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THE IMPACT OF RESEARCH AND DEVELOPMENT FOR BUSINESS INNOVATIONS IN LITHUANIA

Dalia Streimikiene*

Vilnius University, Kaunas Faculty of Humanities, Kaunas, Lithuania

Abstract

The paper aims to assess the impact of research and development on innovativeness of the country as research and development is one of the main drivers of economic development and creation of modern knowledge based economy stipulating efficient use of natural resources and reducing negative impact on environment. The paper analyzes the main Lithuanian policy documents aiming at promotion of knowledge economy, innovations and research and development and financing of research, technological development and innovation. The programmes aiming at modernization of enterprises and trends of sustainable industrial development in Lithuania are critically reviewed. The Summary Innovation Index (SII) of Lithuania was applied to assess the impact of implementing policies promoting research and development in Lithuania. The analysis indicated that one of the main factors determining the relatively low Lithuanian SII is the insufficient level of investment in research and development (R&D). While R&D expenditure in the general government and higher education sectors corresponds to the EU average, it remains low in the business sector.

Keywords: research and development, sustainable industrial development, modernization of enterprises, innovation index

JEL Classification: L2, L26; L53; O32; O35

Introduction

Research and development is one of the main drivers of economic development and creation of modern knowledge based economy stipulating efficient use of natural resources and reducing negative impact on environment. The results of R&D and innovative activity in Lithuania have to achieve the general targets declared at the European level and ensure Lithuania a strong competitive position in global markets. Over the next decade, Lithuania has to create an economy based on innovations, new technologies and qualified human resources and create better general and financing conditions for scientific research and innovation so that innovative ideas are translated into goods and services aimed at promoting growth and new job creation. The National Programme for the Development of

* Author's contact: e-mail: dalia@mail.lei.lt

Studies, Scientific Research and Experimental (Social and Cultural) Development for 2013–2020 (Republic of Lithuania, 2012a) and The 2013–2015 Action Plan for the National Programme for the Development of Studies, Research and Experimental (Social and Cultural) Development For 2013–2020 (Government of Republic of Lithuania (2012b) were developed with a view to defining the main directions of studies, scientific research and experimental (social and cultural) development (hereinafter – SR&ED), which would encourage sustainable development of people and society, improve the country's competitiveness, and comply with the key provisions of the Lithuanian Progress Strategy 'Lithuania 2030'(Government of Republic of Lithuania, 2010a) and the Commission Communication "Europe 2020: A strategy for smart, sustainable and inclusive growth" (EC, .2010). The Programme will provide grounds for training highly qualified specialists who are able to compete on the labour market, creating conditions for high-quality SR&ED practices to form, and developing interinstitutional, intersectoral and international cooperation. The strategic objective of the Programme is to encourage the sustainable development of people and society, which improves the country's competitiveness and creates conditions for innovation by developing studies and implementing SR&ED(Republic of Lithuania, 2012a).

To foster competitiveness, Lithuania will follow these priority action directions identified in Lithuanian innovation strategy for the year 2010-2020 (Government of Republic of Lithuania, 2011b):

- Develop national sectors of high and medium high-technologies by attracting public and private sector investments to R&D and promoting science and business partnerships;
- Develop clustered innovative traditional industries;
- Develop new fields of economic activity: clean technologies, future energy, creative and cultural industries, areas of health and welfare;
- Improve business and investment conditions in Lithuania;
- Promote foreign investment by developing service hubs for export in Lithuania;
- Improve the quality of the education system with special attention to lifelong learning;
- Train highly qualified specialists meeting public and economic demands;
- Develop and use R&D results in order to highlight and strengthen the country's advantages;
- Ensure quality functioning of the study and R&D system;
- Strengthen foreign language teaching.

The aim of the paper is to review Lithuanian research and innovation policies seeking to develop and implement resource efficient technologies, environmentally safe production. The main tasks to achieve this aim are:

- to analyze the main Lithuanian policy documents aiming at promotion of knowledge economy, innovations and research and development;
- to analyze financing of research, technological development and innovation;

- to analyse programmes aiming at modernization of enterprises in relation with trends of sustainable industrial development in Lithuania;
- to define the main results of implementing policies promoting research and innovations in Lithuania.

1. Lithuanian innovation strategy

After the new 15th Lithuanian Government took office in late 2008, the priority of creating the innovating and knowledge-based economy was put high on the political agenda. The new much stronger political will was demonstrated, firstly, by adopting the national innovation strategy in 2010 and, secondly, by establishing the national Agency for Science, Innovation and Technology (MITA) the same year. A number of other innovation policy related measures and initiatives were introduced during the period of 2009-2011. The Lithuanian Innovation Strategy (LIS) for the period 2010-2020 aims to drive innovation in various areas, acknowledging that this is needed to modernize the economy (Government of Republic of Lithuania, 2011b). The strategy emphasises that the Lithuanian government should foster innovation by any means. The longer term objective is to improve the Lithuanian innovation index to the European average level by 2020. To this end, the Lithuanian government intends to strengthen cooperative research projects that can support the long-term objectives. The LIS Action Plan 2010-2013, containing a list of specific measures related to research and innovation and developed as a result of efforts by the 12 ministries, was approved in October 2010. This document demonstrates a shift in the overall innovation policy approach as compared to the previous fragmented pool of strategic documents and priorities (Government of Republic of Lithuania, 2010c):

- LIS demonstrates a shift towards the ‘horizontal’ (‘broad-based’) innovation policy. The objectives of the Strategy call for greater emphasis on the knowledge triangle policies as a common effort of several ministries. The Action Plan for 2010-2013 integrates the innovation policy related measures of all ministries operating in Lithuania.

- The document extends the definition of ‘innovation’, by including new objectives to foster social innovation, customer-oriented innovation, non-technological innovation, demand-oriented innovation, and public innovation. Unfortunately, the appetite of the new Government for strengthening the innovation policy mix is constrained by the State budget crisis due to the recession. The Strategy ‘inherited’ the previously planned RTDI policy mix. Therefore, the Action Plan for 2010-2013 does not foresee any *specific* measures that would contribute to fostering the social, customer-oriented or public innovation;

- There is much stronger emphasis on the internationalization of the innovation policy mix and innovation networks. The Strategy supports integration of the business actors and Public Research Organizations (PROs) into the international innovation networks; it puts higher emphasis on direct foreign investments, internationalization of business, etc.;

- There is also greater emphasis on creativity and entrepreneurship, especially on the establishment and growth of the young innovative companies, start-ups, and ‘gazelles’. The overall aim of the Strategy is to foster the creative society.

The innovation policy mix has not changed much since 2009 for two reasons. Firstly, current innovation policy mix is implemented largely through the 2007-2013 EU Structural

Funds, which were planned in 2006-2007. Secondly, the government's ability to strengthen the budget for innovation and introduce new measures remains heavily constrained by the State budget cuts. Therefore, despite the newly adopted Lithuanian Innovation Strategy which introduced new approach to innovation support, no major changes occurred in the innovation policy mix. The few exceptions are discussed below (Paliokaitė, 2012). The national budget funded pilot measure of 'innovation vouchers' (each worth €2,900–€5,800, annual budget €0.3m) was introduced by the MoE and MITA in summer 2010. The funds were distributed in less than a month, therefore the innovation vouchers were re-launched in summer 2011. The measure is targeted at the small and medium-sized enterprises (SMEs).

The Lithuanian Innovation Strategy defines a list of so-called 'breakthrough' sectors and technologies, namely: biotechnologies, laser technologies, ICT, electric and optical technologies, 'clean' technologies, future energy, creative industries, health and wellbeing, chemicals sector, transport and logistics, wood and furniture, textiles, and food industry. In general, with small amendments, this list remains unchanged since 2002.

In January 2011 the Minister of Education and Science and the Minister of Economy approved the High Technology Development Programme for 2011-2013 that will invest into high technologies development in five priority sectors: biotechnology, mechatronics, laser technology, ICT, and nanotechnology and electronics (budget for 2011 is €0.29m). In March 2011 the Minister of Education and Science and the Minister of Economy approved the new Industrial Biotechnologies Development Programme for 2011-2013, which is expected to accelerate development of the Lithuanian biotechnology industry (budget for 2011 is €0.29m). Both programmes are administered by MITA (Republic of Lithuania, 2012c).

National Programme for the Development of Studies, Research and Experimental Development for 2013–2020 is aimed at strengthening the country's competitiveness and increasing welfare by developing the study, R&D and innovation systems. Planned measures include (Republic of Lithuania, 2012a):

- Continuous update and improvement of the study content and process;
- Modernization of the necessary study infrastructure for the organization of the quality study process;
- Ensuring the implementation of R&D activities conforming to the highest international level, meeting public and economic demands and creating a high value added, strengthening of intellectual R&D potential;
- Development, update and concentration of infrastructure which would enable high impact technologies and other promising R&D directions and economic sectors to be developed;
- Creation and development of the innovative use of R&D results;
- Ensuring the monitoring of activities, quality assessment and communication between research and study institutions.

Planned measures include Republic of Lithuania, 2012b):

- Implementation of measures provided for in the General Education Curriculum Formation, Assessment, Updating and Implementation Strategy (2006–2012) pertaining to the teaching and widened choice of foreign languages and increasing student choice in studying foreign languages;

- Implementation of projects of the School Improvement Programme Plus (SIP+) and other projects aimed at improvements in school infrastructure, developing management competences and leadership skills, increasing student choice in foreign language learning, improving early teaching of foreign languages and ensuring project continuity.

A new version of the Law of the Republic of Lithuania on Higher Education and Research passed by the Seimas of the Republic of Lithuania in 2009 lays down foundations for a systematic reform of science and studies. As of 2009, studies in higher education establishments have been funded from the so called student's basket. The number of entrants to higher education is in line with the financial possibilities of the state. Actual studies are funded from public and private funds.

2. Integrated science, studies and business centers

To make science more competitive, the focus is placed on project-based competitive funding for research. The development of science and technologies, cooperation between universities and businesses, scientific cooperation and public-private partnership are still of great relevance, therefore much attention is given to the advancement of the integrated centers (valleys) for science, studies and business. Programmes for five Valleys have been approved by resolutions of the Government of Lithuania in 2008. It has been decided to prepare Joint Research Programmes (hereinafter referred to as JRP) aiming at co-ordination of the implementation of the projects of Valleys and better utilization of the funding allocated.

Integrated Science, Studies and Business Centers (hereinafter referred to as Valleys) are developed in Lithuania with a view to building up research, studies and knowledge economy clusters of international level in Lithuania, accelerating the development of knowledge society and consolidating the long-term foundation for the competitiveness of Lithuania's economy. The Valleys' development programmes are designed including their objectives, tasks and establishment conditions as specified under this Concept and approved by the Government of the Republic of Lithuania. The main objectives of development of Valleys are the following (Paliokaite, 2012):

- Concentrate, upgrade and optimize the infrastructure that would facilitate the development of high technologies and other most viable sectors of science, technology and business as specified in High Technology Development Programme for 2007–2013, the Foresight for the Lithuanian Economy in the Light of Regional and Global Tendencies, the Strategic Research Plans (Agendas) of the National Technology Platforms and other strategic planning documents of national economic development;

- Consolidate the links with research and studies, and training of researchers and other experts;

- Provide favorable environment for the transfer of scientific know how and technology to the business sector;

- Establish centers for promoting research, studies and knowledge intensive business synergies, capable of competing on the international arena, developing scientific cooperation of the highest level, and attracting foreign investment that requires high intellectual potential;
- Establish knowledge economy clusters on the basis of science, studies, and knowledge intensive business.

The Programmes of Valleys were adopted in Lithuania (Table no. 1). The 5 Integrated science, studies and business centres(valleys) were established: „Saulėtekis“, „Santara“, Santaka“, „Nemunas“ and Lithuanian maritime sector development.

Table no. 1: Integrated Science, Studies and Business Valleys

The name	Aims of valley creation	Funds	MTEP directions	Initiators
„Saulėtekis“	to create an integrated centre/valley of science, studies and business for the development of the sectors of physical, technological and civil engineering through the development of business, internationally competitive fundamental and applied research, as well as the preparation of human resources to work in the mentioned R&D areas.	93,4 m. €	Laser and Light Technologies; Materials Science and Nanotechnologies; Semiconductor Physics and Electronics; Civil Engineering	Vilnius University; Vilnius Gediminas Technical University; Center for Physical Sciences and Technology; Public entity „Sunrise Valley“
„Santara“	to establish the valley aimed at the development of the sectors of biotechnology, molecular medicine and biopharmacy, innovative medical technologies, ecosystems and sustainable development, informatics and communication technologies in Lithuania, to enable starting up of business and development of fundamental and applied science competitive on the international market, also to train highly qualified specialists in the mentioned R&D areas.	95,914 m. €.	Biotechnology; Innovative Medical Technologies, Molecular Medicine and Biopharmacy; Ecosystems and Sustainable Development; Informatics and Communication Technologies.	Vilnius University; Vilnius Gediminas Technical University; Innovative Medicine Centre; Nature Research Centre; Vilnius University Hospital Santariškių Clinics; Visoriai Information Technology Park
„Santaka“	to establish the valley where public and private research will be performed, knowledge-intensive businesses will be launched and knowledge-intensive services will be provided.		Sustainable Chemistry (including Biopharmacy); Mechatronics and Related Electronic Technologies; Future Energy and (including Environmental	Kaunas University of Technology, Lithuanian University of Health Sciences, Lithuanian Energy Institute

The name	Aims of valley creation	Funds	MTEP directions	Initiators
			Engineering); Information and Telecommunication Technologies	
'Nemunas'	Developing available facilities, to create a specialized branch integrated science, studies and business centre (valley) NEMUNAS that has its infrastructure for public and private research and studies in the agricultural, forestry and food industry sectors as well as conditions for the establishment of knowledge-intensive businesses.	55,14 m. €	Agrobiotechnology, Bioenergy and Forestry; Food technology, safety and health	Lithuanian University of Agriculture Lithuanian University of Health Sciences Lithuanian Agrarian and Forest Sciences Centre Kaunas University of Technology
Marine valley	to create the centre (Valley) for the development of Lithuania's maritime sector, aimed at promotion of fundamental and applied studies competitive on the global market and at training highly qualified specialists for the needs of Lithuania's maritime sector	59,954 m. €	Marine environment; Marine technologies	Klaipėda University, Nature Research Centre

Source: Government of Republic of Lithuania, 2012.

The governing body of the valley's development process is the Valleys' Supervisory Council (Council); formed by the order of the Minister of Education and Science and Minister of Economy (the two ministries coordinate development of valleys). Its main function is to consider and submit proposals to the Ministry of Education and Science, the Ministry of Economy and the Government on strategic decisions regarding for development of the valleys and Joint Research Programmes. Valleys' monitoring group is composed from Lithuanian and foreign experts. Its main function is to monitor implementation and development of Valleys projects and Joint Research Programmes. They provide information, data, consultations and recommendations to the Valleys Supervision Board and the Management Committees of the respective EU SF programmes, necessary to take decisions concerning development, financing and implementation of the Valleys' projects and the JRPs. Monitoring groups provide recommendations and consultations for the institutions, responsible for R&D infrastructure development projects and create an efficiently operated "virtual enterprise" offering the best opportunities for foreign investments and public-private partnership in R&D and innovations. These institutions also introduce stage-gated funding control and relate the requested funding to a set of key performance indicators and perform regular evaluation of valleys' projects development issues.

3. Financing the research, technological development and innovation

The reorganization of research institutes has practically been completed: 16 research institutes have merged with universities, 13 research institutes merged in five research centers (research institutes), six institutes have been granted the status of a research institute. The science (art) funding arrangements have been amended, whereby one part of public funding shall be linked to the payroll and long-term institutional programmes, and the other part shall be linked to scientific (artistic) performance outcomes, thereby increasing public accountability of research institutes, as their long-term programmes (which are their main activity) will be approved by the Minister of Education and Science. The new scheme is expected to better meet specific academic requirements. State funds for research will fall in seven fields: humanities (13%), social research (12%), physical research (25%), biomedical research (19%), agriculture research (6%) and technological research (21%), as well as arts (4%). The proportion of funds has been set in accordance with the number of scientists working in a specific field and the level of research. Applied research will get a larger share of funds than before. A new financial instrument has been introduced: part of the funds will be allocated through the Lithuanian Science Council to support research commissioned by economic entities (BTI, 2012).

The current research, technological development and innovation RTDI policy in Lithuania is mainly funded by the European Regional Development Fund (ERDF)/ European Social Fund (ESF); only an insignificant part (about 2%-5%) is funded from the State budget. The public-private partnerships do not play a role in leveraging additional and/or complementary funding. The largest share of RTDI funding in Lithuania (more than €600m, or about 45% of total policy budget available for 2008-2013) is currently devoted to promoting and sustaining the growth of innovative enterprises. Venture capital funds comprise the highest share (about €415m) of funds in this category. The financial engineering funds as well as support to organizational innovations received highest political attention during the financial and economic crisis. Another 43% of the total public RTDI funding is to be allocated to research and technologies. More than half of it will be allocated to strengthening the public R&D infrastructure in the five integrated science, business and studies 'valleys'. The take up of these funds has been relatively low so far – less than 2% of the science 'valleys' funds were allocated in 2010.

The remaining 12% of the RTDI funding are planned for the investments in human resources (€157m for 2007-2013 periods; about €12.1m of which allocated in 2010). In order to ensure the long-term accumulation of human resources for R&D, for the programming period of 2007-2013, a national 'Researchers Careers' programme' (RCP) schedules a variety of actions. For example, such actions like the attraction of the highly-skilled researchers, funding short-term visits of the researchers from abroad, the researcher mobility between science and industry, etc.

Clearly, governance and horizontal RTDI policies, as well as markets and innovation culture, are currently beyond the RTDI policy attention in Lithuania. On the other hand, there are certain non-financial measures in these categories. For example, in December 2009, the Minister of Education and Science approved a set of IP Management Recommendations (guidelines) for the HEIs and Pros' In these Recommendations, the organizations are advised to organize IP management strategies in a way that creates more incentives for knowledge commercialization (BTI, 2012).

About 20-25% of the total planned RTDI funding is thematically or sectorally focused. About €300m will be allocated to the integrated science, studies and business 'valleys' that were selected in the priority research fields. Twelve national complex research programmes (NCPs) were approved in: biotechnology and biopharmaceuticals; lasers, new materials, electronics, nanotechnologies and applied physical sciences; sustainable chemistry; ICT; medical sciences; sustainable environment; mechatronics; civil engineering and transport; cultural and creative industries; marine sector; agriculture, forestry and food industry. Thirty four research projects under the NCPs will be during 2010-2013 with a total budget of €34m. The State will invest €5.7m in each of the national research programmes before 2013. The programmes were approved in these thematic R&D fields: future energy; chronic non-infection diseases; Lithuania's eco-system: climate change and human factor; safe and healthy food; State and the nation: heritage and identity.

4. Programmes aiming at modernization and restructuring of enterprise

Lithuanian Innovation Strategy for 2010-2020 is aimed at developing a creative society, facilitating the promotion of entrepreneurship and innovations so that the Lithuanian Summary Innovation Index reaches the European average in 2020. General National Programme for Cooperation Between Research and Science on the One Hand and Business on the Other Hand is aimed at promoting closer long-term cooperation between national research institutions and business by developing the most promising R&D directions in Lithuania, determining the commercialization of R&D results and technology development.

Planned measures include: promotion of business investments in R&D and creation of conditions for business to take advantage of R&D results; development of high-competence R&D centers in Lithuania; concentration of the available scientific potential for the resolution of problems that are important and relevant to the State, in order to ensure the practical use of R&D results; promotion of the establishment and engagement of national research networks into international research networks; creation of conditions for the activities of research groups in the centers of excellence; promotion of commercialization of R&D results (Government of Republic of Lithuania, 2010a).

The Administrative Burden Reduction Action Plan for 2012 encompassing administrative burden assessment and reduction on the basis of the European Commission methodology in 7 priority areas of transport, tax administration, employment relations, statistics, environmental protection, real estate operations, territorial planning and construction; developing the administrative capacities of civil servants in this area and disseminating information about better regulation; business environment improvement according to the World Bank's *Doing Business* Report; maintenance of a favorable and stable business taxation base; ensuring the availability and diversity of required financial resources meeting the needs of business entities; organization of entrepreneurship-promotion events and implementation of projects; optimization of business-inspecting authorities: simplification of the inspection function, reduction of the inspection burden for businesses and improvements in inspection transparency.

With a view to improving the quality of business support and financial assistance systems, it is planned to increase the availability of financial resources to SMEs, by further implementing financial engineering measures (guarantees to credit institutions to secure loans granted to SMEs, preferential loans, venture capital invested in the share capital of SMEs) and new measures (guarantees for leasing transactions concluded by SMEs, new venture capital measures – investments for the start of activities).

Improvements in the business environment can provide a significant boost to Lithuania's economic growth. It is especially important to improve the conditions for business start-ups, reduce the administrative burden for businesses, ensure the availability of financial resources, free and fair competition by removing burdens for new players willing to enter the market, and promote productive investments (Arbačiauskas *et al.*, 2010). Together with the assistance of EU Structural Funds, these measures will improve the competitive position of Lithuanian enterprises, facilitating the shift towards higher value-added activities. In the field of improvement of the business environment, the main work is related to the improvement of conditions for business activities. The setting-up companies online has been made possible by significantly shortening the time for incorporation of a company (29.5% of all newly-established private limited liability companies were incorporated online in 2011). Almost all (99.9%) annual financial reports are submitted to the Register of Legal Entities electronically. The measures to improve business conditions added to the growth of the number of newly established companies (13%, or 1,193 companies more), decrease in the number of deregistered (47%, or 2,844 companies less), and the creation of new jobs (4%, or 46,000). After the conditions for the issuance of construction permits had been improved, the length of the construction permit issuance procedures shortened from 162 to 83 days (Government of Republic of Lithuania, 2010b).

Besides that Lithuania has implemented the state-owned enterprise (SOE) reform which intended to lead to an increase in the transparency of the activities of these companies and an improvement in strategic activity plans. According (Government of Republic of Lithuania, 2012c) the reform contributed to the growth of SOE income by 7% – up to LTL 6.85 billion, to the growth of profit from SOE activities – a profit of LTL 183 million in 2011 from a loss of LTL 2 million in 2010, and to the growth of net profit from the SOE portfolio – up to LTL 79 million (LTL 76 million more than in 2010).

5. Innovations and sustainable industrial development

There is close relationship between promotion of research and development, innovations and sustainable industrial development (Brilius, 2010; Dzemydienė, 2008; Grybaitė, Tvaronavičienė, 2008). The practical application of sustainable development principles in activities of industrial enterprises is becoming an important aspect of business competition (Wenkateswaran, 2004). On the other side, sustainable development opens new business Opportunities, e.g., development of more environmentally friendly products and processes. Additionally, application of preventive environmental management measures helps to increase productivity, to reduce the use of natural resources and associated costs, to reduce costs for waste management and pollution control, to reduce risks, etc., i.e. to improve environmental, economic and social performance and thus provide a competitive advantage (Staniškis *et al.*, 2006).

To strengthen the ongoing activities and to ensure systematic application of sustainable industrial measures in industrial enterprises, the National Program on Sustainable Industrial Development has been developed and adopted in 2005 in Lithuania. The Program aimed to create the framework conditions that promote sustainable industrial development and enable effective implementation of sustainable industrial development measures, particularly in the areas in which not many activities have been undertaken in the country so far.

The main product-oriented measures include eco-design and life cycle management. These measures are aimed at improving the product environmental characteristics, taking into

account its entire life-cycle from raw material extraction to production, use and ultimate disposal as well as transportation in different phases of its life cycle. Product-oriented measures could significantly contribute to the process of sustainable development, because up to 80% of environmental and economic costs of products are determined in the phase of product design (Staniškis et al., 2002).

In terms of opportunities to reduce environmental impact and innovation level, product eco-design could be divided into four main categories: product improvement without product or production technology change, product modification which includes changes of product components, function innovation that includes product substitution by particular services, and system innovation which covers the major changes of a product and of the related technological and institutional system (Rethenau Institute, 1996). Life cycle management or a product-oriented environmental management system could be a way to apply eco-design principles and other innovations aimed at systematic improvement of product environmental characteristics. Although life cycle management has some distinct features, the general principles discussed in the previous sections could be used for development of such management systems (Wade, 2005; Welford, 1993).

Development of sustainability reports motivates enterprises to analyze their activities and helps to identify opportunities for improvement of their environmental and economic performance. On the other side, sustainability reporting contributes to raising public awareness in sustainable development (Pivoras, 2002). In Lithuania, the number of industrial enterprises implementing sustainable industrial development measures is increasing. Forty enterprises from 100 most advanced Lithuanian enterprises participated in various programmes and projects related to sustainable industrial development. However, most of the implemented measures lay in the areas of cleaner production and environmental / quality management systems. In other areas, such as product-oriented measures of sustainable industrial development and sustainability reporting activities are in the phase of initiation.

The Institute of Environmental Engineering of Kaunas University of Technology (APINI) initiated implementation of cleaner production in Lithuania and is the main institution in the country to work in the area. During tow last decades with support provided by different donors and in co-operation with different foreign and local partners, APINI supported more than 100 Lithuanian companies to implement cleaner production projects. Most active in this regards were textile (21 companies) and food industry (19 companies). Cleaner production measures mainly have been used to reduce energy consumption (93 projects) and water consumption (70 projects). The number of projects in the areas of water pollution reduction, waste minimization and air emission reduction was almost the same (34, 36 and 37, respectively). In terms of innovation type, most of investments have been used in process optimization and technology change (BTI, 2012).

Various sources of financial support are available for SMEs in Lithuania to finance innovations. These sources include national and EU funding in the form of various funds in the framework of different programmes. EU support can be provided directly (e.g. EU subsidies) or through the programmes administered on the national level, e.g. the EU structural funds. National support is provided in accordance to The Law on Development on Small and Medium Sized Business, which states that governmental support is provided in accordance with national, regional and municipal programmes for small and medium sized business development. Support for SMEs can be provided through: tax reductions

(in accordance with existing legislation); financial support (soft credits, compensation of particular costs, including bank interest rate for credits, quality certification costs, etc.), subsidies for establishment of new work places; consultations, training for SME managers and employees; and establishment of business incubators, technology parks and their services (Arbačiauskas *et al.*, 2010). In 2007 – 2013, the EU structural support to SMEs in Lithuania is provided in line with the Strategy for Use of EU Structural Support, approved by the European Commission on 26th April, 2007. The Strategy specifies priority investment directions of the EU structural support. There are several financial measures that provide support for technical feasibility studies, support for applied scientific research in development of innovative products, services or processes and/ or technological development, support for diffusion of knowledge and technologies, support for acquirement of new productive equipment (high technology), support for implementation of modern management processes or control systems.

Though there are several financing mechanisms in the framework of the EU structural funds are available for SMEs in Lithuania none of the available financing mechanisms provides support for innovation development. International project SPIN (Sustainable Production through Innovation in SMEs) in the Baltic Sea region aims to ensure an increase in exploitation of the innovation potential from SMEs to enhance sustainable production processes in SMEs leading to the creation of public benefits and private profits whilst reducing economic and environmental costs. Therefore, there is a clear need to intensify use of information dissemination about eco-innovations and a proactive approach in solving environmental problems, and associated capacity building activities.

6. The impact of promotion of research and development in Lithuania

There were several attempts to assess the impact of research and development on country competitiveness and development of innovations (Kaplinski, Tupėnaitė, 2011; Žvirblis, Buračas, 2012). However seeking to compare results achieved by countries summary innovation index can be applied (BTI, 2012). In 2011, the Summary Innovation Index (SII) of Lithuania was 0.255, while the EU-27 average was 0.539. Taking into account recent trends in the Lithuanian SII and the economic, social and political situation, it is expected that the Lithuanian SII will be 0.280 in 2015, reaching the EU-27 average observed in 2008 by 2020.

One of the main factors determining the relatively low national SII is the insufficient level of investment in research and development (R&D). In 2009, LTL 765 million were allocated for R&D activities (0.84% of GDP), whereas, in 2010 this amount was LTL 755.6 million (0.79% of GDP). In 2010, the largest share of investment in R&D comprised funds of the general government (47.5%), business entities (24.1%), foreign funds (20.0%), higher education and non-profit institutions (8.4%). While R&D expenditure in the general government and higher education sectors corresponds to the EU average, it remains low in the business sector (BTI, 2012).

It has been projected that Lithuanian R&D expenditure should reach 1.9% of GDP in 2020, first of all, by providing better conditions for the private sector to invest in R&D. Private investments in R&D may be attracted by raising the level of the quality of scientific research, which requires adequate infrastructure and intellectual potential, and by creating

favorable conditions for science-business partnerships and developing common support schemes for business-science projects.

As significant EU assistance is already scheduled for 2011-2012, R&D expenses will apparently increase; and subsequently, additional investments by the state and the private sector will grow in importance. When setting the rate of targeted R&D expenditure, it was assumed that by increasing its investment in R&D infrastructure, environment and human resources to about 1% of GDP, the State could attract larger investments from the private sector and foreign investors that could provide funding amounting to around 0.9% of GDP. Important factors expected to contribute significantly to raising the R&D expenditure are corporate income tax allowances for enterprises that invest in R&D and technology renewal. Reforms in the education and studies system should also contribute to attracting foreign investment. Moreover, it is crucial to project R&D expenditure during the 2014-2020 EU assistance periods.

The value for Technicians in R&D (per million people) in Lithuania was 445.06 as of 2010. As the graph below shows, over the past 13 years this indicator reached a maximum value of 650.38 in 1996 and a minimum value of 412.61 in 2006. Comparing with other countries it is 445 per million populations comparing with 627 in Estonia or 628 in Denmark (BTI, 2012).

Despite the improvement of demand for innovation, public or private, does not appear to be a strategic priority, first weak signs and fragmented actions demonstrate that this issue is being slowly recognized by the policy makers as important for spurring and diffusing innovations. The Lithuanian Innovation Strategy adopted in 2010 for the first time mentions an intention to foster 'demand oriented innovations (Government of Republic of Lithuania, 2010b). The Strategy lists a number of measures for the period 2010-2013 that will contribute to achieving this objective. Despite the versatile innovation policy mix already in place, Lithuania needs to ensure better support to newly established firms and knowledge commercialization, as well as to take a step in linking supply and demand-side measures and exploring the full potential of demand-side policies in innovation.

Conclusions

The priority of establishing the creative and knowledge-based economy was placed high on the political agenda in Lithuania and the Lithuanian Innovation Strategy (LIS) was adopted in 2010 together with establishment of the Agency for Science, Innovation and Technology (MITA) in the same year however Lithuania hasn't reached very good results in innovation indicators development.

Lithuanian Innovation Strategy for 2010-2020 is the main policy document which provides for developing a creative society, facilitating the promotion of entrepreneurship and innovations. General National Programme for Cooperation Between Research and Science and Business prepared under Lithuanian Innovation Strategy promotes closer long-term cooperation between national research institutions and business by developing the most promising R&D directions in Lithuania, determining the commercialization of R&D results and technology development

However the current research, technological development and innovation (RTDI) policy in Lithuania is being financed mainly from the European Regional Development Fund

(ERDF)/ European Social Fund (ESF). Though the largest share of RTDI funding in Lithuania is currently devoted to promoting and sustaining the growth of innovative enterprises more resources are necessary. Another important share of the total public RTDI funding is allocated to research and technologies through financing of the public R&D infrastructure in the five integrated science, business and studies 'valleys'.

Lithuanian innovation policy has focused on the supply-side and has paid little attention to the demand-side for innovation. Nevertheless, there are weak signs of the emerging awareness on the demand-side policies. The future innovation policy challenges cover the improving the efficiency of the currently planned policy mix and finishing the institutional structure reforms; planning for the next Structural Funds period (2014-2020) and eventually bridging the gap between the actual policy measures and policy objectives established by Lithuanian Innovation Strategy in 2010-2020.

Several financing mechanisms in the framework of the EU structural funds are available for SMEs in Lithuania to finance innovations but none of the available financing mechanisms provides support for innovation development. International project SPIN (Sustainable Production through Innovation in SMEs) in the Baltic Sea region aims to ensure an increase in exploitation of the innovation potential from SMEs to enhance sustainable production processes in SMEs leading to the creation of public benefits and private profits whilst reducing economic and environmental costs.

In 2011, the Summary Innovation Index (SII) of Lithuania was 0.255, while the EU-27 average was 0.539. One of the main factors determining the relatively low national SII is the insufficient level of investment in research and development (R&D) from the state budget. While R&D expenditure in the general government and higher education sectors corresponds to the EU average, it remains low in the business sector.

Despite the versatile innovation policy mix already in place, Lithuania needs to ensure better support to newly established firms and knowledge commercialization, as well as to take a step in linking supply and demand-side measures and exploring the full potential of demand-side innovation policies.

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