science Link" announced contests and data on ex-Baltic Sea Region existing investment in the R&D projects present evidence, that the greatest interest and real investments in the sectoral innovation have been made in chemical, nanotechnology and industrial engineering companies. The data also shows that a greater activity and expressed willingness to cooperate is among the enterpreneurs of Sweden, Germany, Finland and Denmark, while it is smaller in Poland and the Baltics. The research of the research istitutions show that, for example, the enterprises in Latvia companies lack the funds for R&D development.

7.1. Industry areas

It as been already mentioned, that one of the quantities characterizing the demand of R&D is the project "Science Link" announced tenders. During the first and second tenders the project managers called to sign up the enterprises that would be willing to cooperate with research centres. Overall 26 countries responded to it, out of which there were eight BSR countries.

The largest number of the enterprises was from Sweden (eight), the smallest – from Denmark - one. Among the industries the biggest interest was shown by the chemical producers, of which seven companies responded, six more enterprises worked particularly in the nanotechnology sphere.

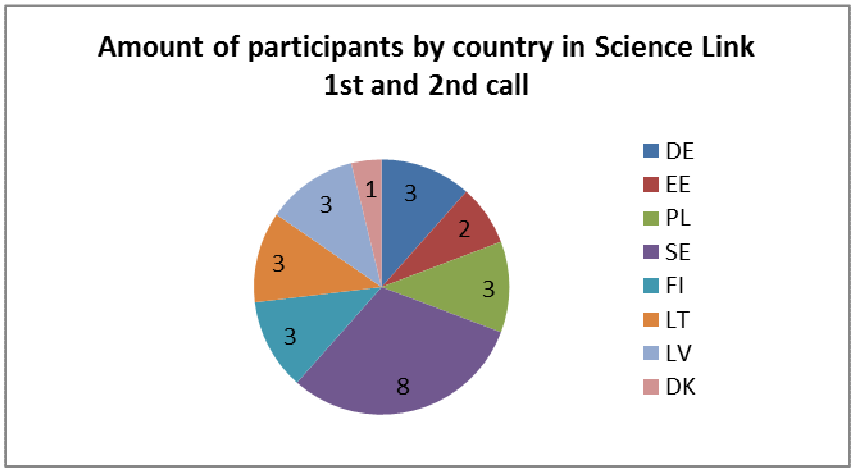

Figure 12 Amount of participants by country in Science Link 1st and 2nd call

The relationships that there are one type companies applied from the same country types of businesses within the project "Science Link" were relatively observable.

For example, four out of eight Swedish companies operate in the field of nanotechnology, one of them parallely - in the R&D research. The two companies that operate in offering the R&D services, are located in Sweden. However, the both also have other interests. It should be noted that in the area of nanotechnologies six companies were applied, which means that the four Swedish companies shape the largest part of the enterprises in this sphere.

Among the Latvian and Polish companies, which applied for the tender, two in each country, operate in the field of chemicals. As it will be seen later, there are some relations between the interests existing in the project "Science Link" and the research centre offer in the corresponding country. A very bright example is Sweden, where the development of new technologies is one of the main interest and operating areas, and among the Swedish enterprises operating within the "Science Link" projects there nanotechnology companies dominate mostly. The ”cases” of Latvia and Poland are not so bright, however - logical, because the research of natural sciences, including chemistry research, tkes place in the research institutions of both countries. There are also opposite examples – the only company, which applied from Denmark, operates in the field of forestry or wood-processing, which among the fields included in “Science Link” iekļautajām nozarēm, is in comparison little observable in Denmark.

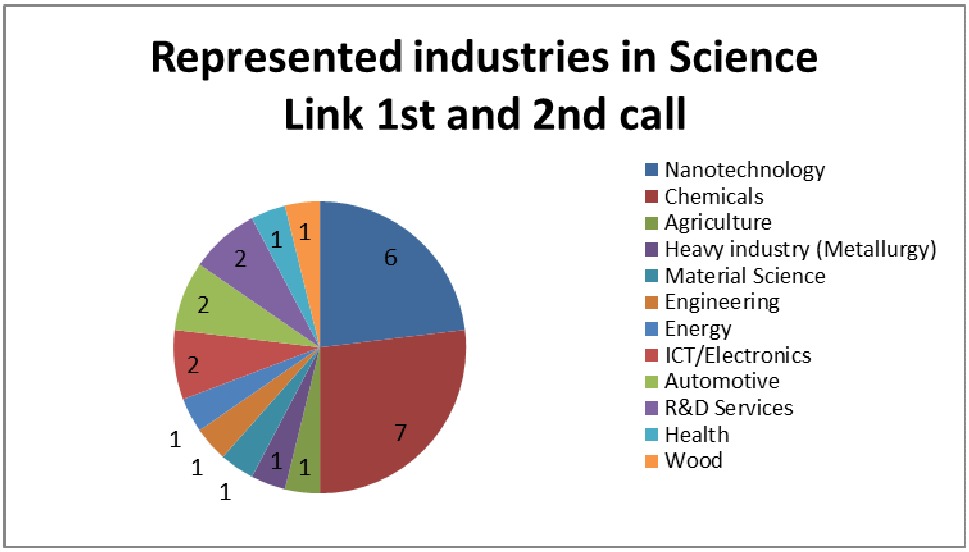

Figure 13 Companies sorted by industries; Data: Science Link 1st and 2nd call

When asked about the industry's needs in research, the representatives of the research centres name different considerations.

For example, not all companies in Latvia, can afford all R&D services, therefore a part of the research centre cooperation partners is regularly form abroad.

From the pharmaceutical companies there is usually a partner of a medium size (annual turnover of 50-500 million EUR), but there are also two partners of the world's largest pharmaceutical enterprise top - 5. Approximately a half of the partners are the "start ups" - companies with a small number of employees." [103] The director of the Latvian Organic Synthesis Ivars Kalvins specifies that "a potential partner is usually either a pharmaceutical firm or "a start up", or a" spin off" company, which does not have its own research capacity in the development of new medicine, and which is usually funded by the "venture capital funds". He admits that most of the partners are foreign enterprises, because there are not enough funds of Latvian companies to pay for the services of the institute or the introduction of new medicine. *"We are working with 10-14 cooperation partners from the industry concurrently. A part of them we find ourselves, to another part we are recommended by our customers."*[104] GEMS traders often require to perform

[103] LU Latvian Institute of Organic Synthesis computerized response

[104] Ibid

different measurements and analyse the data, but sometimes there are requests to resolve a problem with synchotrons, which is actually out of the interest range of the center.[105]

The role of the personal sontacts is also emphasized by the DTU and VU. The DTU rarely ezpress an offer to a company abroad.

The contacts are made in a personal manner, for example, meeting during some conference.[106] VU points out that on their cientists` work the industry gets to know from the existing clients or their employees – Lithuanians. However, the VU estimates the amount of collaboration with the industry as destructing. "*Catastrophe (very small), the data of 2012 show that 0,08% of our research budget are the result of collaboration with the enterprises*."[107] VU adds that the potentional collaboration partner is usually a small company with around 70 employees who wigh advice, improve or create the products, and there are 3 – 4 such projects yearly, where the total amount is USA $ 150 00 - 200 000 (about EUR 117 000 -156 000). The R&D projects in Lithuania generally take place slowly and is a problematic issue.[108]

Sometimes the small interest of the industry can be explained by the lack of knowledge. [109]. GEMS has a big entrepreneurs` interest in work with synchotrons and neutrons, which is only a part of the centre`s working field. "*At the moment the amount of the contract analysis demand with a large scale instruments is not big.That is mainly because of the industry`s lack of knowledge on these techniques."*[110] Usually the enterprises work in the fields of the new materials and technologies, and amount of employees is around 50 peoople. Marco Kirm (the University of Tartu) characterizes its clients. [111] As one of the most significand enterprise wishes is the ability of the scientific institution to solve its problems directly.[112]

The Sweden "Max IV" Laboratory doctor doktors A*ndreas Lassesson* points out that the connection with the industry is kept by participating in different markets of the industry. „We inform them about the R&D possibilities, on the intellectual property protection that they will get, about consultations that they can

[105] GEMS computerized response

[106] DTU computerized response

[107] VU Institute of Material Science and applied research computerized response

[108] Ibid

[109] DTU computerized response

[110] German Engineering Material Science Centre computerized response

[111] The University of Tartu computerized response

[112] The Tartu Science Park computerized response

receive from our personnel, and about the possibilities which are available in such projects as "Science Link"".[113] In total, the client scope of the "Max IV" reach up to 30 companies.

I. Kalvins points out that the scientific institution itself has to try ro rouse interest in the potentional collaboration partners.

" We inform about our previous achievement in the development of medicines and in the field of the gainig procedure technology field (patents, collaboration partner contacts), we participate in exhibitions, maintain our home page, publish informative leaflets, regularly perform in mass media."[114]

Also the VU Institute of Biotechnology mentions the meaning of the scientific publications and patents in attracting new partners.[115] "We do not have any marketing strategy. The channels of communication are the scientific conferences and direct participation in international projects."[116] Another way to rouse interest in industrial partner, is *trade fair*, conferences and regional development markets.[117]

Klas Malmqvist, the professor at the Lunda University, characterizes its collaboration with the industry as organized and slowly increasing in amount.[118] Also others point out that the R&D amount among the scientific institutions and enterprices keeps growing.[119] [120] [121] The most popular way of collaboration is writing of the industrial doctoral thesis.[122]

LIAA characterizes the enrepreneurs` interest as "medium to low". "The interest is sometimes promoted by the state support programmes." *The Latvian entrepreneurs have a weak understanding of the necessity and preconditions of the competitiveness; the foreign entrepreneurs have insufficient information about the competencesof the Latvian scientists.*"[123] However, in cases when the industry wish to collaborate with the Latvian scientists, the orders can be of different kind. *"Depending on the maturity of the enterprise,*

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[113] "Max IV" Laboratory computerized response

[114] LU Institute of Organis computerized response

[115] VU Institute of Biotechnology computerized response

[116] VU Institute of Material Science and Applied Research computerized response

[117] German Engineering Material Science Centre computerized response

[118] Lunda University computerized response

[119] TU computerized response

[120] "Max IV" laboratory computerized response

[121] Poland Science Academy Institute of Physics computerized response

[122] DTU computerized response

[123] LIAA computerized response

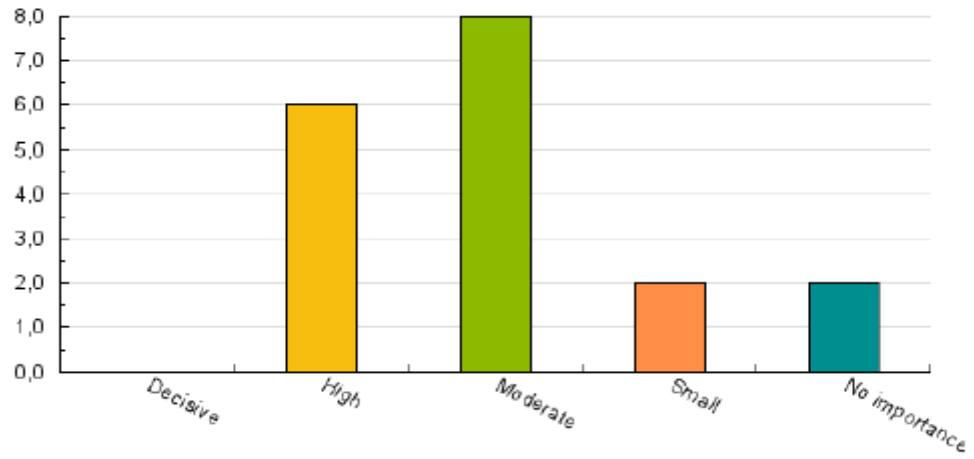
field, the leader comprehension of technologies, those can be very different fields – solutions of different problems, performing a research in the field, or collaboration for a new product, or the new product checking or testing."[124] On the other hand, the LIAA knows mani examples, when the product has entered the market after collaboration of the Latvian enterprise and Latvian research institution: yogurt "Labdaris" – in collaboration of the RSU Istitute of Microbioplogy and Dundaga diary, event timer "Eventech" – in collaboration of the Institute of Electronic and Computer Science and Ltd. "Eventech",

a large amount data base management devices – in collaboration of the LU Institute of Mathematics and Informatics and Plc. "Dati", as well as other IT enterprises, etc.[125]

Among the partners of the „Science Link" a survey was done. The aim was to understand, how important is it to use the synchotron and neutron research. All in all 22 companies responded, a half of them represented three fields: chemicals, life sciences and material sciences. Most of the enterprises have their R&D structure, which is financed at their own expense. Half of the companies affirmed that they have experience in using dispersion technologies, 70% admitted that they have helpe to improve some new product. Thus, the industry in many cases is uncertain about the advantages of these technologies, and do not use them. Also, there is a possibility that getting to know this technology better, that would be used by more companies. The biggest part of the enterprises which have experience with such kind of technologies, spoke approvingly.

[124] LIAA computerized response

[125] Ibid



Val	Svar	% av svarande	% av total
Decisive	0	0.0%	0.0%
High	6	33.3%	27.3%
Moderate	8	44.4%	36.4%
Small	2	11.1%	9.1%
No importance	2	11.1%	9.1%

Figure 14 Work Package 4 – Survey on customers needs from partners within ScienceLink network

Another way how to look at the industry interest in R&D is cluster activity. A bright example is the Danish national science and innovation network, which joins 22 separate scientific and research centres, where each is specializing in its own field. [126]

The network is state supported, and its aim is to promote the research and business merging.

Its task is to give consultations and advice, as well as create the products in its field. Danish companies, scientific institutions, business support institutions are involved in operation of the network.

Within the research network range of „AluCluster" there is a *Knowledge and tehnology centre for aluminium,* whose aim is to popularize the aluminium use in Denmark, helping the companies operating in the field, including the new, innovative solutions. For example, the project „AMAS", where it is researched, how to develop the production of unpolluted antimicrobe aluminium surfaces. The programmes, which have indicated the organizations working in their centres, or ofered information on their researches mention, that among the participants, there are also research institutions, for exapmple, in the network of environments technology innovations work DTU, OU, AU a.o. This network includes also other fields included in the project "Science Link" iekļautās nozares: food sector, where the *Innovation*

126 http://fivu.dk/en/research-and-innovation/cooperation-between-research-and-innovation/collaboration-between-research-and-industry/innovation-networks-denmark/list-of-danish-innovation-networks Denmark National Science and Innovation Network home page

Network for the Food Science operates in, *Innovation Network for Biotech* „Biopeople" , „InnoBYG" - *Innovation Network for Energy effiecient and Sustainable Construction*, *Innovation Network for Biomass*, *Plastic and Polymer Innovation Network*, *Innovation Network for Renewable Energy VE - Net* and *Innovation Network for Environmental Technology*.

One more entrepreneurship and science merging example is the *Tartu Science Park,*where 60 companies operate in, and part of them work in the fields the project „Science Link" is interested in: material technologies, biotechnologies, ICT.

7.2. The Financial Investment of the Industries in R&D

Data show that the EU collaboration in research with different participants – researchers, industry representatives – happen basically among the four countries – France, Italy, Great Britan and Germany.[127]

The BSR countries, similarly to the other EU region countries that are located outside the „big four" and collaborates less with other countries. From the BSR states Sweden and Denmark collaborate the mostwith other countries. Besides, both have the stronger connections either with each other or the countries outside the BSR.

The biggest investions in R&D inamount of more than a billion EUR, the EU enterprises have made in auto industry . Moreover, the biggest contribution has been given by the German company „Volkswagen", but the third biggest – by „Daimler". Big investments in R&D have been made last year also in pharmacy and biotechnologies – 15% and 12 % of the total amount of investments. Significatly, that big investments in the field of ICT have been made by the companies working in the BSR: „Nokia" from Finland, „Ericsson" from Sweden.

In total, these three fields have done slightky more than a half of all investments in R&D last year. It is true that several considerations make to investL auto industry is pressed to seek a way to implement higher security standards and reduce consumption, pharmacy and biotechnologies are looking for the next "big product" or „blockbuster", but the ICT are trying to implement a further development in smartphones.

[127] http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=statistics-analysis-part-ii&section=competitiveness-report&year=2011, EC research on innovation competitiveness, 2011

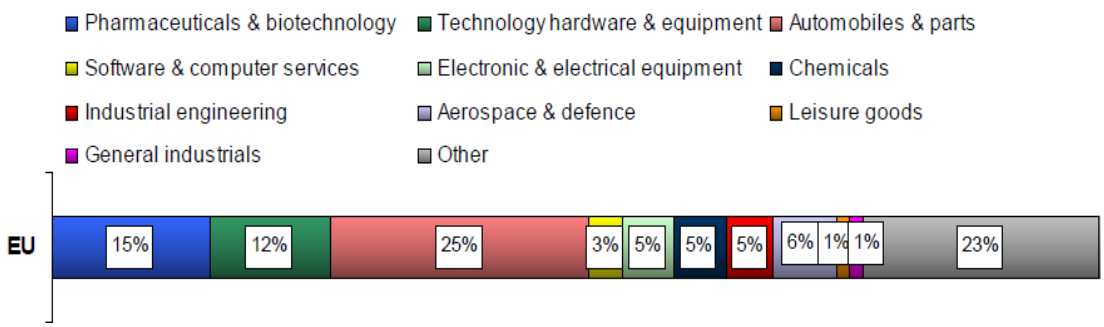
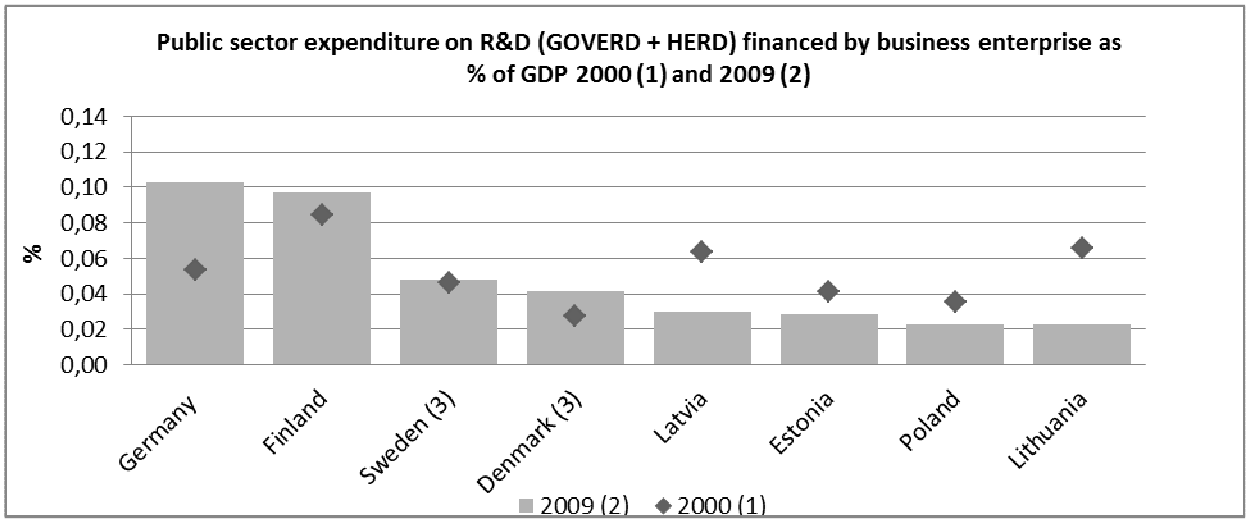


Figure 15 The 2012 EU Industrial R&D Investment Scoreboard Source: European Commission, JRC/DG RTD.

In almost 10 years, period from 2000 – 2009 the public sector expenditure in R&D financed by a business enterprise, has significantly changed. In 2000 the amount of expenditure of all eight countries given by R&D was more similar: in Finland – slightly above the 0.08% of the GDP as the maximum amount, in Germany – about 0.03% as minimal. In 2009 the biggest investment of GDP was in Germany – 0.1%, but the smallest – in Lithuania – 0.02%. It means that in Germany, Finland, Sweden and Denmark the expenditure of the public sector has increased, but in the Baltic states and Poland – decreased, and the difference between the country investing the most and the less, has increased.

The changes have happened because of several conditions. Firstly, the enterprises wand to diversify their activities, thus are seeking for new operation fields, where they are ready to invest. Secondly, the companies want to collaborate with a public scientific centre to get the ERAF funds. Thirdly, the public scientific institutions have knowledge that the enterprises want to use, but they are not available to them.



Source: DG Research and Innovation

Innovation Union Competitiveness Report 2011

Data: Eurostat, OECD

Notes: (1) EL, CY, SE, IS, NO: 2001; AT, HR: 2002; IT, MT: 2005.
(2) EL: 2005; BE, LU, NL, AT, NO, IL: 2007; EU, BG, DE, ES, FR, IT, CY, PT, IS, CH, US, CN, JP, KR, IL: 2008.
(3) DK, FR, HU, NL, SE, NO, TR, JP, KR: Breaks in series occur between 2000 and 2009.

Figure 16 Public sector expenditure on R&D (GOVERD + HERD) financed by business enterprise as % of GDP 2000 (1) and 2009 (2); Data: DG Research and Innovation; Source: DG Research and Innovation

Fourthly, the companies have admitted neccessity and benefit to invest in the innovations ofdifferent fields. Indicatively, within the nine years the level of investments has increased only in the „old" EU member states, thus making to accept, that the „new" member states no not see the financial return in investing in collaboration with R&D.

The companies based in the EU in 2012 increased their investments, if compared with the previous year, by 8.9 %, which is slightly less in comparison with the USA – 10% in 2011.[128]

The biggest investments in R&D in the world among the countries, was made by the Japanese auto construction company "Toyota Motors", but the only company from the EU, which is among the TOP 10 biggest investors, is the German auto construction company "Volkswagen".[129]

Also ES from the companies which are in the list of "Scoreboard", in 2010 in R&D the biggest investment has been made by the companies operating in the field of auto construction. In comparison with the previous year, the auto production companies "BMW" and "Renault" have contributed the most funds to R&D – accordingly, increase of 21.6% and 19.4%. In 2010 among the countries the biggest increase was in the investments of the Great Britain and Germany enterprises – accordingly, 13.1% and 9.5%. Among the

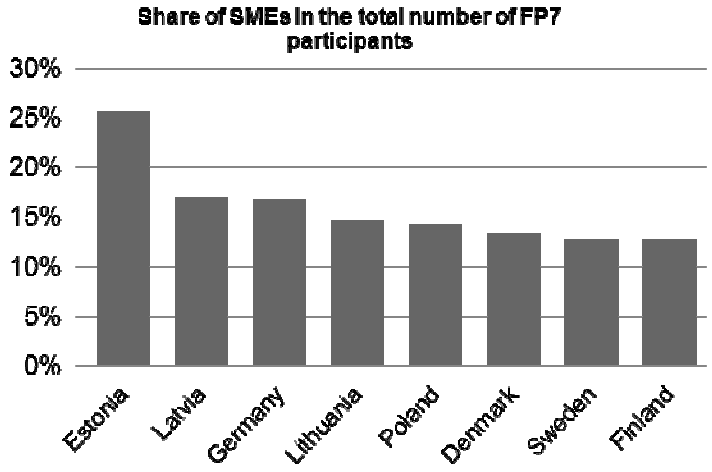
[128] „EU R&D Scoreboard" („The 2012 EU Industrial R&D Investment Scoreboard"), European Commision Joint Research Centre Directore – General for Research and Innovation, 2012. P.6.

[129] Ibid, P.7.

fields the most of funds have been allocated to production of cars and their details – 16.2 % increase. In other fields whose work is significant tio the welfare of Europe, the increase has been small: pharmacology – 2.4% and in plane manufacturing – 1.1%[130]

In 2012 1500 biggest companies R&D allocated EUR 510.7 billion and the basis of 405 companies was located in the EU. The mostly represented fields were pharmacy and biotecnlology-36, and industrial engineering – 35. From the fields mentioned in the "ScienceLink" projects or the ones connected with them, programming and computer production-29 must be mentioned, car detail production – 28, electronical equipment production – 24, chemical field. The German companies have invested the most in R&D among others. 108 enterprises are listed mong the TOP companies (including also the regions that are located outside the regions examoned in this research), as well as 81 from the Great Britain, 58 from France and 26 from Sweden. Within the context of "Science Link" , also Danish and Finnish companies have to be mentioned, the amount of which are accordingly 21 and 14.[131]

The collaboration between the research infrastructure and the field in BSR include several aspects. One part of the enterprises which collaborate with the research, are small and medium size companies. Earlier during the research it was pointed out that many respondents from the scientific institutions indicated that their clients are used to be the enterprises, where are only two employees. There are more of such companies, where some tens are working. As the next table shows, such companies are mosly located in Estonia – slightly more than 25% of the total amount of the participants of FP7. That is significantly more than the other countries not only in the BSR, but in the whole EU.



[130] „EU R&D Scoreboard" („The 2012 EU Industrial R&D Investment Scoreboard"), European Commision Joint Research Centre Directore – General for Research and Innovation, 2012., P.7.

[131] Ibid, P.15.

Figure 17 Share of SMEs in the total number of FP7 participants Innovation Union Competitiveness Report 2011; Data: DG Research and Innovation; Source: DG Research and Innovation

Next, Estonia is followed by Latvia and Germany, a smaller part of such enterprises is in Lithuania and Poland. Another trend is that a part of the public studies are financed from the field funds, and the enterprises write joint publications with the scientific institutions. The last places in collaboration with scientific institutions are taken by Denmark, Sweden and Finland – only approximately 12% - 13%.

The Nordic countries have made the bigger investments among the BSR countries, also, the German companies have invested a lot. But their headquarters are located in regions, which have not been examined within the framework of this study. Also, none of the Polish or Baltic state companies has been included among the 25 bigger investors of R&D; however, there are 6 Danish enterprises and German and Finnish companies, 3 from each. The biggest part of the companies come from Sweden – 12.

The most significant investments in R&D have beed made by technology companies. However, sgnificant investments have been made also by the industrial enginering and pharmacy, as well as biotechnology companies. The same, there are companies in the list that operate in the fields of health services, energy, electricity, oil and gas, forestry, a.o.

The biggest R&D investors in 2011 in BSR countries[132]

Position in the list	Position in global rank	Company	Country	Industry	Investment in R&D (mill. EUR)
1.	3.	"Volkswagen"	Germany	Auto industry	7203,0
2.	15.	„Nokia"	Finland	Technology and parts	4910,0
3.	29.	„Ericsson"	Sweden	Technology and parts	3656,9
4.	55.	„Volvo"	Sweden	Industrial engineering	1965,2
5.	90.	„Novo Nordisk"	Denmark	Pharmaceuticals and biotechnology	1209,9
6.	236.	„Vestas Wind Systems"	Denmark	alternative Energy	393
7	361.	„Electrolux"	Sweden	Household goods,	229,2

[132] „EU R&D Scoreboard" („The 2012 EU Industrial R&D Investment Scoreboard"), European Commision Joint Research Centre Directore – General for Research and Innovation, 2012. P. 84.- 124.

				houses	
8.	367.	„Hexagon”	Sweden	industrial engineering	223,4
9.	394.	„Atlas Copco”	Sweden	industrial engineering	195,4
10.	432.	„Novozymes”	Denmark	Pharmaceuticals and biotechnology	173,1
11.	438.	„Wartsilla”	Finland	industrial engineering	172
12.	454.	„Danfoss”	Denmark	industrial engineering	166,8
13.	455.	„SKF”	Sweden	Industrial engineering	166,1
14.	458.	„Grundfos”	Denmark	industrial engineering	164,1
15.	461.	„Maxingvest”	Germany	investments	163
16.	480.	„SAAB”	Sweden	Space, Defence	152
17.	523.	„Dragerwerk AG”	Germany	Health Care and Services	140
18.	541.	„Assa Bloy”	Sweden	Design, materials	134,9
19.	550.	„Vattenfall”	Sweden	electricity	131,4
20.	578.	„Getinge”	Sweden	Health Care and Services	124,7
21.	597.	„Metso”	Finland	industrial engineering	118
22.	608.	„Elekta”	Sweden	Health Care and Services	114,9
23.	625.	„Husqvarna”	Sweden	industrial engineering	110,9

Table 1 Largest investors in R&D in BSR, 2011 Source: European commision

These results largely complpy with the review done in the EC on the entrepreneurship sector activity in implementing several innovations.[133] There among the fields pharmacy and biotechnologies, technologies and their details, programming and computer services, and health care and services have been named

[133] Monitoring industrial research: The 2012 EU Survey on R&D Investment Business Trends, European Commision, Joint Research Centre, Research & Innovation, P.34.

with a high R&D level. It is added inthe review that also other fields have a significant level of R&D, but they are not named. The fields included within the project "Science Link" – food science, chemical production have been recognized as fields, where the R&D level is medium, but in building – low.

Such conclusions have been made by surveying the EU member state enterprises about their collaboration with the foreign companies or researchers, as well as the new product licencing.

The previously told information can be supplemented by the EPO review of the TOP 50 companies, which had submitted the patent applications in 2012.[134] In the list, where are many non-European companies, only few companies have been included from the BSR: Nordic technology enterprises "Ericsson" (nr.9 in the list), "Nokia" (nr.38 in the list).

The "Eurostat" review on total – industry and other sponsor – spent funds testify that bigger funds from the GDP are invested by the Nordic countries and Germany, however, not only by the regions examined in this research.[135] Meanwhile, Poland and Baltic states` regions have not got among the European regions where the funds are mostly invested, calculating EUR per one person.

The first place in the EU is taken by the the capital region of Denmark – Hovedstaden.In TOP 30 have been included: Stockholm in Sweden, Pohyol in Finland, Ethel in Finland and many regions in Sweden, Finland and Denmark.The results are similar when estimating how many companies in each BSR country in 2008 were ready to manufacture products.[136] If there are 80% of them, and more than a half there is also in Estonia, Finland and Denmark, then in Lithuania, Poland and Latvia less that 1/3 is made up of such companies. However, LIAA points out that the problem is not only the inability to pay for the scientific institution services, to which I. Kalvins, the director of the Institute of Organic Synthesis, but also the entrepreneurs` and scientists` inability to cooperate. *"It is necessary to educate the scientists about the potential collaborationwith the industry and entrepreneurs, as well as commercalization of technologies (..). The successful business projects have to be created, based on synergy between the entrepreneurs and scientists."*

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[134] http://www.epo.org/about-us/annual-reports-statistics/annual-report/2012/statistics-trends/top-applicants.html#tab=2 EURpas Patentu biroja home page

[135] "Science, Technology and Innovation in Europe" "Eurostat" European Commision, European Union, 2012., P.29.

[136] Ibid, P.72.

Concurrently, the Latvian and even more the forign companies will be possible to tempt by modern infrastructure and highly qualified labour.[137]

One more way how to examine the enterprise interest in research, is the amount of patents, and how many of the applicants are enterprises. Among the BSR countries Germany and Nordic countries prevail.[138] [139] However, not all of these patents can be results of the industry-supported researches. In 2012 in the EPO (European Patent Office) more than 3400 patents were submitted from Sweden, which is followed by Findant, Denmark and Poland, Baltics – with a smallamount of applications. In comparison, a similar situation was, when the amount of patents was calculated per one million people. A big amount of applications, when looking at the country, was from Germany, however, per one million people it was slightly lower than for Sweden.

Country	Amount of patents in 2012.	Number of patent applications per million inhabitants 2012	Patent applications in 2009.	Number of patent applications per million inhabitants 2009
Denmark	1607	288	1337	243
Estonia	41	32	44	33
Latvia	25	13	20	9
Lithuania	18	6	14	4
Finland	1900	350	1149	216
Poland	385	10	260	7
Germany (whole country)	27 295	334	24 152	295
Sweden	3471	363	3073	332

Table 2 Total number of patents in the BSR countries. Source: European Patent Office

Similarly as to comparing the interest about the "Science Link" announced tenders and BSR richer enterprise material investments in R&D projects, as well as in correlation with the EU scale patent

[137] LIAA computerized response within the scope of the research

[138] http://www.epo.org/about-us/annual-reports-statistics/annual-report/2012/statistics-trends/patent-applications.html#tab=3 EPO home page

[139] Monitoring industrial research: The 2012 EU Survey on R&D Investment Business Trends, P.82.

demand, the most active countries are Germany, Sweden and Finland. Within the scale of fields, the biggest interest on patent applications was in medicine technologies.[140]

Finally,a proof of the collaboration between the science and industry is the amount of jointly created publications. The data on such collaboration in time from 2003- 2008 are available only about the"old" EU member states –Denmark, Sweden, Finland and Germany. Exactly the Nordic countries have been stable leaders during all 5 years in creation of joint publications. Sweden takes the first and second place, Finland is slightly behind. In germany the joint publications are created significantly less in comparison with the Nordic countries. This characteristics can be explained with two assumptions. Firstly, in all three countries, at least two, comparatively new fields are very developed – ICT and biotechnlologies, as well as pharmacy, which is not a new field, but in which during the last 10 – 15 years big development steps have been taken. Both, entrepreneurs and scientists are interested in development of the mentioned spheres, as well as opportunities for the scientists to perform significant researches. Secondly, the Nordic countries have traditionally been ones of the ICT, biotechnology and pharmacy pioneers, therefore there are finances and goal to keep their positions. The Baltic states and Poland are not included in this review.

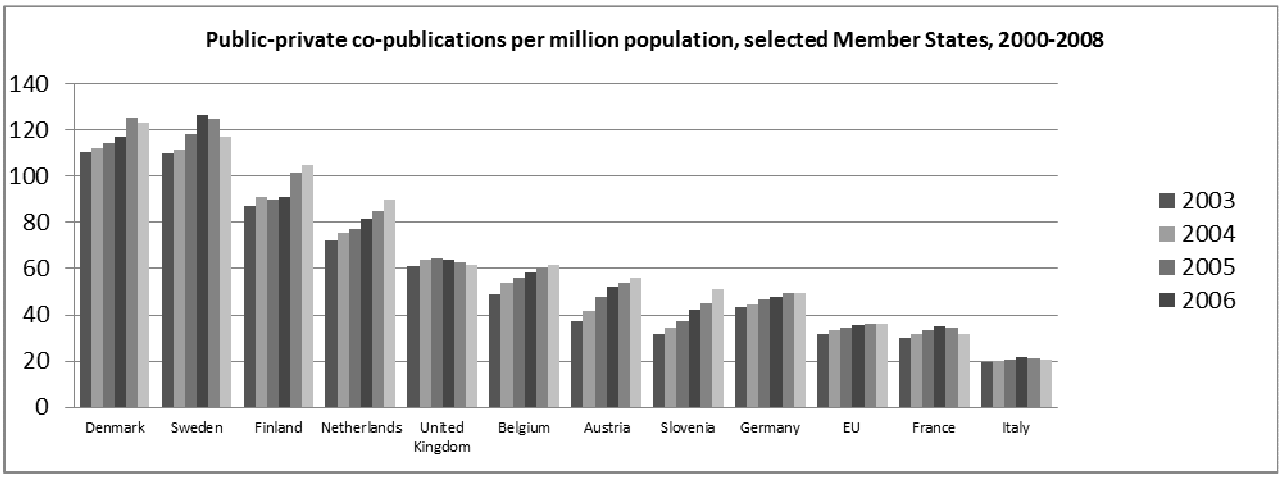

Figure 18 Public-private co-publications per million population, selected Member States, 2000-2008; Innovation Union Competitiveness Report 2011; Data: DG Research and Innovation; Source: DG Research and Innovation

140 http://www.epo.org/about-us/annual-reports-statistics/annual-report/2012/statistics-trends/patent-applications.html EPO home page

Summary

Many data and tender results show that the insustry is mainly interested in different kinds of technologies and innovations in them, e.g., nanotechnologies, biotechnologies, ICT, as well as technologies necessary in medicine. A big interest is also in the chemical manufacturing and industrial engineering. Typically, that the Nordic states and Germany enterprises have a bigger interest and, possibly, in many cases ability to invest in innovations. Thus, exactly those countries have bigger possibilities to satisfy the R&D needs of their industry,and frequently also substantial scientific infrastructures have paid attention to the fields which are interesting also to enterprises.

8. THE INDUSTRY DEMAND AND SCIENTIFIC INFRASTRUCTURE OFFER

The level of demand within the Baltic Sea Region differs radically: while in one country the industry participates and finances large-scale researches, in another it is capable to perform comparatively small order works, sometimes not even those. Simultaneously, also the science infrastructure offer to the industry differs greatly: while in one country some scientific institution is capable to perform large-scale researches, in another – only the small ones. Thus, in the part of the Baltic Sea Region world-scale researches take place, and there exists a close industry and science cooperation. On the contrary, in other countries the cooperation between the industry and scientists is sometimes conditional, not excluding the opportunity that also small, qualitative, narrow field focused researches can be carried out there.

Such situation can be partially explained with the support offered by Germany and the Nordic countries to the science and R&D projects. It exceeds 3% of each country GDP and enlarges the persperctive of these countries to perform qualitative researches in broad sectors. Thus, the Baltics and Poland has to focus on narrower fields, which generally reqiure less capital and not so big amount of human resources – researchers. The attention in the Baltics and Poland in many cases is focused on sub-sectors.

Typically, a closer cooperation between the industry and science takes place in the countries with a higher lever of welfare, so called "old" European Union Member States with financially richer and multiform science infrastructure, and a clearly indicated goal and wish to cooperate.

Namely, the scientific institutions in Denmark, Sweden, Finland and Germany more than the other Baltic Sea Region countries indicate their desire to cooperate with enterprises in their home pages, mentioning the examples of previous cooperation and indicating certain employees, with whom it is necessary to get in touch in order to develop the cooperation. In the Baltics and Poland such characteristics are observed less.

The Baltic scientific institution representatives indicate that the cooperation with new partners frequently starts by the suggestion from the existing clients or acquaintances. Namely, the entrepreneurs become aware of the research centre through their personal channels, and later agrees on a joint work.

Among the Baltic Sea Region research centres a certain specialization or intensified focussing on some specific field is observed. For example, in Denmark a greater role is assigned to biotechnologies and life sciences, in Finland – a little more than in others – to ICT, in Sweden – to life sciences, also natural sciences and ICT, in Germany – to natural sciences, besides, in the Leibniz Institute and the Fraunhofer Institute a specialization on a narrower field can be observed, for example, in the natural sciences or

chemistry. Thus, as it has been said, a part of the Baltic Sea Region research institutions is able to perform a broader and more diverse content researches, another part – a narrower scale researches, where a bigger focus is put on some sub-sector.

The situation is identical concerning demand. In one part of the Baltic Sea Region countries – mostly in the Nordic countries and Germany – the enterprises are able to fund large-scale researches, but in other countries, for example, in Latvia and Lithuania, the enterprises face the difficulties to pay for the science institution services even in the case, when the potentional cooperation seems interesting to them. Thus, it has to be assumed, that the cooperation potentional in many Baltic Sea Region countries is not exhausted, and it holds the growth potentional, but first of all it is denied by the insufficient company wealth. Thus, the amount of cooperation growth between science and enetrprises is hindered by both, the financial and communication problems. On the other hand, statistics shows that the Estonian and Latvian enterprises are the most active in cooperation with research institutions. It is true that in the European Union more scientific joint publications, created by the enterprise and the institution, can be found in Denmark, Sweden and Finland. Thus, the enterprises see their value and gain in creation of the scientific publications. Besides, the students frequently do researches, while being trainees in some enterprise. Thus, it is a win-win situation, where the student has obtained a practical experience, but the enterprise can gain a practical benefit from the work done by the researcher.

Last year, in 2012, the enterprises in the European Union made investments mostly in the car industry – 25%, as well as in pharmacy and biotechnology development – 15%. Overall, the R&D enterprises made the investments billion worth: the investments of 15 companies alone exceeded two billion, but the investments of 33 companies – a billion euro. 12% more are invested in the ICT, their details and equipment. These data largely correspond with the enterprises, which invest in R&D the most. In the car industry those are "Volkswagen" and "Daimler", in pharmacy and biotechnology development - "Roche" and "Sanofi", in ICT – the enterprises of the Nordic countries, the leaders in the Baltic Sea Region are "Nokia" and "Ericsson".

8.1. Demand peculiarities in each of the Baltic Sea Region countries

1. Denmark. The biggest interest and readiness of the entrepreneurs and the country to invest the funds is in biotechnologies – pharmacy, as well as ICT. Similarly to Sweden, Finland and Germany, also the new business and science opportunity presence tempts the entrepreneurs and scientists in Denmark, thus developing the PPP in such a high intensity, which cannot be encountered in any other Baltic Sea Region country. Since many important science centres in Denmark are located

within the structure of the universities, the entrepreneurs cooperate with them quite often. Also, a big interest is expressed about the engineering and natural science researches, food science and chemical industry, and forest industry to a lesser extent. However, apart from the industry, the new technology and innovation implementation dominates in the cooperation of both parties. Frequently, a popular and recognized enterprise in its field cooperates with scientists. Also, the cooperation itself takes place differently form the other Baltic Sea Region countries. An individual employee or a small epartment takes care of the relations with the industry. The stories on the "good examples" can be found in the research centre home pages telling, how the entrepreneurs have solved their problems with the help of the researchers, or how the scientists offered some invention, which has served for the entrepreneurs as a new product or as a component of an existing product. Also, the cooperation process sequence is outlined, etc. In other words, relations with the industry are maintained purposefully, in an organized manner, striving to rouse interest for cooperation.

2. Estonia. More often than in other Baltic Sea Region countries the science infrastructures are desired to be used by the small and medium-sized enterprises. An intensified interest in ICT and other newest technologies is present. A prooof of that is, for example, the existence of the Tartu Science park. Reasoning also by the references of other research centres, the industry holds the biggest interest in the researches of different technologies, as well as medicine and health researches. Estonia is a country, taking part the most of all in the projects within the framework of the Seventh Framework Programme (FP7), thus testifying its goal to operate in an international scale.

3. Latvia. The interest of the industry about the opportunities to use the science infrastructure is comparatively small. Its potentional growth is hindered by both, the enterprise insufficient purchasing power to use the services of the scientific institutions, as well as the lack of comprehension about the work specifics of the science centres. Probably, there is a comparatively small amount of the enterprises in Latvia in the field of which, at least theoretically, there would be a necessity to cooperate with scientific institutions. However, among the enterprises which cooperate with the scientific centres, a bigger interest is expressed about the researches in natural sciences and pharmacy. In other words, the more the sector is or resembles the fields with a lot of innovations, the bigger is the interest of the industry about the scientific centre work. Similarly to other countries, foreign enterprises is a part of the cooperation partners. At the same time, there are many unique orders in Latvia to be implemented elsewhere in

Europe, because there is a unique equipment in several infrastructures. Similarly to other "small" countries, Latvia is one of the most active companions in the Seventh Framework Programme (FP7) in both, the scientist mutual cooperation, and the enterprise cooperation with scientists.

4. Lithuania. Similarly to other "new" Member States of the European Union, data shows a low level of the science and industry cooperation. On the one hand, the industry holds a big interest in various engineering works: among the Lithuanian research centres there are comparatively many enetrprises having this kind of orders. On the other hand, five new knowledge centres – "valleys" will be discovered soon in Lithuania, where the financial support is offered for the construction and equipping of them not only by the country and the European Union, but also by the enterprises. Thus, it can be assumed, that the industry interest and collaboration will increase in the R&D project development in laser technologies, material science, biomedicine, chemistry, mechatronics and agriculture.

5. Poland. If at the moment the industry pays a lot of attention to engineering, natural sciences, then soon the leader positions could be taken by the newest technology and life science researches. However, the popularity will be kept also by the engineering and natural science researches. These changes could take place simultaneously with discovering some new research centres, the aim of which will be the research of the technologies and natural sciences. Taking into account the limited amount of information in the materials on the R&D projects in the Polish research centres, it can be assumed that the industry sometimes lacks the knowledge about the opportunities of taking part in the researches, and the researches themselves.

6. Finland. The biggest interest in Finland is shown about ICT, to a little lesser extent – biotechnologies and engineering. In comparison with other Baltic Sea Region countries, the biggest interest is demonstrated in the forest industry. The industry interest in science in Finland is testified by the big amount of joint publications, as well as investments in researches. The same as in other Nordic countries and Germany, a considerable amount of funds is invested in the R&D projects by the industry leaders, the enterprises recognized in the world, thus promoting the total R&D growth and the service provider – research centre - abilities to ensure a qualitative research performance.

7. Germany. A convinving number of the German biggest companies work, as well as their offices are located in the regions, which are not examine in this research. For example, the German car inustry gigants "Volkswagen" and "BMW" have created their main offices in Wolfsburg and

Munchen, respectively. The biggest industry interest in Germany is about engineering, also some technologies and natural sciences. The PPP level is comparatively high: it is not as considerable as in the Nordic countries, but it is bigger than in the Baltics and Poland. Typically, small research centre "chain" "Fraunhofer" or "Leibniz" institutes exist in Germany. There are many research centres within the structure of those, where each of them focuses on specific and often also narrow science issues.

8. Sweden. The state and industry biggest demand is observed in the natural sciences and ICT, where a big role is played by the company "Ericsson". The big interest of the industry in the results of the scientific researches is testified by the big amount of joint publications, as well as the investments in R&D. In Sweden, similarly to Denmark, the state control over priority defining is smaller in comparison with the other countries of the Baltic Sea Region, thus the biggest power in the research development and direction defining is hold exactly by the scientific institutions and the industry. The field leaders are frequently the investors in R&D.

8.2. Suggestions to the science centres in cooperation with entrepreneurs

1. Mostly the Baltic an Polish science infrastructure owners have to inform the entrepreneurs about the potentional cooperation opportunities in their materials and other ways of information transfer:

   a) If the research institution focuses on a narrow field, the information should contain its specialization, as well as the previous cooperation examples, if such are available.

   b) The information has to be simple, but not trivial, thus to be understood also by the potentional cooperation partners, who do not represent science daily. For example, if some potentional cooperation partner is interested in the science centre work and its infrastructure, one has to comprehend the offer from the information presented in the home pages or other materials. Specific terms, which could be incomprehensive to lay persons, should be avoided.

2. It is necesary for the scientific centres, for example, the Latvian scientific institutions, to study the enterprises in the operation of which scientist services would be necessary. A monitoring system should be established to follow the enterprise activities and trends regularly in the most essential fields. As soon as the enterprise needs some service, the science centres have to be ready to cooperate. Such planning will let to maintain a close connection with the enterprises, comprehend their challenges and find the solutions. Most credibly, the enterprises themselves

would define the needs of their fields more precisely and effectively, however, also the initiative demonstrated by the science centres would be a way to start cooperation.

3. The research centres need to create their own inner cooperation network within the whole Baltic Sea Region. For example, in a case some Latvian or Lithuanian enterprise would like to receive a service or a product available only in Germany or Denmark, the risk is present that it will refuse its intent. The costs to get the product or service ordering it in Germany or Denmark will be too big. Thus, if the research institutions would establish their own cooperation network and let the enterprises to receive the service closer to their location, both, the research institutions and enterprises would gain. If the service, however, is not possible to be received on the site, the enterprises should be encouraged to cooperate with other Baltic Sea Region research centres. Both, enterprises, as well as the foreign and local research centres would gain. However, it is crucially important, that in order to make such network operate and create motivation in the research centres, a pan-Baltic innovation fund has to be set up, which would evaluate the submitted or potential research projects in a centralized manner with the Baltic Sea Region centres.

4. One more aspect to make the research centres cooperate more is their weak present cooperation within the framework of the Baltic Sea Region, which does not ensure a sufficient receptiveness and readiness to cooperate with enterprises. The institution specialization and self-set priorities could let the Baltic Sea Region infrastructure owners agree on particular bigger projects instead of implementing a big amount of smaller projects. The previously mentioned example about different countries` institution cooperation in service offering is one more form of such cooperation.

5. The scientific institutions have to pay particular attention to their financial resources in order to be able to attract new employees and keep the existing ones, including the cooperation with the higher education establishments. In cases, when the enterprises can offer bigger remuneration, the risk is present that the employees and students will choose an enterprise instead of an institute or a research centre as their work place.

6. It is preferable to specialize, i.e., to be an expert in as many science issues as it is possible to reach the highest rank. Namely, to work only in those fields, where the science centre can be competitive and gain the best results, as well as offer innovative solutions. Thus, the research centre can gain an expert reputation in a narrow sphere, but it will have the recognition and fidelity form the entrepreneurs. It is true, this point is largely able to be carried out under

condition, that the country increases the funding. In the case of Latvia the base funding has to be 1% of GDP.

7. In particular cases within the framework of cooperation the science centre can undertake to perform the order of the enterprise, thus receiving funding for equipment purchase or improvement of another infrastructure.
8. If possible, specially hired employees are necessary in the science centres, whose task is to conclude deals with the enterprises and seek for the cooperation partners, popularize the science centres and their works in social networks, etc. In the countries, where the research centres are too small to hire such specialist for each of them, it is possible that many centres can agree on cooperation with some marketing or public relations agency. Such step would make the science centres more open and recognizable in society.
9. It is necessary to internationalize the R&D institution services offered to entrepreneurs as export services.
10. A regular involvement in different seminars, forums and conferences is necessary. The experience of the centres included in the present research show that the seminars or forums are the places, where the initial negotiations take place, or even the particular agreements are concluded for cooperation.

8.3. Suggestions to the state and local authority institutions for improving the cooperation

1. The state has to set a definite amount of priorities where, using the mentioned tax reliefs or offering other opportunities, it attracts the enterprises, which are ready to invest in R&D projects. These science spheres are prior at the level of the state and defined to be particularly supported. The priorities are those recognized fields, which are economically and financially beneficial to be developed, where the infrastructure is at least partially developed, thus decreasing the costs in surrounding equipping, as well as the necessary human resources and background experience, allowing to regard the particular field traditional to Latvia or any other Baltic Sear Region country. The technical fields should become the prior ones, where Latvia and other Baltic Sear Region countries are capable to be internationally competitive in the scientific aspect, being able to obtain income simultaneously.

2. The attention should be paid particularly to the support of so-called "spin – off" enterprises.
3. The prior fields for Latvia from the list of the spheres mentioned in "Science Link" could be pharmacy, forestry, also food science and particular spheres of chemistry and physics. These are the ones the Latvian enterprises has knowledge in and experience with, as well as developed infrastructure.
4. The local authorities can act according to a similar principle. Namely, to define the fields in accordance with the criteria named before, which they support in R&D projects.
5. By a similar scenario, to define the priorities, combine the financial means, human and other resources. One or many fields can be developed by one or several Baltic Sea Region countries. This point is particularly important to the Baltic states and Poland, taking into account that nowadays, for example, the Nordic countries and Germany develop the newest technologies, which require big investments. Thus, it is possible to gain the competitive capacity by performing considerable investments in the particular project, which can be done by the Baltics and Poland, combining their power.
6. Following up the previous point, the Baltic Sea Region countries have to agree on, within the limits of the scale, creation, usage, specialization, division of labour of a remarkable infrastructure, as well as they have to find motivation for such projects. Namely, the work has to be with a financial and/or scientific return.
7. The state or local authorities have to prescribe the grants to the students, who perform the master`s or doctoral thesis in the prior fields for the sake of some enterprise or state and local authority institution. It is essentially to increase the number of PhD students, thus promoting the new talant staying in own country. It is also possible, if the state and scientific institutions get involved even more in several international projects, where the level and goals correspond to the highest criteria and the ones, where the new talants wish to work.
8. The small and medium sized enterprises have to be supported, but the support has to be offered by evaluation. Namely, the enterprises frequently do not know themselves, in which innovative directions they should work to gain financial return, thus the support and avice has to be limited.

APPENDIX

LIST OF MATERIALS AND SOURCES USED

List of sources

International institutions

•http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=what European Commission on research infrastructures home page
http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/dk/country „Erawatch" country report- Denmark
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/ee/country "Erawatch" country report– Estonia
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/lv/country „Erawatch" country report- Latvia
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/lt/country?section=NationalPolicyDevAndEuropeanResearchArea&subsection=ResearchInfraestructures „Erawatch" country report–Lithuania
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/pl/country „Erawatch" country report– Poland
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/fi/country "Erawatch" country report- Finland
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/de/country „Eraqwatch" country report- Germany
•http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/se/country "Erawatch" country report- Sweden
•http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri ESFRI science infrastructure implementation
•EU R&D Scoreboard" („The 2012 EU Industrial R&D Investment Scoreboard"), European Commision Joint Research Centre Directore – General for Research and Innovation, 2012.
•Monitoring industrial research: The 2012 EU Survey on R&D Investment Business Trends, European Commision, Joint Research Centre, Research & Innovation.
•http://www.epo.org/about-us/annual-reports-statistics/annual-report/2012/statistics-trends/top-applicants.html#tab=2 EC information on innovation implementing in the EU
•"Science, Technology and Innovation in Europe" "Eurostat" European Commision, European Union, 2012.

Scientific institution home pages and information on scientific institutions

Denmark

•http://www.dtu.dk/English.aspx DTU home page
•http://www.dtu.dk/upload/english/about_dtu/dtu_in_profile/131185%20dtu_2012_uk_web.pdf DTU 2010 report
•http://www.dti.dk/ Danish Technological Institute home page
•http://www.dti.dk/annual-report-2011/32150 Search Danish Technological Institute 2011 report
•http://www.ku.dk/english/ Copenhagen University home page

•http://www.en.aau.dk/ Aalborg University home page
•http://www.okonomi.aau.dk/digitalAssets/51/51948_--r2011-eng-10--udkast-af-20--juli-2012---komprimeret.pdf Aalborg University 2011 report
•http://www.au.dk/en/ Aarhus University home page
•http://www.au.dk/en/about/profile/publications/ Informative materials and 2011 report on the Aarhus University
•http://www.ssi.dk/English.aspx The State Serum Institute home page

Estonia

•https://www.emu.ee/en/ Estonian University of Life Sciences home page
•https://www.emu.ee/en/about-the-university/concept/annual-reports/ Estonian University of Life Sciences home page
•http://www.ttu.ee/en Tallinn University of Technology home page
•http://www.tlu.ee/?LangID=2&CatID=3215 Institute of Informatics, Tallinn University home page
•http://www.ut.ee/en The University of Tartu home page
•http://www.lote.ut.ee/index.aw/set_lang_id=2 The University of Tartu Faculty of Science and Technology home page
•http://www.ut.ee/en The University of Tartu home page
•http://www.ut.ee/en/research/research-university-tartu University of Tartu Faculty of Mathematics and Computer Science home page

Latvia

•http://www.innovation.lv/fei/ Institute of Physical Energetics home page

•http://www.innovation.lv/fei/Projects/FEI_gada_2011.pdf Institute of Physical Energetics Report 2011

•http://www.edi.lv/lv/aktualitates/ IECS – Institute of Electronics and Computer Science home page

•http://biomed.lu.lv/lv/ Latvian Biomedical Research and Study Centre home page

•http://biomed.lu.lv/lv/par-mums/parskati/ 2011 report

•http://www.osi.lv/ Latvian Institute of Organic Synthesis home page

•http://www.cfi.lu.lv/ The University of Latvia Institute of Solid State Physics home page

•http://www.lumii.lv/ The University of Latvia Institute of Mathematics and Computer Science (IMCS LU) home page

•http://www.bior.gov.lv/lv The Institute of Food Safety, Animal Health and Environment - "BIOR" home page

•http://www.pmi.lv/New/LvInstituteAbout.html The Institute of Polymer Mechanics (IPM) of the University of Latvia home page

•http://www.pmi.lv/Assets/Files/LU_PMI_gada_parskats_2011.pdf The Institute of Polymer Mechanics (IPM) of the University of Latvia home page

Lithuania

•http://www.ftmc.lt/en Centre for Physical sciences and Technology home page

•http://en.ktu.lt/content/research/institutes Kaunas University of Technology home page

•http://en.ktu.lt/content/about-ktu/welcome Presentation of Kaunas University of Technology

•http://www.lei.lt/index.php?k=9&i=0 Lithuanian Energy Institute home page

•http://www.lei.lt/_img/_up/File/atvir/2012/leidiniai/LEI_2011_Annual_Report.pdf Lithuanian Energy Institute 2011 report

•http://portal.meril.eu/converis-esf/publicweb/research_infrastructure/2982 Information on the Semiconductor Technology Center

•http://www.lmt.lt/download/1367/2011_kelrodis_lmtik-b5-en-spreads.pdf Information on the Semiconductor Technology Center

•http://www.vgtu.lt/en Vilnius Gediminas Technical University home page

Poland

•http://www.pg.gda.pl/en/ Gdansk University of Technology home page
•http://www.tu.koszalin.pl/eng/civil.html Koszalin University of Technology home page
•http://www.cezamat.eu/index.php?lang=en Centre for Advanced Materials and Technologies (CEZAMAT)
•http://www.wayforlight.eu/eng/synchrotrons/solaris.aspx Information on the project "Solaris"
•http://www.synchrotron.uj.edu.pl/aktualnosci?p_p_id=56_INSTANCE_Zo55&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-3&p_p_col_pos=1&p_p_col_count=2&groupId=3863852&articleId=3894544 Information on the project "Solaris"
•http://www.uwm.edu.pl/en/ University of Warmia and Mazury home page
•http://www.cent3.uw.edu.pl/ The Warsaw University Biological and Chemical Research Centre (CENT III) home page
•http://www.cent.edu.pl/s,in_english,16.html Information on the New Technology Centre of the Warsaw University *OCHOTA*
•http://www.pw.edu.pl/engpw/Research/Research-Centres The Warsaw Institute of Technology home page
•http://www.zut.edu.pl/west-pomeranian-university-of-technology-szczecin/home/news/current-news.html The West Pomeranian University of Technology home page

Finland

•http://www.vtt.fi/?lang=en VTT Technical Research Centre of Finland home page

•**http://www.thl.fi/en_US/web/en** National Health and Welfare Institute home page

•https://portal.mtt.fi/portal/page/portal/mtt_en The Agricultural Research Centre of Finland home page

•**http://www.metla.fi/index-en.html** Finnish Forest Research Institute Metla home page

•**http://www.helsinki.fi/university/** University of Helsinki home page

•http://www.tut.fi/en/ Tampere University of Tehnology home page
•http://www.btk.fi/home/main/ Turku Centre for Biotechnology home page

Germany

•http://www.helmholtz-berlin.de/index_en.html Helmholtz Research Centre for Materials and Energy in Berlin

•http://www.embl-hamburg.de/aboutus/index.html Information on European Molecular Biology Centre•https://www.xfel.eu/ European X-Ray Electron Laser Laboratory home page
•http://www.iap.fraunhofer.de/en/kontakt.html Fraunhofer Institute for Applied Polymer Research IAP home page
•http://www.ibmt.fraunhofer.de/en.html Fraunhofer Institute for Biomedical Engineering in Potsdam home page
•http://www.ifam.fraunhofer.de/en.html Fraunhofer Institute for Manufacturing Technology and Advanced Materials in Bremen home page
•http://www.pyco.fraunhofer.de/en.html Research Institute for Polymeric Materials and Composites in Teltow home page
•http://www.izm.fraunhofer.de/en.html The Fraunhofer Institute for Reliability and Microintegration home page
•**http://www.isit.fraunhofer.de/en.html** Microelectronics and Microsystems Technology in Itzeho home page

•http://www.inp-greifswald.de/web-n.nsf/index?OpenPage&Eintrag=19D6C24CD60E2B35C12573B0003C6F5F&Language=eng The Leibniz Institute for Plasma Science and Technology (INP Greifswald) home page
•http://www.fmp-berlin.info/home.html Leibniz Institute for Molecular Pharmacology (FMP) in Berlin home page
•http://www.fz-borstel.de/cms/en/science/about-us.html Medicine and Biosciences Leibniz Institute home page
•http://www.catalysis.de/index.php Leibniz Institute for Catalysis (LIKAT Rostock) home page
•http://www.mbi-berlin.de/ne/ organization/divisions/c/MAX BORN INSTITUTE for nonlinear Otics and Short Pulse Spectroscopy in Berlin home page
•http://www.pdi-berlin.de/ Paul Drude Institute for Solid State Electronics home page
•http://www.hzg.de/central_departments/gems/about/index.html.en German Engineering Materials Science Centre home page
•http://www.fbh-berlin.com/ Ferdinand-Braun Institute in Berlin home page
•http://www.desy.de/ German Synchrotron Research centre home page
•http://photon-science.desy.de/ Information on German Synchrotron Research centre

Sweden

•http://www.ltu.se/?l=en Luleå Centre of Technology home page
•https://www.maxlab.lu.se/about „Max IV" Laboratory home page
•http://bbmri.se/en/ The BioBanking and Molecular Resource Infrastructure of Sweden home page
•http://www.vr.se/download/18.7257118313b299b0f27204/1357820119559/Interim+evaluation+of+11+national+research+infrastructure+No10+2012.pdf Interim Evaluation of 11 National Research Infrastructures 2012; Swedish research council, 2012;

Institutions which provided answers to the electonically sent quiestionnaires during the research

- DTU-Denmark Technical University
- LIAA-Investment and Development Agency of Latvia
- Lunda University
- Latvian Institute of Organic Synthesis
- The University of Latvia (LU) Institute of Solid State Physics
- „MAX IV Laboratory"
- Institute of Physics, Polish Academy of Sciences
- University of Tartu
- Tartu Science Park
- GEMS - German Engineering Materials Science Centre
- Institute of Biotechnology Vilnius University (VU)
- Vilnius University Institute of Applied Research

Other sources

•http://www.scanbalt.org/the+region/northern+germany Home page on the administrative division of Germany

•http://www.liaa.lv/files/liaa/attachments/frascati_rokasgramata_0.pdf Frascati manual

List of questions inelectronically sent questionnaires

Questions to the partners of the project „Science Link"

How would you define a large scale scientific infrastructure in your field?

1. What kind of information do you deliver to the enterprises operating in the industry, which could be interested to cooperate with your institute?
2. Do you have any contacts with the companies abroad?
3. What kind of communication channels do you use to attract the industry?
4. How would you evaluate the interest of the industry in general to cooperate with science infrastructures: very small, medium or sufficient?
5. What is the profile of the companies looking for cooperation possibilities?
    a. Industry (what kind of industry is represented?)
    b. Employees (amount of employees working in the enterprise)

c. The research content

d. The amount of projects that is done in cooperation with paticipants of the specific idustry

6. What is the amount of enterprises that have bought the services from you within the last five years?

7. What is the amount of the enterprises that have bought the services from you within the last five years?

8. How is increasing/ decreasing the amount of the industry proposals for cooperation?

9. What kind of services are mostly demanded by the industry?

10. Have you made an observation wihin the last five years, what kind of components, e.g., laboratories, the enterprises are looking for in your science infrastructure?

Questions to the science infrastructures

1. How would you define a large scale infrastructures in your field? What are the characteristics of them?

2. What kind of products/ services is the industry mostly interested in?

3. What kind of information do you deliver to the industry, enterpreneurs in order to rouse their interest to cooperate with your scientists and use your infrastructure?

4. Do you have any cooperation partners apmong the enterpreneurs, industry abroad? How did you establish such contacts? If you do not have them, what has disturbed you to establish them, and has there been any interest to establish them?

5. How do you evaluate the interest of the industry, enterpreneurs to cooperate with you and overall with the scientific institutes and infrastructures?

6. What is usually the potentional cooperation partner like:

6.1. What field does one operate in?

6.2. How large is the enterprise – how many eployees does it have?

6.3. What would be the potentional research on – what kind is it?

6.4. What kind has the previous cooperation of the company with scientific or research institutions been at? At least: has there been any earlier cooperation with you?

7. How many enterprises have bought and used the services offered by your scientific intitute or centre within the last five years?

8. What are the trends? Is the interest increasing, decreasing or constant?

9. Are there any data, fact summarization that would illustrate the interest of enterpreneurs or industry on your scientists and science centre service usage within the last five years? For example, how many cooperation projects have taken place, what kind of enterprises have addressed you, and what kind of services or products have they required?

Questions to the state institutions

1. How would you characterize the interest of Latvia and foreign enterpreneurs to cooperate with scientists from Latvia, for example, by ordering a research?
2. In your point of view – what could allure the Latvian foreign enterpreneurs or other kind of partners to cooperate with the scientists of Latvia, and use its scientific infrastructure?
3. What can the Latvian scientists offer to the enterpreneurs – what kind of services or researches? To do a research, develop a new project, or anything else?
4. Are there any data available on how many eneterpreneurs and of how big value have ther ordered researches to the scientists?
5. Which field enterpreneurs cooperate the most with the scientists? Can you name the brightest examples?
6. Name a product or products that have entered the Latvian and/or world market, and have been created after the cooperation with enterpreneurs (also foreign, if known) and scientists?
7. Has the cooperation with the scientists promoted the competitiveness of the Latvian enterpreneurs, introduction of a new product, etc.? If yes - in what way? (for the Latvia state institutions)

1. How would you characterize the infrastructures competitive in international level What characteristics should they have?
2. Are there possible the public scientific infrastructures in some particular categories? For example, large infrastructures, which are able to organize a large scale projects and smaller ones that prefer working together with other institutions (research centres, universities, institutes, etc.)? Probably, there are also other ways, how to define different kinds of research infrastructures?
3. In which fields of those included in reseach, is the scientific infrastructure more competitive in your country? Could you provide an example?
4. Are the universities, institutes and rsearch centres trying to attract the enterprises? Are they interested to cooperate with companies? What kind of products and services can the research centres offer to the enterprises?

5. How big is the interest of enterpreises to cooperate with research centres? If the answer is affirmative, what kind of services does the industry want the most?

6. Is the science infrastructure in your country consistent with the requirements and needs of the enterpreneurship?

7. Is it known, how many researches have been made within the last five years by the industry order? Also, is it known, how big funds have been invested by the enterpreneurs in the research projects?

8. Which universities, colleges, public science centres or institutes are the most active in cooperation with the enterprises?

9. Which universities, colleges, public science centres or institutes are rated uppermost among the enterprises?

10. Can you give any example when the enterprise and science institution would have had a productive cooperation? For example, during the cooperation there would be developed a new product or service?

11. Do you have any documents, facts, statistics or reports on amount of cooperation among the enterprises and research institutes in your field and country? Could you suggest any institution or person, that could give facts or documents on the cooperation of this kind? (Questions to the institutions of all countries, except Latvia – translation from original)

Questions to the enterpreneurs

1. What kind of products or services has your company been willing to develop or create in cooperation with scientific institutions? What was the aim?

2. What conditions promote or distrub cooperation with scientific institutions? What are criterion for estimating the potentional cooperation, for example, cooperation with institutions could be too expensive, thus you reject the cooperation, or vice versa – you believe the scientific institutions to be prestige and reliable establishments, thus you willingly cooperate?

3. How does your company evaluate the previous cooperation with different scientific institutions? For example, was it easy to cooperate and come to agreement, was the expected goal, set before the cooperation, reached?

4. Why would/ would not your company be willing to meet the scientific institutions?

Questions to enterpreneural organizations

1. How would you characterize the Latvian and foreign enterpreneurs` interest to cooperate with Latvian scientists by, for example, ordering some research?

2. What are the entepreneurs interested in (if at all) in the work of scientists and their offer? To do a research, develop a new product or anything else?

3. Is there any data available on the issue, how many enterpreneurs and of how big amounts of money they have ordered the researches to the scientists?

4. Which field enterpreneurs cooperate with scientists mostly? Which are the brightest examples?

5. What should be done to improve the cooperation between the scientists and enterpreneurs?

6. Can you name any product that has entered the market after cooperation of enterpreneurs and scientists?

7. Are there any calculations how big in terms of money have the enterpreneurs` orders to scientists been?

8. Have there been any cases when the work of scientists would be at least partially repaid by improvement of the science infrastructure?

9. In your view – what could allure the Latvian foreign enterpreneurs or other kind of partners to cooperate with Latvian scientists, and use the Latvian scientific infrastructure?

10. In which fields is the Latvian scientific infrastructure competitive in the scale of Baltics, Northern Europe, Central Europe? (for the Latvian Latvijan enterpreneurs` organizations)

1. What kind of products or services can the science centres offer to the business companies in your field?

2. What kind of services the business companies are looking for in collaboration with the research institutions?

3. What are the circumstances that encourage or delay the enterpreneurs to cooperate with the research institutions in your field?

4. Have you yourself ever cooperated with any university or research institution? If the answer is "No", then why? If the answer is "Yes", how would you assess this cooperation: was it productive? Would you be willing to cooperate again?

5. Is the business infrastructure correspondingto the business demand and needs in your country?

6. Do you recall any example when the companies have had productive cooperation with research institutions? For example, during the time of cooperation a new product is created, or a new service offered?

7. Is there any data describing the amount of researches conducted in your country by the order of the enterprises during the last five years? Is there a calculation done, how much resources have been invested in these projects by the entrepreneurs?

8. What is a typical company like, which is looking for opportunities to cooperate with a research institution?

8.1 What area does operate in?

8.2. How big is the enterprise – how many employees are employed?

8.3. What should the potentional research be on – of what kind is it?

8.4. What has been the company's cooperation with scientific research institutions like-

at least, has it cooperated with you in the past?

9. Do you have any documents, facts, statistics, reports of cooperation between the business and science institutions in your area, state, etc.? Maybe you can recommend any institution or person that can deliver some facts, documents? (Questions to the institutuions of all states, except for Latvia - translation of the original)