Chapter 5.

Innovation policy and governance in Lithuania

This chapter examines public innovation policy and governance in Lithuania. It begins with an overview of the historical evolution of science, technology and innovation policy in Lithuania. It then examines the main policy actors and governance arrangements under the light of observations made in earlier chapters and outlines areas in need of dedicated policy attention.

5.1. The evolution of science, technology and innovation (STI) policy in Lithuania[1]

The first phase (2002-07)

During 2002-07, Lithuania's innovation policy was characterised by ambitious plans to foster high-technology-oriented strategies. At the same time, the plans lacked sufficient commitment and financial investment for implementation. The underlying rationale for the strategies during this period was to achieve cohesion with Europe. The strategies took account of the national context, and recognised critical weaknesses of the innovation system. However, the institutional capacity to build up the evidence base for strategy development was weak at the time. Policies were developed top-down, involving little stakeholder consultation. This may have been one of the reasons why the resulting strategies lacked clear focus, priorities and selectivity, and some of them were not implemented. All this indicated significant weaknesses related to policy governance. Ambitious, sometimes unrealistic objectives and a lack of prioritisation met with a scarcity of resources. Scarce resources were spread across a number of initiatives which tended to be too small to have significant impact. Major research and innovation strategies and policies during 2002-07 are summarised in Box 5.1.

Box 5.1. **Research and innovation strategies and policies during 2002-07**

The **Long-term Strategy on Development of Lithuania** in 2002 was one of the first documents recognising the importance of innovation policy. The strategy highlighted societal goals and three main pillars: knowledge society, secure society and competitive economy. Several measures were planned to target research and innovation, including science and education, administrative capacity, information and communication technologies (ICT) infrastructures and science-industry collaboration.

The **Long-term Strategy of Economic Development by 2015,** prepared in 2002, was foreseen to complement the Long-term Strategy on Development of Lithuania. However, the strategy was never actively implemented. The Ministry of Economy took action in 2007 to revise this strategy with the help of external assistance, but the revised strategy was never approved.

The **Lithuanian Science and Technology White Paper,** prepared in 2001, was the first integrated strategy and vision for research and development (R&D). It recognised that Lithuania already possessed some of the pre-requisites for developing its R&D system (such as pockets of high-level research, potential for industry-relevant applied research, some high-technology products and research-intensive services).

In 2003, the white paper was used as the basis for the **Long-term Research and Development Strategy**. The strategy identified the need to take action in supporting R&D and competitiveness of industry, agriculture, construction and services, to improve the environment for private investments into research; to enable the scientific and business partnerships, high-tech start-ups, use of tax policies, venture capital and European Union (EU) funds; improve the quality of research focusing on the European Research Area, support joint projects with other countries; to establish an effective national innovation system, which guarantees favourable conditions for new technologies and methods of operation, development and diffusion; create a database of statistics on R&D policy. Reaching European innovation practice for science-industry collaboration, increasing gross expenditure for R&D (GERD) to 3% and business expenditures for R&D (BERD) to 2% and increasing high-tech share of gross domestic product (GDP) to 20% by 2010 (in seven years) were the ambitious, yet in retrospective highly unrealistic objectives set in the strategy.

Box 5.1. **Research and innovation strategies and policies during 2002-07** (*continued*)

Lithuanian R&D priorities for 2002-06 were selected in a top-down process. They included:

- research on human quality of life (genomics and biotechnology for health and agriculture; food quality, safe and ecologically clean food technologies, ecosystems and climate change
- research for the knowledge society: information society technologies; citizens and governance in a knowledge society; national identity in the context of globalisation
- research to develop nanotechnology (nanoscience, nanotechnology, multifunctional nanostructured materials
- research and experimental development for nuclear safety in the operation of the Ignalina nuclear power plant operation and decommissioning, radioactive waste management challenges (nuclear safety; radioactive waste management technologies)
- research and experimental development of Lithuanian industry to increase international competitiveness (biotechnology, mechatronics, laser, information and other high technologies).

The World Bank report **"Lithuania Aiming for a Knowledge Economy"** (World Bank, 2003) dealt with reforms and bottlenecks Lithuania was facing. The report's key recommendations were to improve collaboration between business, academia and the public sector, reform public institutions related to the knowledge economy, provide incentives for innovation, learning and networking, support labour market development to address future skill gaps, and strengthen the regulatory framework.

Major programmes during the period 2002-07 included:

The **High-technology Development Programme 2003-06** aimed to support already existing high-tech industry. It focused on:

- biotechnology
- mechatronics
- laser technologies
- information technology (IT)
- nanotechnology and electronics.

There was also a biotechnologies development programme.

The **Innovation in Business Sector Programme 2003-06** sought to promote innovation, increase public awareness of innovation, promote scientific and business community co-operation, improve the environment and support the development of infrastructure

The second phase (2007-13)

Since 2007, R&D and innovation policies have followed EU Structural Funds planning periods as these were the source of a large part of R&D and innovation funding. The period 2007-13 was marked by the EU Lisbon Strategy, which was reflected in the content and objectives of relevant national strategies. Overall, 2007-13 was a period of learning to design policy initiatives and instruments and transparency in policy design (stakeholder consultation), and innovation policy increased.

Science, technology and innovation (STI) policy was characterised by large investments in the research infrastructure. Other notable policy characteristics included efforts to attracting foreign direct investment, promoting exports and creating financial engineering instruments. While the basics of research and innovation policy did not change from the previous period, much more emphasis and resources were devoted to their implementation.

Attempts were made to address the gaps identified already during the earlier period. However, as a number of additional measures were launched, the policy mix became more complex and issues co-ordination increasingly pertinent. Administrative costs incurred by the support schemes were perceived as too high by businesses which led them to apply for less demanding schemes, which in some cases were less effective in reaching the overall policy objectives. Key research and innovation strategies introduced during 2007-13 are summarised in Box 5.2.

Box 5.2. **Key strategies introduced during 2007-13**

The **Economy Promotion Plan 2009-10** was developed by the Ministry of Economy as a response to the economic crisis. As a crisis measure its implementation was made top political priority with key indicators and assigned responsibilities. The plan focused on expanding business financing opportunities (especially with the aid of financial engineering), building energy efficiency (e.g. home renovation), quicker flow of financial resources in the EU Structural Funds national implementation system, better conditions for business environment, investments and export promotion. A public performance measurement system with a scoreboard approach and marketing campaign received positive feedback from the business community. However, many highly ambitious goals were set and were subsequently not reached. The plan was partly separated from the rest of the innovation policy, which created management problems and overlap between different measures, especially with other ongoing programmes implemented by the same ministry. Furthermore, the plan was drawn up quickly and lacked consistency and appropriate indicators. In 2010 the web page for monitoring the plan was closed, an analysis of factors of success and failure was not performed and lessons learned were not fed back into the policy cycle.

The **Lithuanian Innovation Strategy 2010-20** was a reflection of the government's goal to make innovation a top policy priority. Several measures were taken to address co-ordination problems in the national innovation system, and a new co-ordination instrument, the Agency for Science, Innovation and Technology (MITA) was established in 2010. The strategy presented a vision for 2020 highlighting that the Lithuanian economy would be based on high value-added products and services. The main goal was to build a creative society and conditions for the development of entrepreneurship and innovation. Goals were linked to Lithuania's integration into the global market, improving creative and innovative public education, the development of a variety of innovations, and the development of a systematic approach to innovation. The strategy emphasised priority sectors characterised by:

- high value-added and competitive in the international market (e.g. food products and drinks, wood and wood products, textiles, chemical products, transport and logistics)
- advanced and medium-advanced technology industry able to help traditional industry (e.g. biotechnologies, laser technologies, electrical and optical equipment, ICT)
- promising new areas in the economy (e.g. clean technologies and energy, the creative industry, pharmaceuticals, medical and wellness services, medical equipment, ecological food products).

An important focus was put on the development of mechanisms for co-ordination of fragmented innovation measures (mainly through concentrating efforts within MITA) and on the reform of research institutes. The strategy also emphasised the need for periodic evaluation of reforms and proposed to measure progress according to the results of the EU Innovation Scoreboard.

Overall, the lack of a systemic approach to research and innovation policy was evidenced by the prevailing policy mix. Innovation policy had a pronounced technology-push orientation which was driven mainly by scientific interests and ambitions in the area of high-technology. While this reflected the needs of a small number of typically R&D-intensive high-technology enterprises, it hardly addressed those of the majority of industry and the economy at large. Furthermore, several programmes targeted more or less the same target groups leading to overlapping or competing schemes which were likely to lead to inefficiencies.

There seemed to be an issue of intertemporal coherence. Long-term R&D investment requires predictability and is often put on hold or undone if uncertainties become too high. Managing the transition between programming periods is therefore an important issue and prolonged gaps are likely to reduce trust in the policy commitment of government. The launch of new measures for the new Structural Funds Operational Programme 2014-20 showed a similar gap in time. Key research and innovation policy programmes during 2007-13 are summarised in Box 5.3.

Box 5.3. **Key policy programmes during 2007-13**

The **"Valleys" programme 2007-13** started as a joint initiative between the Ministry of Education and Science and the Ministry of Economy. The attempt was to improve co-ordination between these ministries and to complement the previous top-down process with bottom-up stakeholder consultation. As the goal was to build the Valleys around strong centres of scientific excellence, universities were seen as the main stakeholders. Although the "Valley" concept foresaw mandatory consultations with other stakeholders, business showed little interest and was reluctant to engage in complex procedures. The programme eventually focused on the needs and interests of universities. The Valleys Programme, which led to the launch of five Valleys in 2007-08, had a pronounced technology-push orientation. It was complemented by the objective to develop a favourable environment for R&D-intensive businesses, which was reflected in eight national programmes focusing on R&D-intensive businesses, knowledge transfer, clusters, etc. Most of these other instruments included further infrastructure investment or focused on R&D-intensive businesses and science-industry knowledge transfer, thereby enhancing the technology-push approach rather than complementing it with an orientation towards industry or market needs. In 2009, the **Innovation in Business Programme 2009-13** was launched based on evaluation of its predecessor in 2003-06. It was prepared by the Ministry of Economy and aimed at the promotion of an innovation culture. The new programme aimed at encouraging innovative business, increasing innovative and high-tech and medium-high-tech enterprises in industrial and service sectors and promoting exports. Measures were aimed at increasing efficiency of innovation support institutions and capacity of human resources.

The **High-technology Development Programme 2007-2013** was launched to continue the previous programme from 2003-2006. Although it was partly overlapping with "Valleys" and other programmes, the priority areas remained the same: biotechnology, mechatronics, laser technologies, information technologies, nanotechnologies and electronics. The programme was complimented with **Industrial Biotechnology Programmes** during **2007-10** and **2011-13**. In 2014 Lithuania joined the European Space Agency as a co-operating state. Despite the community of dedicated companies and researchers, the **National Research, Technology and Innovation Programme for Space 2010-15** faced issues of implementation and funding.

While one of the original objectives of R&D and innovation policies during 2007-13 was to address the science-industry gap, the initiatives eventually launched largely failed to achieve this goal. However, as this period also saw the introduction of financial

support measures for business R&D and innovation, the seeds for a more balanced R&D and innovation policy were planted. Instruments such as small and medium-sized enterprises' (SME) innovation vouchers encouraged a larger number of companies to seek collaboration with public research organisations.

While the financial instruments introduced for business R&D and innovation during 2007-13 were not so much focused on science-industry collaboration, they were important in allowing a number of innovative and R&D-intensive companies to develop and grow. Measures targeting start-ups and early-stage companies were of particular importance. The number of high-growth innovative companies is still very small and contributes very little to the economy at large. However, a lively and active ecosystem for innovative start-ups is important in changing the entrepreneurial culture, attracting high value-added foreign direct investment (FDI), and facilitating the necessary renewal of industrial structures in the long term.

The third phase (since 2013)

In 2012, **Lithuania 2030**, a national strategy document which outlines the vision of Lithuania's future, was approved after having been prepared by a broad-based consultative process. The key objective of the strategy is to become one of the ten most advanced EU member countries by 2030 with intermediate objectives set for 2020. The implementation of the strategy is overseen by the State Progress Council with secretarial support from the prime minister's office. The Open Progress Forum "Lithuania 2030" was established to promote and maintain continuous dialogue within society.

Research and innovation-related issues recognised in the strategy include: the need for regulatory simplification and reducing restrictive regulations for businesses; enhancing the entrepreneurial culture; enhancing the production and protection of intellectual property; better international integration; attracting FDI; market-relevant innovations from research; and green procurement. Furthermore, the strategy calls for better stakeholder participation in policy design, evidence-based management, and enhanced analysis capabilities. It also highlights a one-stop shop approach in developing public services and customer satisfaction.

The implementation of the Lithuania 2030 strategy materialised in the **National Progress Programme for 2014-20**. The programme provided a basis for the EU Structural Funds (EU SF) support. The main priority was a "favourable environment for economic growth", which required 57% of the total funds reserved for programme implementation. These funds were envisaged to be invested in the development of transport, energy and IT infrastructures as well as in preserving nature, fostering entrepreneurship and creating an overall favourable economic framework for business creation and development. A share of 14% of total programme funds (comprising national funds and the EU SF support) were planned to be invested in education of society, science and culture, 13% into socially secure and active society, and almost 5% into building smart governance systems. Almost 12% of total funds were planned to be invested in the development of the networked economy, oriented towards higher value-added creation. The latter priority focused mainly on innovation networks and research collaboration, joining global networks and global markets as well as fostering innovation in business and demand for innovation.

As one of the outcomes of Lithuania 2030 and the National Progress Programme, the Lithuanian Innovation Strategy 2010-20 was replaced by the Lithuanian Innovation Programme 2014-20 which is a step towards more open, transparent and participative planning methodology.

The Lithuanian Innovation Development Programme 2014-20 (see MITA, 2014) has four main goals:

- develop an innovative society
- increase the innovative potential of the business
- promote the creation of value networks, their development and internationalisation
- improve the formulation and implementation of innovation policies as well as to promote innovations in public sector.

One of the new features of the programme was to create a legal model for joint activity of business and science/education institutions, which will provide for the implementation of common projects and foster the transition from mere provision of intellectual services to the creation of intellectual property and its commercial application. It is planned to expand the forms of partnerships and to improve patenting and licensing processes. The innovation programme also foresees the creation of new institutions and instruments: technological centres, which will help to accelerate "experimental development" before placing the products on the market. The programme also highlighted the need for a new legal act regulating R&D activities and a common system for implementation, co-ordination and monitoring of results.

The creation of value networks was related to facilitation of clusters and integration of innovation actors into international networks. The programme noted that financial engineering (guarantee, venture capital investment, loans and export credit insurance) is an important driving force. The subsequent Entrepreneurship Action Plan 2014-20 of the Ministry of Economy aimed to increase entrepreneurship, to support the creation of start-ups and to develop a supportive environment. In 2012 the European Investment Fund (EIF) and the three Baltic countries launched the Baltic Innovation Fund (BIF) – a fund-of-fund initiative to boost equity investments made into Baltic SMEs with high growth potential. The plan also highlights the importance of ensuring Investment and Business Guarantee Institutions (INVEGA), together with the Ministry of Social Security and Labour to administer the Entrepreneurship Promotion Fund (financial instruments). The programme aims to enable people to launch their own small businesses, to adopt new ways to promote innovation and to improve the regulatory environment for innovation policy making. It also emphasises the need to create demand for innovation and to address social, economic and environmental challenges. As a solution to such challenges various models of innovative procurement and pre-commercial procurement (PCP) are foreseen. The programme also changes the system of indicators used so far to monitor progress, which formerly relied only on the EU Innovation Scoreboard. A new system of indicators is based on the EU Innovation Scoreboard as well as on a mix of indicators provided by Eurostat, the Lithuanian Department of Statistics, and the World Innovation Index or collected by the Lithuanian authorities. The institution responsible for the annual monitoring based on this system of indicators is MITA while the Ministry for Economy is responsible for the co-ordination of the implementation of the programme.

The National Programme for the Development of Studies, Research and Experimental (social and cultural) Development 2013–20, approved in December 2014 is linked to the first main goal of the Lithuanian Innovation Development Programme and includes measures to promote knowledge and technology transfer, science and business co-operation.[2]

In April 2014, the government approved the programme of smart specialisation and ordered the Ministry of Education and Science and the Ministry of Economy to create the

co-ordination group and to prepare implementation plans. This group consisted of representatives of ministries, industry and science. It discussed roadmaps and prepared proposals for the implementation plans, which were approved by the ministries. Preliminary investments across all priorities were EUR 678 million.

The Smart Specialisation Strategy 2014-20 (RIS3) sets out the priorities of R&D and innovation development considering the business potential for excellence, the strengths in research, technological development and innovation, also a capacity to foster the collaboration among different stakeholders to respond to national, regional and global challenges. RIS3 was requested by the European Commission and closely linked to potential finance from EU Structural Funds 2014-20. The fact that the European Commission would review the strategy, in terms of the robustness of the analysis and the extent to which the priorities selected were fully discussed with a broad range of stakeholders, provided an additional incentive to build evidence, and make the process of setting up priorities transparent and clear. The Smart Specialisation Strategy development process was managed by the Ministry of Economy and the Ministry of Education and Science with the support of MOSTA, and ended in 2015 with approval of action plans for the implementation of the priorities shown in Box 5.4.

5.2. Main innovation policy actors in Lithuania

Main policy actors

At the highest decision-making level, the Lithuanian STI policy is set by the Lithuanian Seimas (parliament) and the government of Lithuania. At the strategic level, development of R&D and innovation (as well as the development of related priority areas) is in the hands of the Strategic Council for Research, Development and Innovation. The council is chaired by the prime minister and consists of the representatives of the ministries in charge of or engaged in R&D and innovation development, LMT), MITA, research institutions and HEIs, business, social and economic partners and independent experts. However, the potential of this body does not seem to have been fully used (Box 5.5).

The two ministries mainly responsible for the development of science and innovation policy are the Ministry of Education and Science and the Ministry of Economy: The Ministry of Education and Science is mainly responsible for policy development in the areas of research excellence in public science system, highly-skilled human resources, including for R&D, etc. The Ministry of Education and Science is in charge of a major part of financial and other resources for the implementation of national research policy. The ministry also proposes the establishment, reorganisation and closure of research institutions. The Ministry of Economy is the principal institution involved in designing policy for the promotion of innovation and business development. However, the Ministry of Economy has a limited mandate to participate in the process of R&D policy development which is led by the Ministry of Education and Science. The latter is also responsible for government funding of R&D. The Ministry of Economy co-ordinates the establishment and the operations of innovation support organisations such as science and technology parks (STPs) and business incubators. The recent establishment of the Innovation Department in the Ministry of Economy indicates the increased importance attached to research and innovation policy. Other ministries are active in sector-specific STI policies in their respective policy domains. So far, inter-ministerial co-ordination of STI-related policies remains weak.

Box 5.4. Proposed research, development and innovation (RDI) priorities in smart specialisation

Agro-innovation and food technologies:

- safer food and sustainable use of biomaterials
- functional food – innovative development, improvement and processing of biological raw materials (biorefinery).

Energy and sustainable environment:

- smart systems for energy efficiency, diagnostic, monitoring, metering and management of generators, grids and customers
- energy and fuel production using biomass/waste and waste treatment, storage and disposal
- technology for the development and use of smart low-energy buildings – digital construction
- solar energy installations and technologies for using them for power generation, heating and cooling.

Health technologies and biotechnology:

- molecular technologies for medicine and biopharmaceutics
- advanced applied technologies for individual and public health
- advanced medical engineering for early diagnostics and treatment for an inclusive and creative society
- modern self-development technologies and processes promoting formation of creative and productive individuals
- technologies and processes for the development and implementation of breakthrough innovations.

New production processes, materials and technologies:

- photonic and laser technologies
- functional materials and coatings
- structural and composite materials
- flexible technological systems for product development and fabrication.

Transport, logistics and ICT:

- advanced electronic content, content development technologies and information interoperability
- ICT infrastructure, cloud computing solutions and services
- smart transport systems and ICT
- technologies/models for international transport corridors management and integration of modes of transport.

Sources: www.mosta.lt/images/ss/Proposals_for_Smart_specialization_Lithuania.pdf; http://s3platform.jrc.ec.europa.eu/documents/20182/124683/151030_2_JP_LT_R%26I_Ecosystem.pdf/cdae05a2-767c-4baf-9689-8dfa779c2a47.

Box 5.5. The potential role of the Strategic Council for Research and Innovation

The full potential of the Strategic Council for Research and Innovation may not have been realised, and STI governance would benefit from a stronger co-ordination body. There is no unique blueprint for such a body that could be used as a model. According to Schwaag Serger, Wise and Arnold (2015) international comparison shows that a national council's influence or impact is not only determined by its mandate or its composition, for example the extent to which the council is composed of high-level decision makers as opposed to "merely" experts in their own right. Rather, there are many factors – acting in combination with one another – that contribute to councils' impact on innovation policy, including:

- **A mandate, composition and anchoring at top political level to give legitimacy**; in order to be able to have an impact on policy making, an innovation council must have a combination of relevant, recognised and sought after expertise and anchoring at top political level. The latter could mean that the council reports to or is chaired by the prime minister. However, it should be pointed out that the prime minister chairing the innovation council or the innovation council reporting to the prime minister are not sufficient determinants of its ability to have an impact.
- **A focus that is relevant and anchored in the national context – taking a broad perspective on innovation and a systemic approach** including aspects such as education, sustainability, etc. While it is not realistic to expect the council members to possess all the expertise necessary for a broad-based innovation policy, it is important that its composition does not lead to a limited or narrow perspective on innovation, and that the council's mandate and working practices allow it to access competence and examine issues that are outside "traditional" fields of innovation policy. One challenge is finding the right balance between being focused enough to be able to make meaningful policy recommendations and broad enough to address framework conditions and to secure societal relevance.
- **A mandate, governmental anchoring and composition that fosters receptiveness and willingness on behalf of government to receive and act upon suggestions put forward or decisions made in the council**.
- **Focus/approach and composition which acknowledge the increasing internationalisation of research and innovation in order to avoid the council (and innovation policy) becoming inward-looking**, for example through the inclusion of international experts in the council or the establishment of an advisory group consisting of foreign experts who are connected to the council.
- **Resources (budget and staff) that allow the council to produce and/or commission relevant analysis and engage in forward-looking activities, which are necessary in order to work proactively and promote broader visibility.**

Source: Schwaag Serger, Wise and Arnold (2015), "National research and innovation councils as an instrument of innovation governance, characteristics and challenges, Vinnova".

Major funding agencies and advisory bodies for research and innovation

The Research Council of Lithuania (LMT) – which is accountable to the Lithuanian parliament (Seimas) and government – is a counsellor of the Seimas and the Lithuanian government on issues of research and researcher training, implements programme-based competitive funding of research, administers the most important Lithuanian science development programmes, evaluates research performance and represents Lithuanian science in various European institutions and other international organisations. Legal

changes in 2008 provided LMT with the status of an agency with the mandate to fund competitive research programmes. It thus complements institutional research funding. LMT started administering the programme for competition-based R&D funding in 2009 with the overall focus on providing funding for high-level research projects. In accordance with its mandate LMT sees its main areas of activity in research policy and legislation, research funding and scientific advice. Examples for activities in the first area (research policy and legislation) are the roadmap for the development of Lithuanian research infrastructures (renewed in 2015), LMT's role in the Smart Specialisation Strategy formulation and as co-ordinator of open access to research in Lithuania. The third category (scientific advice) involves the evaluation of Lithuanian education and science institutions and doctoral studies (50 evaluations completed in 2014). LMT exerts influence at all three (decision making, strategic and implementation) levels of STI policy. This is a rather unique position which may carry some potential for conflict of interests. The European Social Fund Agency (ESFA) administers EU Social Fund aid and implements measures assigned to the Ministry of Education and Science in the development of human resources for science, technology and industry.

An important policy monitoring role is played by the Research and Higher Education Monitoring and Analysis Centre (MOSTA) which was established by the Ministry of Education and Science as an attempt to formulate the evidence-based approach in the field of studies and R&D. MOSTA provides recommendations on the development of the national research and higher education systems, performs monitoring, analyses the state of the Lithuanian research and higher education systems, and participates in the development and implementation of research and higher education policies. MOSTA played a central role in providing the evidence base for the Smart Specialisation Strategy by initiating studies and stakeholder consultations; it executed, in collaboration with LMT, the Research Assessment Exercise which was initiated by the Ministry of Education and Science and concluded in 2015; it was responsible for the co-ordination of the monitoring process of the Valleys Programme and the Joint Research programmes, including public procurement processes for international expertise and support of international experts; it has developed and implemented the Research and Higher Education Monitoring System which produces reports, foresight and analysis to support the strategic governance of higher education in Lithuania; it produces the annual Lithuanian Science Reviews; and reports to the Ministry of Education and Science.

The Lithuanian Academy of Science (LAS), an association of scientists, provides independent advice for the parliament, the government and its agencies on the topics of research and higher education, culture, social development, economy, environmental protection, health care and technology (LAS, 2015). The mission of LAS is to bring together Lithuanian and international scientists for meaningful collaboration, to act as an independent advisor in the areas of study, technology, economy, culture, social development and public health and to provide the best scientists needed for R&D. LAS also aims at encouraging the integration of Lithuania into the European Research Area and at helping to develop a knowledge society in Lithuania. LAS offers a number of scholarships and prizes.

Under the supervision of the Ministry of Economy the Lithuanian Business Support Agency (LVPA) administrates the EU funds allocated to business support programmes, including those for innovation and R&D in the business sector. Development and implementation of indirect public innovation support measures that are linked to export promotion and FDI are managed by Enterprise Lithuania and Invest Lithuania which are also supervised by the Ministry of Economy.

The Central Project Management Agency (CPVA) under the Ministry of Finance administers large-scale investments in the development of research infrastructure as well as international co-operation programmes (Lithuanian – the Swiss Co-operation Programme, EEA Grants and Norway Grants for Green Industry Innovation, etc.). The government of Lithuania gave this institution the mandate to provide methodological and advisory assistance on issues of public-private partnerships.

During recent years, INVEGA has played an increasing role in the implementation of STI policy. This institution implements and administers financial and other support measures for small and medium-sized businesses. In addition to traditional measures (very small loans, micro-loans) it started to implement STI-related financial engineering, entrepreneurship promotion and financial support measures as well as venture capital investment.

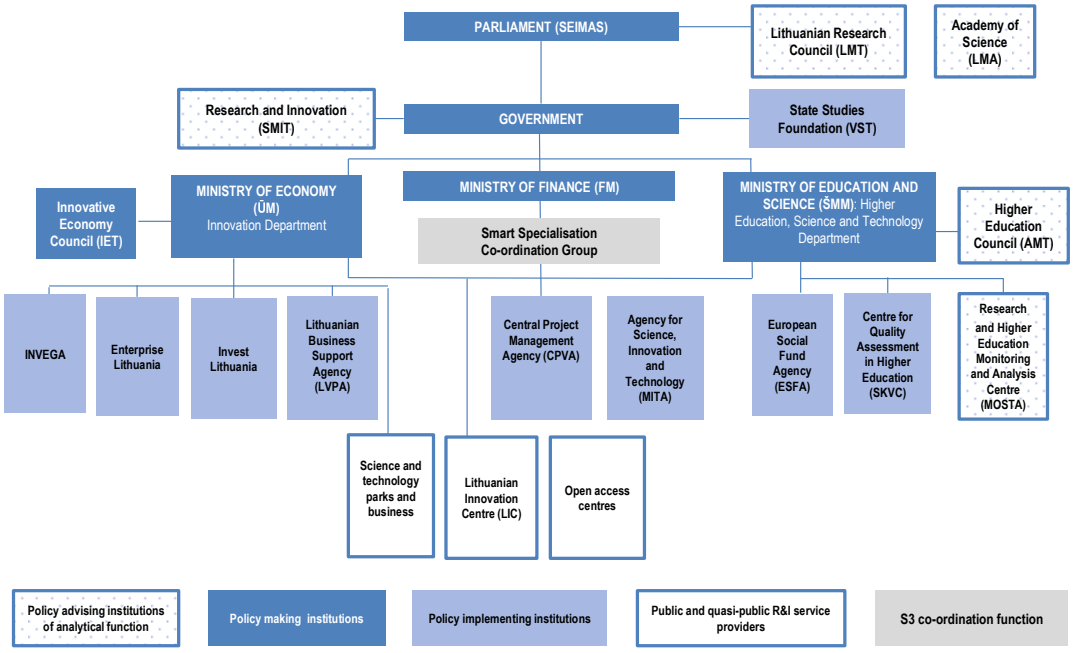
With the purpose of co-ordinating the development and implementation of STI policy the Agency for Science, Innovation and Technology (MITA) was established in 2010 as a result of an agreement between Ministry of Economy and Ministry of Education and Science. Its goal was to foster business and science co-operation and to create a friendly environment for business needs and innovation. These goals derived from the National Innovation Strategy 2010-20, approved by the Lithuanian government. The activities of MITA are jointly supported and funded by the two ministries. This institution administers a number of measures and programmes aimed at innovation and especially R&D collaboration, for instance the Industrial Biotechnologies Development Programme and the High-technology Development Programme, which have in the meantime come to an end. Both programmes were transferred to MITA from the LMT. MITA also administers the issuing of "innovation vouchers" for SMEs, which was piloted back in 2010 and then re-launched.

Enterprise Lithuania (VL) is an agency supervised by the Ministry of Economy with the mission to provide support for SME and encourage Lithuanian exports. Invest Lithuania is an agency supervised by the Ministry of Economy with a mission to attract foreign investment. This institution provides advice to global companies interested in doing business in Lithuania. The agency serves as a point of contact for foreign companies and guides international businesses through every step of the process of setting up operations in Lithuania.

Figure 5.1 provides an overview of the key actors in research and innovation policy.

Compared to many other countries, the number of agencies dealing with one part of business innovation or enterprise policy is high in Lithuania. In order to develop a coherent and enterprise-oriented policy (see for instance Di Anselmo and Saublens [2015]) and a good policy mix, close interaction and co-ordination between the support agencies is needed. Ireland, for example has strong co-ordination of enterprise policy between the key enterprise agency (Enterprise Ireland) and the agency responsible for FDI (IDA Ireland). They jointly implement programmes such as the technology centres. In Estonia, Enterprise Estonia manages the grants and support for innovation and internationalisation while Kredfex manages the financial instruments for start-ups. In this case, too, the co-ordination is in the hands of two organisations that use EU Structural Funds resources to manage their own programmes. In Lithuania, where separate agencies are dealing with EU Structural Funds project management, the organisation of enterprise support differs. This organisational model might create efficient project monitoring but it does not seem to fit the concept of being business-centric.

Figure 5.1. **Structure of the R&D and higher education (HE) policy institutions in Lithuania**



Source: Paliokaitė (2015b), "RIO country report Lithuania 2014", https://rio.jrc.ec.europa.eu/en/country-analysis/Lithuania/country-report.

As indicated earlier, the agencies for supporting business and innovation form a rather complex, fragmented and partially overlapping structure and there seems to be scope for improving information flows between these agencies. Also, there seem to be overlaps in funding between the Lithuanian Business Support Agency (LVPA), the Central Project Management Agency (CPVA) and MITA. While they have their own mandates, all these organisations manage funding for industrial R&D and innovation. Care should be taken that the division of labour in providing business support, in particular between LVPA and MITA, is clear and closely co-ordinated.

In many countries business R&D, and particularly innovation, are also financed using reimbursable forms of funding, especially soft loans. These can be rather effective close-to-market. Loans typically have a lower state aid intensity and cover a much higher share of the funding needed than e.g. grants. In Lithuania, all reimbursable support is centralised at INVEGA. This implies that projects that include, for example, industrial R&D combined with piloting and demonstration (where soft loans could be rather effective) may be difficult to support as the projects would most likely have to be divided into at least two different projects and funding from two different agencies would have to be applied for. One way to address this issue would be to combine grants and soft loans into unified support schemes. These could be operated by one agency alone, either by one agency acting as a "reseller" of the support from another agency or as a joint support scheme operated by the two agencies together (one application, one decision). In Finland, Tekes provides an example of the first model, whereas the Finnish Growth Track programme is a joint scheme of several agencies offering both funding and soft support.

As regards international trade and investment, outward and inward-oriented flows are often interlinked. A prominent example is inward FDI for export-oriented production. Multinational enterprises located in a country are often important (potential) customers for

local companies seeking access to international growth markets. Given these interlinkages between inward FDI and international market access, the promotion of inward and outward internationalisation has been put under one roof, for example in Finland and Estonia. In Finland, a cluster of agencies is linked to these activities through strategic intelligence and market observation under the "Team Finland" concept.

Observations on STI policy strategies and governance

There are still many indications that co-ordination between ministries is difficult. While the creation of a Strategic Council for Science and Innovation was a step in the right direction, its resources are limited and it does not seem to have played a very strong role within the system. The role of the Strategic Council should be made clearer[3] and it should adopt and lead a systemic policy and ensure that the national strategies, institutional structures and policy initiatives are consistent and coherent across ministries and agencies.

The RIS3 and the more transparent and evidence-based approach applied in its development has contributed to a more balanced R&D and innovation policy. The strategy results in a better balance between the objectives of developing research competences and addressing industry needs, and it introduces a more application-oriented approach, including by identifying societal challenges. The strategy also includes plans to introduce PCP as a new demand-side policy measure. The implementation of the strategy is shared between the Ministry of Economy and the Ministry of Education and Science. Attempts have also been made to introduce R&D and innovation into the agenda of other ministries.

Despite significantly increased transparency and stakeholder consultation, industry participation is still relatively weak. This can be partly attributed to the fact that policy implementation shows very little flexibility and the administrative burden is often high. Another reason might be uncertainty. While many of the industry-relevant schemes will continue during the new funding period, the transition from the previous to the new funding period has not been without friction. Delays in getting the RIS3 prepared and approved by the EU Commission and subsequent delays in launching new or re-designed schemes or continuing existing ones have created a period of uncertainty among companies. While this is understandable, given that the RIS3 process was entirely new and that all policies and policy measures needed to be re-evaluated and most also re-designed, it is equally understandable that this is detrimental to building trust and commitment in the business sector. Overly ambitious policy objectives are also ill-suited to fostering confidence and commitment. Policy objectives need to be ambitious, but at the same time realistic.[4]

Despite efforts to establish the necessary platforms, policy co-ordination is still rather weak. Policy processes lack coherence and systematic practices. Systematic, evidence-based, transparent and interactive policy processes can help to overcome this problem. Establishing such policy processes can build on experiences gathered during the smart specialisation process. It might also be useful to draw on the experiences of OECD countries in this regard. Several of them, for example Germany, Japan, the United Kingdom and the United States as well as smaller countries such as Estonia and Finland, have designed and implemented a national foresight process. A foresight process is typically less prone to confrontation as it takes a longer term view into the future and allows participants from all stakeholder groups to openly discuss what international scientific, technology, market and social trends might mean and what opportunities and threats are related to them. To attract business to participate, the timeframe should not exceed ten years. Alternatively, the foresight process could include two or three timeframes, for example 3-5 years, 5-10 years

and beyond 10 years. The methodological approach appropriate for small countries, and especially countries like Lithuania, where one key objective would be to enhance trust between industry, academia and policy makers should be interactive and based on a series of workshops supported by web-based tools for extending the participation to society at large. The Estonian Growth Vision 2018[5] project might act as a good example for this kind of a process implemented in a small country context. The processes related to evidence gathering, sense-making, monitoring and evaluation are discussed later in this chapter.

The resources for R&D and innovation are mainly based on EU Structural Funds. The monitoring and evaluation requirements related to the use of Structural Funds are mainly based on accountability, i.e. appropriate, acceptable and legally correct use of funds according to regulations, programme documents and project plans. Ensuring compliance with EU rules and regulations, monitoring by the European Union as well the legal enforcement of rules and regulations to combat misuse of public funds, economic crime and corruption, necessitates clear and strict rule setting. At the same time care should be taken to maintain the flexibility that is essential for effective R&D and innovation support systems and to avoid being more restrictive than necessary.

One way to address this issue is to increase the competences available for policy design (or redesign), or use external expertise for this purpose. Several European countries could be referred to as sources of inspiration and expertise in making R&D and innovation support measures more flexible. These include, for example, Tekes in Finland and EAS in Estonia for R&D and innovation project funding, the Ministry of Economic Affairs and Agriculture in the Netherlands and the Research Council of Norway for tax incentives, and the Ministry of Economic Affairs in the Netherlands and the Ministry of Employment and the Economy in Finland for start-up support.

A fragmented system with isolated small-scale agencies, operating on narrow mandates and a set of overlapping and competing schemes, is likely to result in reduced overall impact and efficiency. Transaction costs can be expected to be high in a fragmented system. All agencies need to have competences, for example on regulatory matters (such as state aid), on the specific needs of key industries and types of enterprises, and they need to have access to scientific resources and competences, etc. It is in general more efficient and effective to implement policies using a smaller number of multi-purpose agencies operating a portfolio of programmes and instruments. Examples of agencies with a relatively wide mandate in the area of R&D and innovation include for example Tekes in Finland, EAS in Estonia, FFG in Austria and RVO.nl in the Netherlands. EAS in particular manages innovation-related schemes as well as R&D funding for companies and industry-academia collaboration. It operates almost entirely with EU Structural Funds in a context which has many similarities with Lithuania.

Similarly, instead of a large number of single-purpose schemes it might be more promising to develop target group-oriented multi-purpose schemes. An example of a step in this direction is the new scheme to be implemented by MITA based on a merger of two earlier schemes (one focusing on R&D infrastructure and another on research activities). The new scheme will target growth companies with a combination of R&D and innovation activities and related investments. Good international examples of this type of scheme are, for example, the Growth Track scheme in Finland and the Enterprise Development Programme in Estonia, which are described below in this chapter.

5.3. Strategic intelligence, monitoring and evaluation

In Lithuania, the monitoring, evaluation and review functions are not systematically integrated into the R&D and innovation policy management cycle (Public Policy and Management Institute and Knowledge Economy Forum [2011]; Visionary Analytics [2014]). Over recent years the current system of strategic intelligence in Lithuania has improved in terms of monitoring, particularly in the science, research and HE sector where MOSTA systematically monitors developments and explores new ways of assessing performance (such as the Research Assessment Exercise and various foresight activities). Nevertheless, while understanding of the need for evidence as well as consultation with stakeholders is growing, and efforts to develop these have been made (e.g. in the context of smart specialisation), the systems and processes for strategic intelligence, monitoring and evaluation are still weak. Accordingly, this section first considers some general principles of policy evaluation, derived from experiences across the OECD area (OECD, 2015). The section then concludes with observations on developing a broader system of strategic intelligence, which would draw on policy and programme evaluations as one among a number of inputs.

The following principles reflect good practice in policy evaluation:

- *Make explicit, at the highest level, the commitment to policy evaluation.* There should be an explicit commitment to undertake ex post evaluation of significant innovation policies and strategies. For example, the Finnish Ministry of Employment and the Economy has a strategy to evaluate all agencies once every five years. Some evaluations cover several agencies simultaneously and provide a more holistic view on innovation policy and the innovation system. Overt recognition of the importance of evaluation, by senior policy makers and agency heads, is vital in securing the necessary human and financial resources for evaluation.
- *Consider mandating evaluations when public funding is provided.* Mandatory evaluation requirements are attached to the use of federal funds.
- *Insist on developing data and evaluation strategies as a pre-requisite for the start of programmes.* A clear programme evaluation strategy should be established from the outset, with an *ex ante* evaluation plan which, to the extent possible, articulates the theory of change and shows the main expected channels of impact (from inputs and activities to outputs and outcomes). A strategy should exist to ensure that the data necessary for evaluation are collected from the outset. Governments also have a duty to make more data available so that researchers and other interested parties can also assess policy effectiveness.
- *Choose the evaluation technique in the light of the size and nature of the programme concerned.* Studies of major programmes – especially pilot schemes that could be ramped up later – should use a variety of methods: random assignment, quasi-experimental assessments, interviews with beneficiaries and participatory approaches involving stakeholders. There should be a move to more use of randomised experiments as the basis of ex post impact assessment.
- *Use a mix of evaluation methods*. State-of-the-art econometric methods have a role in assessing components programmes that are part of an overall strategy, but are less likely to be useful for the policy package as a whole. Tracking of macro- or meso-level indicators, international benchmarking, subjective assessments gleaned via surveys, narrative reporting, case studies and other techniques all have a role to play.

- *Insist on full disclosure in evaluation reports. There should be a commitment to public diffusion of evaluation findings of publicly funded programmes.* The choice of methods and evaluation parameters used, methodological drawbacks and areas of subjective judgement should be described in full. There should be a commitment to transparency and early publication of evaluation findings and the data on which they are based. Published evaluation findings should be accompanied by meta-data that facilitate online searches.
- *Robust governance mechanisms are needed to ensure evaluation is objective.* Programmes should be evaluated by, or in collaboration with, genuinely independent experts, possibly from an audit office. Ideally, the body that implements the evaluation would work with programme managers but would not be dependent on continued contracts from the sponsor of the programme.

Developing a system of strategic intelligence

A system of strategic intelligence gathers, organises and assesses all form of policy-relevant data, information and analysis and feeds this into the policy making process. Innovation policies in Lithuania are fragmented into programmes run by different agencies, only some of which are evaluated (to satisfy EU Structural Funds rules, and mostly for reasons of financial accountability). This fragmentation may be one reason why there seems to be no attempt from any organisation in the system to conduct an overall evaluation of the effectiveness and impact of Lithuania's policy mix. An organisation which might commission and oversee such a broad evaluation would be the Strategic Council for Research, Development and Innovation.

Sufficient resources for evidence building and strategic intelligence should be ensured, both in terms of competences and funds. While there is no single best way to organise strategic intelligence, there are instructive international experiences (Box 5.6). However, the generic insights drawn from international experience do need to be adapted to Lithuania's specific policy and institutional environment.

In addition to monitoring and evaluation, it is important to gather wider evidence on such issues as the changing needs of innovation actors, the potential for innovation to address societal challenges, and specific barriers to innovation. This requires processes where topics to be studied are identified. It also requires processes for defining and launching studies to gather evidence. Such work can be co-ordinated by a dedicated government body, such as the prime minister's office or an agency directly under the parliament, or by a separate public-private platform facilitated by an external organisation such as a think-tank. Most OECD countries have either a government-organised think-tank type organisation (such as Sitra in Finland) or make use of NGO-type organisations (such as NESTA in the United Kingdom or Kennisland in the Netherlands).

The approach where evidence gathering is integrated into annual government planning processes relies more on competences within ministries and agencies. For example, in the United Kingdom, government departments allocate significant internal resources for strategic intelligence. While departments also use external research to gather evidence, having well developed internal resources also helps to make sense of the evidence and thus supports evidence-based policy making. In Finland, the prime minister's office (PMO) has been tasked to co-ordinate the gathering of research evidence for policy making. This office collects information on needs for evidence from all ministries and launches appropriate calls for research funding. In the past funding was allocated to each ministry separately. Now funds are managed under the PMO as one

single allocation. This makes it possible for the PMO to co-ordinate research needs between ministries and makes it possible to address more complex evidence needs and launch bigger projects (studies, analyses and research).

Box 5.6. Strategic intelligence: Establishing an evidence base for policy

There is no single best way to organise strategic intelligence. Countries have adopted different approaches to organising strategic intelligence as a recent comparative study of the United Kingdom, the Netherlands, Finland, Denmark and the European Union clearly shows (Technopolis, 2015). This study suggests a need to:

- use foresight techniques for thinking about the future to anticipate policy needs, and therefore the kinds of evidence required in future
- ensure that ministries have personnel who can specify research needs and make use of external research to generate evidence for policy making
- identify "evidence champions", such as chief scientific advisors, to promote and co-ordinate the generation and use of evidence for policy making
- create funded arrangements for generating and sharing evidence to address cross-ministry problems
- maintain long-term links with organisations like universities, including foreign organisations, which work at the boundary between research and policy, but do not allow any of these to monopolise relations
- publish evidence so that policy making is transparent and evidence can be quality assured and used by others
- be prepared to experiment and learn about new intervention designs and ways to develop evidence.

Sense-making – the interpretation of various types of research evidence – is at the core of strategic intelligence, linking evidence to policy design and implementation (Box 5.7). It is important to develop systematic sense-making activities. As with evidence gathering, sense-making can be a co-ordinated one-off national process or integrated into annual governmental processes. Being a part of an annual government planning exercise can increase the likelihood that results will be linked to resource allocations and other policy decisions.

Integrating systematic sense-making activities into annual government planning processes can be done by requesting ministries and agencies to prepare a mid- to long-term futures paper. A futures paper could analyse the current situation (strengths and weaknesses), identify key trends (opportunities and threats), outline rationales for potential changes in policies and policy measures, and provide options how these changes might be implemented and what their impact could be. Such an approach is used in several countries, including Finland and the United Kingdom.

Annual integrated sense-making should be complemented with more open, interactive sense-making processes from time to time. This allows wider stakeholder participation and can help to communicate policy changes and their rationales. Such processes can also be effective in developing shared understanding between stakeholders of the relevant challenges and opportunities, while building trust between politicians, policy makers and private and public R&D and innovation actors. Examples of interactive sense-making include:

- the smart specialisation process recently undertaken in Lithuania
- interactive national foresight processes such as BMBF Foresight in Germany[6] and the United Kingdom's Horizon Scanning process[7]
- research and innovation policy advisory bodies found in many countries (RIC in Finland or AWTI in the Netherlands)
- the activities of the Danish Board of Technology, which manages a wide range of participatory processes, engaging citizens, varied stakeholders and experts.[8]

Box 5.7. **Strategic intelligence 2 – Gathering evidence and sense-making**

Strategic intelligence can be divided into two types of processes: gathering the evidence and making sense of it.

Evidence gathering is a distributed function, in which all ministries and agencies should participate. Several countries also have research organisations, groups and/or think-tanks which focus on evidence gathering relevant to research and innovation policy. Some of these are government agencies with a specific task to collect evidence (such as Sitra in Finland and the former Forfás in Ireland), some are independent civic society organisations (such as NESTA in the United Kingdom), and some are partly or fully owned by research and innovation actors (such as ETLA in Finland). Often these organisations have a dual function: they collect and analyse the evidence, and they facilitate sense-making processes.

Sense-making should be organised as a shared participatory process among all relevant stakeholders. In some cases, this has been organised in the form of a high-level policy council. Such councils can be found in several countries, including Finland (RIC), the Netherlands (AWT) and Chile (National Innovation Council for Competitiveness). The main function of the council is to offer a permanent platform where stakeholders can engage in continuous interaction, where sense-making can take place and needs for new evidence can be identified.

For high-quality sense-making, it is important that policy makers have at their disposal a sufficiently independent body, or a process jointly owned by all key stakeholders. The most efficient way to establish this is to assign the responsibility for evidence gathering to a single independent organisation, which would also have a key role in facilitating sense-making processes. All of the evidence and the eventual policy recommendations would be discussed among all relevant stakeholders in a process facilitated by the same organisation responsible for gathering the evidence. This would create a strong link between the evidence and its use, ensuring that all new needs for evidence would immediately be recognised. Sitra has this kind of role in Finland.

Developing strategic intelligence on and monitoring of firms engaged in research and innovation schemes and other activities (such as the cluster policies) is essential to developing a well targeted portfolio of policies. It would for instance be important to know to what extent various schemes actually target the same companies and to what extent the needs of some companies might be partly or entirely unaddressed. This would be important given a general complaint from ministries and agencies in Lithuania that companies do not state their innovation activities in official statistical surveys. This could lead to an underestimation of private sector innovation.

Monitoring should be developed in an institutional collaboration, as monitoring needs to capture the funding and support provided through several agencies and programmes. Ideally there would be one point where all monitoring information is collected. This

could either be a single agency responsible for facilitating strategic intelligence processes, or another body, such as Statistics Lithuania.

5.4. Nurturing innovation skills

Human capital shapes innovation in a number of ways. In particular, skilled people generate knowledge that can be used to create and implement innovations. Having more skills raises the capacity to absorb innovations. In this regard, innovation in firms is particularly associated with the in-house development of skills, rather than their acquisition through hiring, owing to the former's effects on absorptive capacity (Jones and Grimshaw, 2012). Skills interact synergistically with other inputs to the innovation process, including capital investment. Skills enable entrepreneurship. For example, Cressy (1999) shows that after controlling for the effects of human capital, financial capital is a relatively unimportant determinant of business longevity. And skilled users and consumers of products and services often provide suppliers with valuable ideas for improvement (Von Hippel, Ogawa and de Jong, 2011).

As already highlighted in the previous chapters, a number of points should be highlighted regarding skills and innovation in Lithuania, namely:

- the share of people graduating with a tertiary-level qualification is high compared to other EU countries
- large occupational mismatches exist. Some 31% of employees work in fields unrelated to their studies, compared with 23% on average in the European Union (OECD, 2016a). Several studies report a mismatch between the skills of university graduates and the needs of business
- student entry rates are dropping, particularly in applied engineering and other technical studies
- the phenomenon of international "brain drain" is significant.

The national programme entitled Lithuania's Progress Strategy: Lithuania 2030 (Lithuania 2010) focuses on strengthening the population's capacity to adapt to rapidly changing economic conditions, create new knowledge and support economic processes. Lithuania 2030 is intended to:

- promote lifelong learning by developing opportunities for the population to acquire skills that match labour market needs, via education services and/or diversification of adult learning opportunities
- encourage creativity, entrepreneurship and leadership, and the capacity for innovation among pupils, students and researchers
- promote better career development for researchers and better training of young researchers.

The Lithuanian innovation system has a strong focus on university graduates as a source of skills. The prominent engineering culture is also referred to in Lithuania's White Paper for Science, Technology and Innovation of 2002. These strengths are evidenced in data showing that the share of 20-29 year-old Lithuanian graduates in science and technology was 2.3%, exceeding the EU average of 1.7%.

The percentage of the Lithuanian population aged 30-34 having completed tertiary education is growing, and reached 48.7% in 2012, compared to the EU average of 35.8%.

The percentage of 20-24 year-olds with at least an upper-secondary-level education is increasing slightly, reaching 89.3% in 2012, which is also above the EU average. On the other hand, even though the share of new doctoral graduates has risen, to 0.9 per 1 000 of the population aged 25-34, this is well below the 2011 EU average of 1.7. This shortfall suggests a problem in ensuring the highest levels of qualification for R&D-driven and other forms of skill-intensive innovation.

Despite a number of positive developments, concerns remain about skills shortages in certain fields. Since 2004 the Ministry of Education and Science has launched various schemes to improve the quality of human resources for R&D and innovation. The main aim has been to improve the supply of skills in priority areas of science and technology (biotechnology, agriculture, forestry, mechatronics, laser and optical technologies) and in horizontal themes (such as innovation, entrepreneurship and languages). Schemes have also focused on developing master's and PhD level qualifications in selected fields.

In addition, efforts to upgrade workforce skills and competencies have sought to increase adaptability to change and align with the requirements of the modern economy (IT skills, for instance, have been among the core themes). Upgrading workforce skills is critical, among other things because only 6% of the working population is engaged in systematic learning activities, a share which has not changed in ten years.[9]

Lithuania's emigration rate is amongst the highest in the European Union. Around 788 000 people (one-quarter of the population) has left the country since independence in 1990. In 2013 over 38 000 people emigrated while 22 000 immigrated. Most immigrants are returning Lithuanian citizens. Immigration of foreigners to Lithuania is very low, with an annual average of 2 000-2 500 people.[10] The overall situation of brain drain contributes to skills shortages reported by the business sector.

Policy to encourage skills for innovation

Human capital spurs innovation through many channels (as described at the beginning of this section). In different contexts, generic skills, such as reading, writing and problem solving, as well as technical, managerial, design and interpersonal skills, such as multicultural openness and leadership, all affect innovation.

Jones and Grimshaw (2012) summarise the available assessments of how training and skills affect innovation in firms. In particular, the research shows that both tertiary and vocational education produce valuable skills; there is a positive innovation effect from intermediate technical skills (i.e. skills that are typically bound at the lower limit by unskilled labourers and at the upper limit by university or polytechnic graduates engaged in management, research, design or production); and that sectoral variation in how skills affect innovation suggests that institutions such as sector skills councils are important.

Innovation policy makers often emphasise science, technology, engineering and mathematics (STEM). However, the importance of different fields of study varies by type of innovation and sector of activity. For example, in manufacturing, over 50% of tertiary-educated employees involved in innovation have an engineering (42.9%) or science (7.8%) degree. But in finance, the proportions are 7% and 6.6% respectively (Avvisati, Jacotin and Vincent-Lancrin, 2013).

Because of the diversity of ways in which skills affect innovation, a broad approach to policy is needed. Policy must accomplish many objectives, such as ensuring the development of strong generic skills, so that specific skills can be more easily acquired later; creating arrangements which allow flexible demand-driven resource allocation

across providers of education and training services; developing curricula that are broad enough to expose students to different knowledge content and ways of thinking; using improved pedagogies in traditional subjects (such as metacognitive pedagogies that integrate an explicit reflection about students' learning and thinking); developing students' creativity, critical thinking and communication skills beyond subject-specific expertise; developing interdisciplinary and multi-disciplinary education (for example, the Biodesign programme of Stanford University has brought together students from engineering, management, genetics, biology, medicine and business since 2003 to train medical technology innovators); and establishing a migration regime which facilitates the movement of skilled workers.

Addressing skills mismatch

OECD research shows that potentially significant gains to labour productivity can be achieved by efficient matching of workers to jobs (Adalet McGowan and Andrews, 2015). The OECD (2016a) points to various measures which could help reduce mismatch in Lithuania. These include providing better information to students about the qualification requirements of different jobs; greater efforts to communicate to students the labour market outcomes of graduates by field of study (given recent high enrolment in programmes with low labour market returns); ensuring that the education system teaches skills needed by employers; more on-the-job training and apprenticeships in secondary and tertiary education that teaches practical skills, given the difficulties faced by firms in finding adequately-skilled workers; and measures that further encourage participation by businesses in training and education. Indeed, involving employers and other social partners in the design and delivery of skills policies is important. OECD (2016a) notes however that the Lithuanian government is taking important steps in many of these directions (for instance, the government aims to double the share of work-based learning in HE and in company-based training/apprenticeships that vocational education and training [VET] institutions provide by 2020).

Beyond the specific effects of education policies, Adalet McGowan and Andrews (2015) show that a wider range of policies can affect skill mismatch and its consequences. In particular, less stringent product and labour market regulations, more developed financial services, and bankruptcy legislation that does not excessively penalise business failure are all associated with lower skill mismatch. Reforming housing market policies that inhibit residential mobility may also reduce skill mismatch (such reforms can include lower transaction costs on buying property, less strict rent controls and less stringent building regulations).

The problem of brain drain

As described earlier, emigration is negatively affecting the supply of skills in Lithuania. In order to address the issue of brain drain, the Ministry of Education and Science has implemented the Programme of Brain Regain and Attraction. The main measures of the programme are to encourage researchers from abroad to participate in Lithuanian R&D, to co-operate with Lithuanian science and HEIs, organisations and researchers, and to monitor, collect and store information on the mobility of persons with high levels of skill.

Based on recent OECD analysis of the international mobility of highly-skilled individuals, a number of observations are offered here to help inform thinking on how emigration relates to innovation.

A first point is that a range of innovation activities cannot be conceived without taking into account the role played by mobile talent. This is particularly apparent in science, where progress relies on the circulation of knowledge, interaction between scientists, and the exchange of views and evidence (on average, the research impact of scientists who change university [or research centre] affiliation across national boundaries is 20% higher than those who never move abroad [Appelt et al., 2015]). Furthermore, businesses and academia often seek foreign staff for their specific knowledge and abilities.

The analysis of bilateral flows of scientists provides evidence of two mechanisms by which home countries can benefit from such mobility. First, greater mobility is closely related to scientific collaboration (OECD, 2013). Secondly, the mobility of scientists is strongly related to student flows in the opposite direction. These findings lend support to a "knowledge circulation" perspective on scientist mobility, rather than a more traditional zero-sum view in which some countries win talent at the expense of others. According to Visionary Analytics (2014),[11] Lithuania's rate of participation in international science and innovation programmes remains exceptionally low. This is a sign of the weakness of international knowledge linkages developed by Lithuanian STI organisations.

Some recruitment practices in publicly-controlled research systems can have adverse effects on mobility. If by moving abroad to acquire competences individuals find themselves in a worse position to take jobs in their home institutions, relative to those who stay, this may negatively affect mobility and research excellence. Some institutions address this problem, for instance by recruiting in international labour markets, and precluding the hiring of incumbent students, among other measures.

Financial assistance for mobility and support for the development of absorptive capacity are major policy approaches. Most OECD countries operate programmes to support the short-term outward mobility of students and researchers. These programmes differ with respect to the conditions and expectations placed on individuals upon their return. These types of programmes have also been developed in Lithuania (i.e. the Short Period Visits Programme administered by the Research Council of Lithuania). A major issue is to develop coherent approaches for creating value from investments in acquiring skills abroad. This need not involve the creation of academic positions. Promoting the development of absorptive capacity in the business sector is a complementary option. Several countries offer schemes to attract the return of nationals working abroad or encourage the inward mobility of foreign-born individuals, even to a point where such measures become a central part of science and innovation strategies (OECD, 2014). In this respect, the Ministry of Education and Science has established a competition leading to awards for scientists of Lithuanian origin working abroad.

Some countries also provide tax relief for key foreign employees, so as to help companies attract international expertise to their domestic operations. Such schemes have become increasingly popular in OECD countries. However, the schemes can become complex, imposing substantial compliance and administrative costs relative to the potential gains in employment or innovation (OECD, 2011a). Overall, an effective demand-driven labour migration regime is required. Among other things, such a regime should identify labour market needs, considering demographic and educational changes in the non-immigrant population; establish formal recruitment channels; issue sufficient visas and process them quickly; and, provide efficient ways to verify residence and immigration status (OECD, 2012).

Lastly, for host countries, enrolling international students can help raise revenues from higher education, and be part of a broader strategy to recruit highly skilled immigrants.

5.5. Supporting business R&D and innovation

Support measures for business R&D and innovation

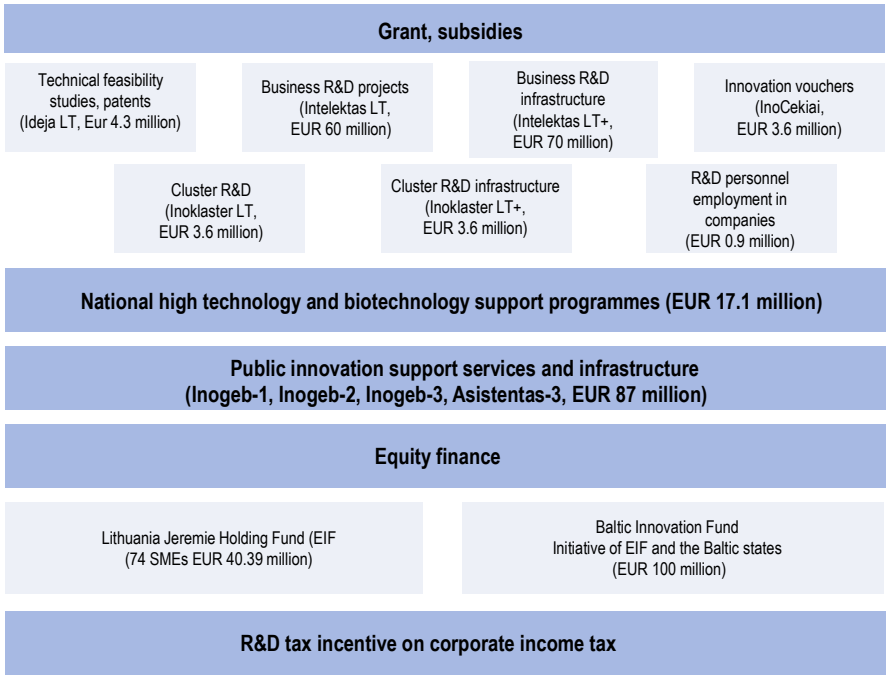
Lithuania offers a wide range of measures of direct and indirect public support for business R&D and technological innovation, aimed primarily at boosting private investment in R&D. Similar to other new EU member states, the main source of finance for the promotion of business R&D and technological innovation in Lithuania comes from EU Structural Funds. As stated above many of the policy schemes at the time of the OECD review stemmed from the previous EU Structural Funds cycle and were in the process of being terminated, altered or restarted.

Figure 5.2 represents a set of measures combining direct and indirect support for business R&D and innovation in Lithuania. The support includes grants and subsidies, financial engineering schemes, public innovation support services and R&D tax incentives on corporate income tax, but lacks measures to stimulate demand in innovation, which are as yet only in the planning stages.

In Lithuania, business R&D and innovation support schemes focus on funding R&D, buying R&D services and providing mainly soft support for innovation (Tables 5.1 and 5.2). Funding for innovation is rather limited and focuses mainly on start-ups and equity instruments.

The Economic Growth Operational Programme's 2007-13 priority number 1 is "R&D for economic development and competitiveness" aimed at increasing private investment in R&D through generic and direct support for business on a competitive basis. During the 2007-13 period of EU Structural Funds, most of the measures prioritised projects related to high- and medium-high-technology industries and high-tech knowledge-intensive services.

Figure 5.2. **A mix of support measures for business R&D and innovation in Lithuania during 2007-13**



Source: Leichteris et al. (2015), *Initial Assessment of Lithuanian Innovation Policy*.

Since 2012, MITA has implemented the Public Study, Research and Experimental Development Programme (2013-20) to support public R&D institutions implementing orders from businesses, while providing EUR 1.3 million in 2013. During 2011-15 MITA organised a national competition for EUR 1.7 million funding for 283 industrial property rights protection projects, resulting in a number of patent applications and registrations of community design. To promote business science co-operation, using national funds, MITA provided financial support (innovation vouchers) for private companies to buy R&D services from public R&D institutions. Innovation vouchers were funded from the national budget during 2010-12, with 222 SMEs receiving more than EUR 0.7 million. Since 2012, funding has been provided by EU Structural Funds (nearly EUR 3.3 million for 776 vouchers).

Table 5.1. **Direct support for business R&D and technological innovation (2007-13)**

Measure	Supported activities
Idėja LT (VP2-1.3-ŪM-01-K)	– Micro, small and medium-sized companies' development of R&D-related technical feasibility studies – Patenting
Intelektas LT (VP2-1.3-ŪM-02-K)	Business R&D activities (excluding R&D infrastructure and equipment, but including depreciation costs)
Intelektas LT + (VP2-1.3-ŪM-03-K)	– Co-financing investments into new or existing business – R&D infrastructure and equipment aimed at creation of new jobs for researchers and technicians
InoCekiai LT (VP2-1.3-ŪM-05-K)	Innovation vouchers to buy industrial or applied research, technological development, and technical feasibility study services from selected public research institutions
Inoklaster LT (VP2-1.4-ŪM-01-K)	Supported activities of cluster co-ordinator include: – Research to develop the cluster and improve its performance – Marketing to attract new cluster members – Management of cluster's open access R&D infrastructure – Implementation of training programmes, workshops and conferences – Promotion of internal and external co-operation
Inoklaster LT+ (VP2-1.4-ŪM-02-K)	Cluster co-ordinator's investment in cluster training, research centre infrastructure and open access R&D infrastructure (laboratories, test facilities, etc.)
Recruitment of highly-skilled workers in companies (VP1-3.2-ŠMM-01-K)	Employment of scientists and other researchers and technical personnel in knowledge-intensive SMEs

Source: www.esparama.lt.

Innovation service support measures aim to improve the dissemination of knowledge and the technology environment, and promote business and scientific co-operation in research and technological development to accelerate and increase business R&D and technological innovation. For instance, Inogeb-2 and Inogeb-1 provided the foundation for infrastructure and improved technology transfer services through technology incubators and technology transfer offices at STPs and universities.

Currently, Lithuania does not have a fully-fledged R&D and innovation policy monitoring system. Therefore, various institutions, including the Ministry of Finance, the Ministry of Economy, or other institutional players of the innovation system, undertake ad hoc policy impact assessments. The most recent impact assessment studies of STI policy measures undertaken during 2011-15 analysed different aspects or levels of policy implementation, especially those related to EU Structural Funds measures. The studies pointed to substantial efforts towards the promotion of public and private R&D but produced mixed results regarding their impact. All assessments used different methodologies with varying levels of inclusion of a number of stakeholders into the analysis, thereby making it difficult to provide an overall and balanced assessment.

Table 5.2. **Financing of innovation support service measures 2007-13**

Measure	Supported activities
Inogeb LT-1 (VP2-1.4-ŪM-03-K)	– Awareness raising about technology and innovation – Innovation support, increasing demand for innovation services (for example, the creation, production and dissemination of information materials, including audio and video) – Creation of information portals, and databases – Technology audits, technology reviews, market analysis and marketing of new products – Technology transfer and adoption – Partner search – Consultation on intellectual (industrial) property rights protection for R&D projects – Advice for entry of new products to the market (testing, certification, labelling, etc.) – Advice on access to finance for R&D and technology innovation – Advice on innovation management methods, and establishment of new innovation companies
Inogeb LT-2 (VP2-1.4-ŪM-04-V)	– Investments in education and/or technology parks infrastructure: – Technology business incubators, open access R&D laboratories and similar facilities – Development of the Integrated Science, Studies and Business Centres (Valleys)
Inogeb LT-3 (VP2-1.4-ŪM-05-V)	– Dissemination of information about R&D and innovation programmes and EU support for business development – Dissemination of information about successful innovation projects in Lithuania – Development and dissemination of information materials (including audio and video) – Creation and support of websites for information dissemination, databases – Innovation support services for SMEs, to foster business and scientific co-operation and innovation partnerships – Partner search services – Determination of corporate technology needs and partnership development – Consultation services in intellectual property protection, commercialisation of research results, and technology transfer issues – The initiation of innovative networking projects, advice on opportunities to participate in international R&D and innovation programmes
Asistentas-3 (VP2-2.2-ŪM-03-V)	Activities designed to encourage: – Entrepreneurship, the creation of new businesses – SME competitiveness – Foreign trade and exports, internationalisation of business – Attraction of good quality direct foreign and local investment – Positive representation of Lithuania 's economic image

Source: www.esparama.lt.

More than half the R&D and innovation initiatives managed by the Ministry of Economy and Ministry of Education and Science have been aimed at co-operation in R&D and innovation. However, the largest part of the funds (approximately 60% or about EUR 480 million) have been allocated to strengthen the knowledge base of the public sector, especially its infrastructure (Public Policy and Management Institute and Knowledge Economy Forum, 2011, Visionary Analytics, 2014). Incentives for business R&D and innovation received only 26%, while the remaining funds (approximately 14% or about EUR 115 million) were dedicated to direct co-operation between companies and research organisations (Public Policy and Management Institute and Knowledge Economy Forum, 2011). Therefore, it is expected that more resources will be allocated to R&D and innovation activities in the coming financial period, especially, for joint projects between research organisations and companies.

The support system for business R&D and innovation consists of isolated support measures based on top-down policy objectives. It is not obvious how companies could benefit from these support measures over time in order to develop their R&D and innovation competences. For example, what would be the logical next step to take after using a voucher? What support or supports would be relevant in developing a product and accessing international markets?

A better grasp of the relevant industrial target groups and their needs would allow the development of a more coherent and consistent support system, with clear tracks highlighting the relevant support schemes from which the companies could benefit. Systematic monitoring of the mix of schemes supporting business R&D and innovation and their participants would allow policy makers to monitor how companies move between schemes and how they develop R&D and innovation competences over time, and hence provide insight into the overall policy impact.

The overall policy mix has been developed towards supporting business R&D and innovation, especially towards the end of the last EU Structural Funds funding period 2007-13 and the preparation of the new period 2014-20. The main challenge is, however, the relatively small number of Lithuanian companies engaged in R&D and innovation. Except for the relatively small number of R&D and innovation-intensive companies, the absorptive capacity of the industry in general seems relatively low.

The policy mix supporting business R&D and innovation should reflect the fact that raising awareness of the importance of R&D and innovation as a source of competitiveness, facilitating competence building and absorptive capacities of companies, and other measures aimed at increasing the number of companies capable and willing to engage in R&D and innovation, are vital in increasing BERD. In this respect, the fit of the policy mix with the Lithuanian business R&D and innovation landscape still seems somewhat unbalanced. The policy mix consists of several measures targeting R&D and innovation-intensive companies. Fewer resources are allocated to identifying and attracting non-active companies to become R&D and innovation performers. For example, many efforts have been made to develop infrastructures supporting business R&D and innovation (Valleys, Open Access Centres, technology centres, STPs, etc.). However, the potential target group of companies seems very small compared to resources allocated to these infrastructures. There is a need to attract a much larger number of companies to engage in R&D and innovation to justify the existence and further development of the supporting infrastructures.

Moreover, the instruments are implemented in isolation from each other by separate agencies with different rules and regulations rather than offered as an integrated package. Even schemes that could benefit companies with lower absorption capacity are closely linked to research rather than more downstream innovation. The resulting policy mix is complex and administratively demanding. Hence, it seems that many companies that could benefit from support decide not to do so.

The bias in the policy mix towards companies already active in R&D and innovation limits the potential long-term impact of R&D and innovation policy. To reach the policy objectives related to the overall private R&D investment and innovation activity, the number of companies engaged in R&D and innovation must be significantly increased. This requires measures that are easy-to-access, easy-to-manage, and possible to tailor to the specific needs of companies. The mix of measures should also encourage and support the companies to systematically develop their internal R&D and innovation competences. Easy-to-access and easy-to-manage entry-level schemes should be followed by gradually more attractive yet more demanding programmes encouraging companies in this development.

One area where the policy mix seems more appropriate is in entrepreneurship and start-ups. Ample focus on access to funding operated by private venture funds, combined with private acceleration services is likely to provide high impact. This is further supported by the closeness of other similar and even stronger systems in the Scandinavian and Baltic regions. The sector in Lithuania is still very small, but it is growing fast. However, it will take a long time before it will have any noticeable impact on the national economy.

The progress in the start-up ecosystem and the related policies supporting it, the policy focus on companies already active in R&D and innovation, and strong investments in public research further highlights the structural mismatch between the policy mix for business R&D and innovation support and the Lithuanian industry needs. Policies mainly target new innovative start-ups, innovative growth companies and companies active in R&D and innovation. The share of these companies of the total company population is relatively small. Hence, the policy impact will inevitably remain small when measured by national level indicators such as BERD/GDP.

A better grasp of industry structures and the challenges and opportunities faced by Lithuanian companies should result in the identification of specific high-potential target groups. High potential may refer to growth in international markets, an increase in R&D and innovation performance or it may particularly refer to the potential to become engaged in R&D and innovation activities in the Lithuanian context. Policy measures should be clearly linked to these specific target groups. Focusing on high-potential target groups also facilitates the overview across policy measures. Instead of viewing each policy measure separately, the view from the side of the high-potential target group will easily reveal if and how different policy measures function in this particular target group, both as individual measures, but even more importantly as a dedicated policy mix.

The gap between R&D and innovation performers and the rest of the Lithuanian enterprise population seems relatively wide. This would further support adopting the target group approach in the design of policies and policy measures, and especially in designing and aligning policy mixes for the selected target groups. The resulting overall policy mix would then consist of:

- target group-specific policy mixes
- generic measures, such as framework conditions, education, etc.
- specific measures strengthening linkages between target groups, such as cluster-type initiatives, procurement-type initiatives, etc.

Several countries are developing business R&D and innovation schemes based on a more customer-oriented approach. The resulting policy mix is a combination of general purpose easy-to-access and easy-to-manage entry-level schemes, general R&D and innovation support and more selective and demanding stage-gate schemes targeting companies with high growth potential. The purpose of the easy-to-access and easy-to-manage schemes is to reach companies with the potential to develop R&D and innovation capacity and companies that have not previously been engaged in R&D. The most common of these types of schemes are R&D or innovation vouchers.

General R&D and innovation support targets the needs of R&D and innovation-intensive companies, but they can also offer a way to move forward from entry-level support schemes. R&D and innovation support schemes consist of bottom-up type schemes aimed at companies and top-down schemes aimed at industry-academia collaboration. While the latter focus more on the needs of R&D-intensive companies, collaborative research and commercialisation of public research, the former often offer support for companies' proprietary R&D and innovation projects.

In order to act as a step forward from the entry-level support schemes, the general R&D and innovation support measures should allow the full range of R&D and innovation activities. This means that R&D support schemes should also target companies with less scientifically demanding R&D: projects focusing on applied research, experimental

development, demonstration, piloting, and generally focusing more on applying existing knowledge rather than creating new knowledge. The focus should be more on how demanding and innovative the project is for the specific company than how demanding or innovative it is in general.

Schemes based on selective stage-gate approaches are gaining increasing interest in many countries. They are most commonly used in targeting high-growth start-ups, such as the Small Business Innovation Research (SBIR)[12] in the United States or YIC[13] in Finland. However, similar approaches are now being adopted to target high-potential SMEs. The main differences between these schemes and more traditional R&D and innovation support schemes include the following:

- The support is offered in stages ranging from feasibility to commercialisation.
- Specific milestones (key performance/success indicators) are set for each stage. Failure to meet the milestones set for a stage typically results in being dropped from the support scheme.
- The support is tailored for each specific company. This is done either by offering flexible funding not, or less limited to, specific costs, or by combining funding from several existing support schemes. Non-financial support is typically organised by securing a pool of potential service providers and allowing the company to choose from within this pool.
- The criteria for selecting companies to join the scheme is based on their ambition and potential for competitiveness, growth, internationalisation, etc., that is, the company's business objective. Instead of focusing on R&D and innovation activities as a proxy for future economic impact, the focus is directly on the expected economic impact, and R&D and innovation are merely part of the activities needed to realise the business ambition.

The benefit of selective stage-gate schemes is that they allow the company to focus and design their project based on their specific ambition and needs, instead of the often rather limited and strict requirements of a specific support scheme. This approach can typically be made administratively lighter for the companies as they can communicate all or most of their needs and manage administrative requirements with a single scheme/agency. Examples of these approaches include the Growth Track scheme in Finland and the Enterprise Development Programme in Estonia (see Box 5.8).

There are some signs of a better match between business R&D and innovation landscape and policy measures in the new EU Structural Funds funding period. Schemes such as vouchers, support for protecting intellectual property, innovation certification, and various other soft measures providing innovation and business support services are likely to reach potential future R&D and innovation performers. Cluster initiatives can also be effective in this respect, if they are industry driven.

The issues related to specific types of support instruments, schemes and target groups are discussed further in the following chapters.

Innovation vouchers

Voucher schemes such as the one in Lithuania are typically targeting the immediate needs of companies. They can be rather effective in raising awareness among companies of potential service providers such as universities. Learning to collaborate with service providers may later lead into extended collaboration once sufficient trust has been built

using the voucher. The challenge is that universities usually do not provide close-to-market services needed typically by companies and even if they did, there would be a risk of unfair competition with private service providers. Another potential problem with voucher schemes is that if service providers see them as a potential source of further funding, they might be tempted to start writing proposals on behalf of companies, and rather than addressing companies' needs, the focus would be on work that is more interesting for the service provider. This might be particularly the case if the vouchers cover 100% of the costs of the services provided.

Voucher-type schemes can be used for both R&D and innovation purposes, covering public and also private service providers. This requires that the operating agency set the necessary code of conduct and rules for the voucher scheme and organise a certification of service providers or some other form of validation, for example through a public tendering process. This allows agencies to focus on operating schemes rather than growing the public sector by hiring experts for providing services to companies. This approach is worth considering in areas where a sufficient supply of private services exists.

The main purpose of voucher schemes is to introduce companies to systematic R&D and innovation activities, and collaboration with R&D and innovation services provided typically by universities and public research institutes (PRIs). One of the key success indicators is the continuation of the relationship between companies and these research organisations. This can be in the form of return projects with additional vouchers or without them, or continuation of the relationship with more ambitious projects.

The key to ensuring success is in designing how the continuation or return projects can be supported. This can be done by allowing the company to apply for several vouchers over time. Another approach is to offer simplified small-scale R&D and innovation project funding for the companies.

EAS in Estonia has approached this by devising a voucher scheme with two types of vouchers.[14] An innovation voucher (maximum EUR 4 000) is available for companies who can use it only once. It is aimed at companies in need of external expertise to develop innovative solutions for their practical problems, carry out tests with new materials, gather knowledge on technologies, conduct studies in intellectual property databases, etc. A development voucher (maximum EUR 20 000) can be used for the next step and obtain external expertise to support the implementation of the identified solution in practice.

There is limited information available regarding the impact of the Lithuanian voucher scheme. A sufficient monitoring system should be put in place to allow further analysis, particularly as it is one of the few measures aimed at increasing the number of companies engaged in R&D and innovation. Evidence of more sustainable impact in the form of continued collaboration or return subscription, as well as entry of companies new to public support, would give the necessary insight into the impact and facilitate further development of the scheme.

Box 5.8. Customer-oriented approach in supporting business R&D and innovation – a way to cut across the fragmentation of public support agencies and schemes

Sensitive to the fragmentation of several support schemes and agencies, some agencies have started to adopt customer-oriented approaches in supporting business R&D and innovation. The rationale behind these approaches is to recognise the individual needs of companies and facilitate tailoring of the most relevant support measures accordingly. As a result, the awareness and access to relevant public support measures can be ensured, and the administrative burden of companies can be significantly reduced.

Growth Track was a service model for Finnish SMEs that strived for rapid growth and internationalisation. The service aimed to ensure that companies could efficiently utilise the best suited public expertise and financing services. Each company selected for Growth Track was given a Growth Pilot, a contact person who helped find the best suited services for the company and co-ordinated co-operation between the various agencies and public service providers.

Growth Track was offered jointly by Tekes, the Centres for Economic Development, Transport and the Environment, Finnvera, Finpro, Finnish Industry Investment Ltd and the National Board of Patents and Registration of Finland. The programme was part of the Enterprise Finland service network. Growth Track was a service model implemented between 2009 and 2014. As of the beginning of 2015, Growth Track became part of **Team Finland** network's services. Growth Track included a total of 135 companies. During Growth Track, their total turnover doubled (EUR 729 million), exports tripled (EUR 150 million) and the number of personnel doubled to almost 4 000.

Enterprise Estonia launched the Enterprise Development Programme in 2016. The target group of the programme is ambitious enterprises with the readiness to invest and the desire to grow, develop and launch new products and services. The total budget for the scheme is EUR 73 million over the current EU Structural Fund period.

Participation in the Enterprise Development Programme is open to industrial enterprises or companies of the smart specialisation fields that have been operating for at least three years (as of date of registration) with a minimum of eight employees have obtained first experiences in export or management of fast growth; these enterprises should also have clear ambitions and potential for growth and the ability to bring new or significantly improved products or services to the market. The Enterprise Development Programme supports the enterprise in making and carrying out planning and management decisions. Together with the enterprise participating in the development programme, EAS finds the best solutions for carrying out changes in the enterprise and making a significant stride in development. At the heart of the programme is the enterprise's multi-year development plan.

The Enterprise Development Programme consists of three stages:

- identifying the enterprise's ambition and readiness for change
- preparing the development plan
- implementing the development plan.

The common feature in these types of approaches and schemes is that the selection of the beneficiary companies is based on the company's ambition and potential to innovate and grow in international markets, not on detailed project plans or budgets. Once the company is accepted into the scheme, it has access to relevant services (e.g. diagnostics, mentoring and consultancy), events (e.g. international visits, fairs and trade shows), and funding (e.g. grants, loans and guarantees), all of which can be tailored to fit with the company's medium- to long-term development or growth plan. The company has easy access to all relevant public support with minimum bureaucracy.

Sources: http://team.finland.fi/en/services; www.eas.ee/service/enterprise-development-programme/?lang=en#articleblock-3stageimplementationofthedevelopmentplan.

Tax incentives for R&D

Since 2008 enterprises have been given the option to deduct 300% of their R&D expenditures from taxable income, this enhanced deduction scheme alongside an accelerated depreciation allowance for some R&D capital. Calculations based on the so-called B-Index show that this incentive is very generous compared to tax incentives in place in in OECD countries (see OECD, 2016b, Figure 1.18). However the utilisation of this support instrument for R&D appeared to be rather low. This is in line with the low R&D capacity of firms observed in previous chapters. However, data from the State Tax Inspectorate indicate that some expansion in terms of numbers of tax payers using the tax relief seems to have taken place recently (2014) although this was not accompanied by a commensurate increase in the volume of the tax relief.

As the recent OECD Economic Survey: Lithuania (OECD, 2016b) pointed out, a survey of Lithuanian businesses found that two-thirds of the respondents were unaware that a tax deduction for R&D expenditures existed (Deloitte, 2015). Of those that were aware, a commonly cited deterrent to applying for incentives was uncertainty relating to the definition of eligible R&D. Upon request by a firm MITA verifies whether activities can be classified as R&D. The Economic Survey recommended that along with the existence of R&D tax incentives, this service should be better communicated to firms.

While R&D tax incentives potentially encourage (additional) business R&D expenditures, it is also known that they may favour incumbents at the expense of young firms. An important reason for this is that the implicit subsidy rate of such measures increases with firm profitability and young firms are often in a loss position in the early years of an R&D project (Adalet McGowan and Andrews, 2015). The Lithuanian tax incentives should take due account of this issues in their design (for example by introducing suitable carry-forward provisions). After nearly one full decade of their existence, an evaluation of the impact of the tax incentives in place in Lithuania would be in order.

Access to debt and equity finance

Chapter 2 described key financial instruments and institutions relevant to finance for the business sector. A number of observations were made on policy, including that bankruptcy processes could be made more rapid and less costly; efforts to promote new forms of financing, such as crowd-funding platforms, could take stock of the recent revisions to related regulations in countries such as Austria and Germany, which aim at developing this form of finance, while recognising that this funding mechanism typically engages relatively small volumes of total investment; and support to improve investment readiness in firms – improving the quality and presentation of investment projects – can sometimes be the best course of action for policy makers seeking to enhance access to equity finance.

According to an evaluation report provided by PricewaterhouseCoopers, UAB and VšI ESTEP (2010), the financial engineering measures undertaken under the 2007-13 EU Structural Funds programming period covered all stages of company development. But the report suggests that more specific measures could be introduced, for example, dealing with export insurance.

Access to equity funding does not seem to be a particular problem in Lithuania. However, equity funding often targets high-growth companies. The wider SME population typically relies on bank-based non-equity finance. Access to non-equity funding might be a barrier for growth among SMEs. SMEs that are not willing to take on outside investors might find it particularly challenging to fund international growth. This could indicate that further public measures would be needed to support growth in the form of guarantees

or mezzanine funding. The evidence is too limited to warrant a clear recommendation here. However, it would be advisable to analyse SMEs' access to private non-equity funding and whether there are barriers which require remedial action, for instance through guarantee schemes. Such schemes are quite common and used successfully in most countries.

Chapter 2 also noted that the Lithuanian government currently provides no tax incentives for business angels or venture capital. As Chapter 2 described, while the venture capital sector in Lithuania is young, it is by some measures developing rapidly. The remaining comments in this section therefore focus on business angel investment.

In some countries, policies to encourage a greater number of angel investors seem to have played a positive role. These include supply-side measures such as tax incentives and the creation of co-investment funds. Countries such as the United Kingdom, with long-standing angel tax incentive programmes, cite the positive impact the programmes have had on increasing angel investment activity (OECD, 2011a). However, tax incentives can also be difficult to structure and target appropriately.

The level, sophistication and dynamics of angel investment often vary greatly across regions within a country. In a number of countries, such as Canada and the United States, policies on business angels are implemented at regional levels. At sub-national level, important benefits could come from supporting business angel networks. Such networks aim to match informal investors with ventures seeking small amounts of equity finance. Public policy towards business angel networks is justified, in principle, by obstacles to the efficient functioning of the informal equity market. An information barrier may exist in this market if business angels are reluctant to publicise their willingness to invest and entrepreneurs are reluctant to reveal innovative ideas. Furthermore, informal investors often rely on friends and business acquaintances for referrals of investment opportunities. This reliance on informal contacts reflects the time required to search for and appraise potential investments, as well as the fact that many business angels invest on a part-time basis. Such information and search-cost barriers, on both the supply and demand sides of this market, can be lowered through support for business angel networks. Angel networks can also create synergies by linking with mentor networks, chambers of commerce, clubs of entrepreneurs and other similar bodies.

Other areas in which policy makers have acted to develop the angel financing market include providing support directly to national angel associations or federations. National angel associations help raise awareness about angel investment, which is a critical step in building the market; also training angel investors can professionalise the sector and attract new angel investors. But such training is often overlooked by policy makers. Because angel investors are typically experienced entrepreneurs and business people it is assumed that they also know how to invest. However, the skills and experience needed to successfully invest in start-ups can differ greatly from those required to be a financial investor or build a company in a particular sector. Training and mentoring, in which new angel investors can learn from experienced angel investors, can be important to promote this form of equity investment.

Incubators, science and technology parks (STPs) and networks

An analysis of Lithuanian STPs revealed that the activity of parks is concentrated on establishing infrastructure, building connections with local businesses and the scientific community, developing administrative skills, identifying local demand for innovation, business and innovation enhancement services and exploring the potential commercial value of these (KEF, 2010).

About 34% of all enterprises established in the STPs were found to operate in the field of ICT; 23% offered financial, business and other consultative services; about 12% were active in engineering technologies, chemistry and the food industry, and 11% of enterprises were engaged in the energy and electronics sectors.

In 2015, seven of the nine STPs were operating in the Valleys and some of them included technology incubators. Some of the STPs are very active in start-ups promotion (for example the North Town STP) and regularly organise business plan competitions, among other entrepreneurship support activities. These are not exclusively focused on science-based entrepreneurship. To date the involvement of enterprises in STPs and open access centres has been limited. Most of these initiatives have focused on the modernisation of public research infrastructures rather than industry-science collaboration (European Commission, 2016).

Compared with other countries, the number of Lithuanian STPs is high and their size is relatively small. The small size of the STPs discourages a significant number of companies. The KEF study also suggests that the precise role of STPs and their engagement with universities is still not well defined.

Most STPs do not own land and buildings, but rent or use them on a contract basis. This may impede the development of parks' infrastructure when there is a disagreement about goals and amounts of infrastructure development with land owners (mostly the state). One potential outcome of this is the lack of commitment of the scientific institutions. Scientific institutions may see STPs as competitors for local, national and EU funding and funding from companies. They may also compete in attracting talented students and graduates. STPs should therefore work in close collaboration with the local (and other relevant) scientific institutions to avoid such potential problems.

The main goals pursued by Lithuanian STPs – incubation, enhanced networking and knowledge flows, promotion of a knowledge and innovation culture, restructuring of industry, and regional development – are common STP goals worldwide. However, an analysis of services provided by the parks showed that Lithuanian STPs have no specific orientation to services useful for institutions that add value to production. Rather, they provide a broad range of services suitable for a variety of companies (KEF, 2010).

The KEF (2010) analysis of STPs' plans to create added-value services shows a tendency to focus on consulting services, partnering services and searches for funding. Such plans for the development of new services were influenced by STPs' involvement in the Inogeb LT-1 programme. This suggests that the current or planned activity of the parks is directly connected with subsidised activities in specific programmes. Taking this fact into account, the programming of financial support from the EU Structural Funds 2014-20 is likely to be of great importance when further STP goals are set. Support from EU Structural Funds increases the possibility of extending the scope of STP's services.

STPs are starting to apply more precise criteria for tenant selection, but there is still a strong tendency towards keeping buildings filled to create revenue growth, with little account taken of the actual focus of the enterprises or their current innovation practices (KEF, 2010).

In summary, the effectiveness of existing STPs and business incubators may be rather limited. While policy makers have turned to business incubation to meet a wide range of policy goals – from raising enterprise birth rates, to commercialising university research, to expanding the supply of infrastructure – there are a number of general lessons from across the OECD area which might be helpful to take into consideration. These lessons are set out in Box 5.10.

Box 5.9. **Technology transfer and intellectual property functions in small countries**

Improving academia-industry collaboration is a key policy objective in Lithuania. STPs and incubators have been set up as a platform for such co-operation. However, to make these platforms more effective, universities need to establish well-functioning technology transfer offices (TTOs) that act as intermediaries between academia and the business sector. As Lithuania needs to expand the numbers of companies active in innovation, the pro-active business development functions of such TTOs would need to be adequately resourced. Evidence from studies of critical success factors for TTOs indicates that a TTO should have the full support of, and autonomy within, the university structure, and should also operate in an external context where legal frameworks support industry-science links. Debackere (2012) emphasises that operating a TTO requires considerable assets: "it is advisable for the TTO staff to have a thorough, in-depth understanding and experience with the academic environment, its *modus operandi*, its norms and values, its intricacies and behaviours. At the same time, a profound understanding of the needs of industry and business is an absolute necessity. As a consequence, an effective TTO operation requires experts able to 'see both sides', who are capable of translating the needs and objectives of the one side into the language understood by the other side." (Debackere, 2012).

People with sufficient knowledge and experience can be hard to find, particularly in a country such as Lithuania, which is small and has a relatively short history of industrial expansion. In terms of raising awareness of intellectual property in universities, TTOs need access to people with specific legal qualifications (Radauer, 2016). Again, these skills are scarce and in high demand. Given the small size of the Lithuanian innovation system and the relatively large number of universities, it would be advisable to consider:

- Pooling the TTO expertise and resources in the country and focusing on the two to three best-positioned universities and research organisations sharing the expertise of the TTO staff, rather than expecting each university to invest in a sub-critical TTO function (see, for instance, Debackere [2012]).
- Accompanying these activities with a capacity-building and awareness-building programme to support these TTOs in building up the pool of knowledge and expertise. It would be advisable to start with a focus on TTO staff with experience in a small number of priority sectors.

There are currently ongoing efforts to improve STP's efficiency and their business strategy. In February 2015, a new STPs Development Concept was approved by the Lithuanian government. This directive indicates that STPs should concentrate and optimise their infrastructure, and orientate to smart specialization strategies. Actions to restructure STPs have started. For instance, two STPs in Kaunas city were united in 2015. The new approach also defined a new responsibility for MITA to monitor and evaluate STPs as well as conduct analysis of STPs' business strategies.

The new Operational Programme 2014-20 plans to finance the operation of new TTOs in universities. Lessons for the setting up of TTOs are highlighted in Box 5.9. As Lithuania needs to expand the numbers of companies active in innovation and enhance industry-science collaboration for research and innovation activities, TTOs would help to build bridges between industry and universities. In deploying these new initiatives, attention should be given to the pooling of resources and provisioning TTOs with adequate resources and competences.

Policy towards enterprise clusters

A "cluster" is a geographical concentration of inter-related firms, often existing in close proximity to HE and research institutions and other public and private entities. In recent years, policies to foster enterprise clusters have been frequent in both OECD and developing countries, in wealthy and lagging sub-national regions, and in jurisdictions with *laissez-faire* and *dirigiste* approaches to economic development. Most OECD countries have some form of cluster or sector-based approach to support innovation.

A significant impetus for cluster development in Lithuania has been created by various public support measures. These have been financed from both national and EU Structural Funds, and include direct measures, such as "InoKlaster LT", and indirect measures, such as the National Cluster Support Network.

There are 52 cluster initiatives in Lithuania (see Box 5.11 for an example).[15] This activity has been the result of an intensive support during the period 2007-13 and great importance given to cluster policy and the creation of innovation value chains. In Lithuania, clusters have emerged in strongest cities economically speaking (Vilnius, Klaipeda, Kaunas and Alytus), which have the most dense concentration of operating economic entities and the highest employment rates. Cluster activity is accentuated more in the services sector than in manufacturing. Examples of industries with cluster activity are: information and communications technologies, creative industries, and health and medical tourism.

However, some of these initiatives are still embryonic, others comprise enterprises whose primary aim is to take advantage of EU Structural Funds, and only about a quarter are forming autonomously and are engaged in developing new products or services through long-term co-operation (Leichteris et al., 2015). Most of Lithuania's clusters participate in international projects, such as projects funded by the European Union's 7th Framework Programme for Research and other EU initiatives to create knowledge and innovation spaces and develop commercial co-operation with foreign partners.

There is anecdotal evidence that the rules for funding of cluster programmes are not always geared to the business sector's priorities. For instance, some firms would prefer not to have to involve a university in the consortium, and would instead wish to involve colleges or other types of organisations.

It is the case that clustered firms – those which are located near to each other – can experience positive economic spillovers from surrounding firms and institutions. These so-called "agglomeration economies" take many forms and are the subject of a vast multi-disciplinary literature dating as far back as Alfred Marshall's *Principles of Economics*. In the broadest terms, the agglomeration of firms and their suppliers permits the creation of locally concentrated and sometimes specialised labour markets. Clustering can encourage an enhanced division of labour among firms (offering greater scale economies for individual enterprises), and attract buyers and sellers. And clusters can facilitate flows of ideas and information that help underpin innovation. Such information flows occur formally and informally, for example when employees change employer, through contacts with common suppliers, and through social interaction. And by operating in close proximity firms can more easily subcontract to competitors those orders that exceed their own capacities, as proximity may allow greater knowledge of the capabilities of potential contractors, which can allow firms to retain valued customers. Similarly, cluster-based collaboration can also foster specialisation and the taking of higher risks, such as launching export activities, by offering peer support and complementary competences. As a consequence of benefits such as those outlined here, significant empirical evidence exists of the productivity- and competitiveness-enhancing potential of belonging to a cluster.

Box 5.10. Policy lessons on business incubators

A first point is that what makes incubation a potentially cost-effective policy tool is that information sharing and synergies can be realised among the firms that use the incubator – the tenants. Such information sharing is not expected to include proprietary knowledge, of course, but rather concerns day-to-day problems that typically affect small, fast-growth firms, such as the challenge of managing cash-flow (in many cases however, incubator managers fail to promote such information sharing). Incubation can also lower the unit cost of delivering services to co-located firms, as compared with providing services to firms that are geographically dispersed.

The services offered by incubators should match the particular goals they have. For instance, technology-oriented incubators typically possess features that differentiate them from mixed-use incubators. They are frequently affiliated with a university and often have selective entry criteria focusing on businesses with high-growth potential. They can also be more expensive to establish and run because of the need for specialised facilities and staff. Their service offering may also include a greater emphasis on services related to intellectual property.

In both mixed-use and technology-oriented incubators job creation is a frequent goal of publicly supported schemes. However, as an objective, business development should generally take primacy over job creation. In the context of incubation, job creation is best achieved through successful business outcomes (moreover, anecdotal evidence suggests that most job creation occurs after tenant firms graduate from their incubators). Incubator managers should therefore work with performance metrics and management incentives closely tied to measures of commercial and technological outcomes.

When it is given, public support should come at the initial stages business development, not through the long-term subsidy of operational costs. Without exposure to commercial disciplines the incubator is unlikely to provide competitive services.

Local authorities and incubator sponsors should encourage local business and community support. They should also seek to link incubator initiatives with wider business networks.

Achieving scale is important. Having a larger incubator opens possibilities for cost and risk reduction, as well as the leveraging of private finance. For small communities incubators should probably be treated with caution. If attempted, it may be advisable to embed the incubator in a larger umbrella organisation or network. So-called "virtual" incubators can be a cost-effective means of providing non-property-based services in areas with small numbers of potential tenant firms.

As the success of incubation programmes often depends on the quality of management, the development of professional training courses should be encouraged. Local and regional bodies that sponsor incubation programmes should ensure the establishment of a board of directors embodying a spectrum of skills and experience.

Incubation programmes should aim for high-quality accommodation to attract high-quality entrants.

Local and regional bodies should ensure that rigorous procedures for benchmarking and evaluation are integral to all publicly supported incubator schemes. There is a need to consider the outcome measures commonly used in evaluations of incubation schemes. As noted above, the focus of incubation should be on different dimensions of enterprise and technology development. This implies a need to record such things as the time that enterprises need to establish market niches or develop new products; the adoption of advanced management practices; the use of new or superior technologies; the number of patents registered; cost reduction resulting from technology developed through the incubator; the number of research projects transformed into business opportunities; the volume of royalties obtained by the incubator, university or research centre as a result of projects supported by the incubator, etc. Some incubators can also have long-run indirect effects that are difficult to measure. For example, technology-oriented incubators can provide concrete examples to university staff regarding the commercialisation of research.

In countries where incubators are numerous, the development of professional incubator associations should be encouraged in order to disseminate best practice, create benchmarks, and implement training. Associations can likewise be encouraged to create an accreditation programme.

Source: OECD/LEED-SOFIREM (2000), "Good practice in business incubation", www.oecd.org/cfe/leed/leed-publications.htm.

Box 5.11. **Photovoltaic Technology Cluster**

The Photovoltaic Technology Cluster is perhaps the most successful and ambitious of the cluster initiatives currently operating in Lithuania. Starting in 2008, this collaboration quickly initiated a new solar energy industry, which is continuing to gain momentum. At present, 19 companies are supported by three universities and the Science and Technology Park. The companies manufacture solar cells, modules and power plants as well as other high-tech products. The companies sell all over the world, and are constantly expanding their research and manufacturing capacities.

Although the cluster itself does not carry out any business activities (it is not a legal entity), it provides opportunities for fulfilling the research, production, and marketing potential of its members. Each enterprise in the cluster develops individually, but joint activities, such as research and prototype development, are co-ordinated inside the cluster. The joint work is facilitated by the Applied Research Institute for Prospective Technologies.

A new research centre of the Photovoltaic Technology Cluster in Vilnius started at the end of 2014.

However, in order to reflect on the possible policy actions to take with respect to clusters, it is essential to first make a number of conceptual distinctions. These distinctions are needed because terminology in this area of policy is sometimes imprecise, and a range of interventions are often subsumed under the same generic category of "cluster policy". For instance, policies that support competence/excellence centres or business networks are often referred to as cluster policies, without any differentiation. But distinctions between a cluster of firms and a business network are important. The two phenomena, or types of initiative, can entail different resource requirements, objectives and evaluation metrics. Business networks operate with varied forms and objectives. Some aim at general sharing of information, while others tackle more specific goals. Business network programmes can be easier to design and implement when firms are located near to each other, but they can also operate well beyond the geographical boundaries of a cluster.

In addition, in policy discussion there sometimes appears to be confusion between the economic benefits to firms of belonging to a cluster and the separate question of why governments need a policy on clusters. At least four observations are relevant in this connection:

- The available evidence suggests that while clustering can bring benefits to firms, the magnitude of these benefits is often modest (Rosenthal and Strange, 2004) and that firms are in any case able to appropriate some of the productivity gains from belonging to a cluster (Martin, Mayer and Mayneris, 2011). To the extent that firms capture such productivity gains, the need for a policy to alter firms' location decisions is lessened.
- The mere fact that firms in a cluster might be more productive than firms elsewhere is not an economic justification for policy support (as it is a state of affairs that could be consistent with efficient markets). Policy needs to start from the identification of market failure(s) that could merit correction.
- Many policies that are likely to have a major impact on clusters are almost never fully considered in programmes to support clusters. These include transport, land-use planning and labour market policies (Uyarra and Ramlogan, 2012). Evaluations also tend to focus on activities implemented as part of relatively short-term enterprise support initiatives, rather than the effects of these other policy variables, some of which operate over a longer period.

- Rigorous evaluations of cluster-related policies are also few (and show mixed results). One cause of this evaluation shortage may be that policy towards enterprise clusters often includes many different types of intervention, some with multiple and inter-related objectives. There also appears to be little evidence on how specific design and implementation features of cluster policy have contributed to policy outcomes. Various evaluations using statistical controls are cited in Warwick and Nolan (2014). A salient finding is that policy effects for the cluster programmes are often modest, and that assessments of long-term impacts are almost entirely lacking. Schemes focusing on business networks appear to give more positive outcomes.

The OECD has sought to distil the implications for policy of the above evidence and discussion (Warwick and Nolan, 2014). Accordingly, should Lithuanian policy makers seek to expand cluster-related activities or support, the following generic observations could provide a degree of orientation:

- *Caution in this area of policy development is prudent.* While cluster-type policies are popular, it remains to be proven which, if any, cluster policy measures are effective, and to what extent they might increase innovation or productivity. Indeed, many clusters have thrived in the absence of policy.
- *Policy should explicitly target market failures.* Several forms of market failure may be relevant. These include under-supply of public goods, particularly infrastructure.
- *The government should work with existing and emerging clusters rather than trying to create entirely new clusters*. A policy aimed at developing entirely new groups of firms in selected sectors can entail high costs and high risks, and give rise to destructive competition should many regions follow the same policies in pursuit of identical industries.
- *A policy on clusters should encourage dialogue and co-operation between firms and the public sector (particularly at local and regional levels of government).* This dialogue could identify and lead to the development of inter-firm networks and improved quality of government action (such as in co-locating complementary public investments, like research facilities).
- *Policy makers should also assess the wider determinants of cluster success, which may in fact be the best targets of policy*. Such determinants include transport, land-use planning, housing, the quality of public amenities and labour market policies.
- *Incentive structures should encourage local linkages between industry and universities.* Many institutional permutations are possible as regards the interaction of local firms, universities and training institutions. These can range from grants and fellowships to targeted research contracts, collaborative research and training programmes. Such arrangements will not always be the responsibility of central government, but if support for a cluster is provided, the programme managers can meet with the relevant local actors, encourage adaptability and assess the need, if any, for complementary actions by local, regional or central public authorities.
- *The government might justify a facilitating or co-ordinating role in developing business networks, owing to the fact that in some places and industries there may have been no, or limited, prior familiarity with the opportunities that networks afford.* However, if "demonstration" is the policy rationale, then this implies that the policy should have a short duration. Funding should be modest, and should be

phased out as participants start to engage more formally and obtain benefits. Precise market-oriented objectives for business networks should be set by, or in conjunction with, firms. Networks that only have loosely-defined goals tend to have limited impact.

In addition, clusters in Lithuania with already close collaboration structures, long-term vision and a focus on R&D and innovation could be developed further into competence centre-type structures. This could support patterns of collaboration which go beyond one-off projects and instead build strategic innovation agendas for the medium to long term. Examples of such centres can be found in several countries, such as Austria[16] and Estonia.[17] These centres often take the form of limited liability companies jointly owned by industry and research organisations, with a long-term objective to become financially self-sustaining.

Business services

The Enterprise Europe Network (EEN) started its activities in 2008 in Lithuania. This network brings together around 600 business support organisations from more than 50 countries with the goal of providing help for small companies to seize the unparalleled business opportunities in the EU Single Market and beyond. In Lithuania, this network is represented by four organisations – Kaunas Chamber of Commerce, Industry and Crafts (Kaunas CCIC), Klaipeda Chamber of Commerce, Industry and Crafts (Klaipeda CCIC), Vilnius Chamber of Commerce, Industry and Crafts (Vilnius CCIC) and Lithuanian Innovation Centre (LIC).

The Lithuanian EEN consortia offer European support services specifically designed to unlock the potential of Lithuanian businesses and researchers through:

- increasing the ability to innovate and create higher absorptive capacity
- improving performance in internationalisation as well as enhancing competitiveness in the EU Single Market
- enhancing management capacities and co-operation with clusters
- better access to new markets and networking opportunities at EU level and beyond
- improving understanding of EU legislation, standards, policies and programmes.

The Lithuanian EEN network plays a significant role in providing EU-level advisory and networking services to the Lithuanian business community, according to an analysis of business support demand (LIC, 2014). EEN services are the first choice of 68% of SMEs with regard to public innovation coaching services and the first choice of 77% of SMEs with regard to public advice on EU programmes and European funding opportunities.

The EEN network complements the Lithuanian business support environment by providing specific services to enable access the benefits of the EU Single Market and contribute to the competitiveness of SMEs:

- The new funding period (2015-20) in Lithuania and the European Union will bring many funding and partnering opportunities for the business and scientific communities. The main national funding agencies offer more than 25 national financial support measures for SMEs, to support internationalisation and R&D. In an analysis of business support demand (LIC, 2014), more than 80% of SMEs identify the need for support in understanding and selecting appropriate EU/national funding or partnering programmes. The Lithuanian EEN consortia reflect these

needs by enriching advisory services with detailed mapping of funding opportunities relevant to the individual SME's business strategies.

- EEN services such as technology audits, reviews of innovation capacity, access to large-scale technology markets and automated queries systems (AQS) are not only unique services to the Lithuanian public business support sector, but also highly valued by users (LIC, 2014).

The main targets for services delivered by the Lithuanian EEN consortia for the development of absorptive capabilities in Lithuanian firms include Lithuanian SMEs already engaged in innovation and/or having the potential to act internationally and adopt new technologies or non-technological innovations in the context of international partnerships, but facing internal barriers to these developments.

The barriers to business with regard to engaging in R&D and innovation relate to both funds and competences. Offering funding alone is therefore not sufficient. Business R&D and technological innovation also need to be supported by innovation support services.

In addition to the EEN network, there are also other business R&D and innovation services available in Lithuania, for example through MITA. However, the utility of these services is considered average (ESTEP, 2015). Visionary Analytics (2014) pointed to the fact that the existing innovation promotion system lacks sufficient "soft" measures, to increase companies' motivation to implement innovative activities and innovation capacity building. Despite the existence of the innovation support services, they lacked both R&D-related mentoring services and qualified staff to work with R&D equipment (Visionary Analytics, 2014, ESTEP, 2015). Evaluation draws attention to quality issues in innovation support service (promotion of networking, knowledge and technology transfer, technology and innovation audits, support for co-operation (business and education), partnerships and promotion of clustering (Public Policy and Management Institute and Knowledge Economy Forum, 2011). The report concludes that the lack of service quality is determined by two factors: a) the lack of expertise and experience; and b) the inefficiency of the performance measurement system (accounting for quantity rather than quality of results).

The typical way to organise R&D and innovation support services is to assign the provision of these to an existing or new network of various public sector organisations. The problem with this is that these public sector organisations are often not able to attract the necessary competences with hands-on experience in entrepreneurship and business development. People with entrepreneurial mind-sets and experience tend to stay in the private sector and work in or with companies, rather than seek employment in the public sector.

Therefore, these services have in some cases been organised in the form of vouchers or procurement contracts, where the services are provided by private sector service providers. These models may be based on the number of companies reached and services provided, but they may also include performance or success-based fees.

The benefit from using private sector service providers is that this approach addresses simultaneously both the demand and supply. The service made available enhances the demand for R&D and innovation support services and makes them visible. On the other hand, allowing the private sector to provide the services enhances the availability and quality of services. This will allow the public sector to gradually reduce its intervention as both the demand and supply develop over time.

However, services cannot be based on private service providers unless the private service market is developed enough. If the quality and availability of private business

R&D and innovation services is limited with high variations in quality, the public sector may have to organise the services itself. An alternative is to make use of certification and validation mechanisms or even selection based on public tendering. The rationale for these is that only those service providers that are able to show the necessary competences and experience, and thereby sufficient quality, are selected and/or certified to provide the service. These may include both private and public service providers. As the quality and availability of these services develop over time, the certification can be taken over and managed by the service providers themselves (self-regulation). This offers the mechanism for reducing public intervention over time.

Public business R&D and innovation services easily tend to become institutionalised, unless they are managed on business principles against clearly defined and monitored performance indicators.

The main challenge with the EEN network is related to its focus. It should provide services for companies regarding EU funding opportunities and other potential sources of funding as well as developing R&D and innovation competences. The relevant target group for these services consists mainly of SMEs with relatively high levels of R&D and innovation capacity. If the EEN network remains focused on these, the wider economic impact of its activities may prove to be relatively limited.

For wider impact, the EEN needs to reach companies with less R&D and innovation competences. However, these companies are typically not able to access EU funding or engage in challenging R&D and innovation projects. The services these companies need differ greatly from services needed by more competent SMEs.

It is therefore important that the EEN and other public innovation support programmes are clearly profiled to specific target groups and specific services. Unnecessary overlaps will inevitably merely confuse potential beneficiaries, and thus limit the impact of these services.

R&D and innovation support services should be made available to all SMEs with the capacity, or at least the potential to develop the capacity, for R&D and innovation. However, these services are often most effective when they are integrated into active development projects undertaken by companies. For example, offering training services in isolation is typically not as effective as those integrated into active projects with the possibility of an additional mentoring/coaching component.

Therefore, the design of R&D and innovation support services should be based on three main fundamentals:

- clearly identified and verified need experienced by targeted companies
- clearly definable and sustainable added value, that is, increase in targeted companies' R&D and innovation competences
- easy integration of the services into other support programmes, particularly R&D and innovation funding.

The supply of business R&D and innovation support services should be need-driven. The EEN network is a European construct based on the generic needs of SMEs with some bias towards companies capable of benefiting from EU support. It is important that the local implementation in Lithuania is strongly tailored to the Lithuanian context, otherwise it may end up focusing on a limited number of companies also targeted by several other measures, overlapping, and adding to the complexity and confusion rather than providing a clear added-value.

Awareness raising can also be viewed as a service. Instead of designing and implementing isolated campaigns, awareness raising can be integrated into services, such as reviews of international market trends and future opportunities, diagnostics and readiness analyses, coaching/mentoring, etc., raising awareness by bringing timely and relevant information to companies when they need it and/or can use it.

Public procurement for innovation

Innovation-oriented public procurement is not yet well developed in Lithuania, with lowest-price criteria still dominating public purchasing decisions. However, in 2014 the *Innovative Public Procurement Guidelines* were published to stimulate public procurement of better quality items more adapted to customer needs, and providing superior performance.

The ambition to develop innovative public procurement is set out in the Strategy of Development and Improvement of the Lithuanian Public Procurement System (2009-13). Despite the fact that current legal provisions provide possibilities for innovation-oriented public procurement, this happens in a rather limited way. The strategy set a goal where, by 2013, innovation-oriented procurement would account for 5% of all public procurement. This objective was not fully achieved.

- Recently, with support from the Ministry of Economy, MITA began an initiative on PCP called "Creation of a legal environment for pre-commercial procurement" (IPTAS) (PCP aims at purchasing R&D, design, prototyping and testing services for products or services that do not yet exist on the market. Such procurement requires innovative technological development work by companies or institutions responding to the tender (Edquist, Hommen and Tsipuri, 2000). Lithuania's IPTAS initiative developed a legal administrative structure as well as draft legal documents for the implementation of PCP.
- In 2015, the government established the "Basis of Pre-commercial Procurement", which enables the public sector to invest in new, innovative products. The Ministry of Economy – in co-operation with MITA, the co-ordinating agency for PCP – conducted a survey of public procurers (ministries, agencies, etc.) on the demand for PCPs (almost 50 at present). MITA is promoting them in different ways. In the framework of Inogeb, LT MITA – in co-operation with LIC – is launching a project aiming to provide advice on PCP to public procurers and business. In addition the European Structural Funds' instrument "Pre-commercial Procurement LT" provides favourable conditions for public procurers to use PCP more widely. Further dedicated activities, including seminars, a competence centre, the provision of methodologies and special guidance for public procurers on implementation of PCP, are foreseen for the future.

There are various rationales for using public procurement to promote innovation:

- because of their purchasing power, governments can shape innovation directly (because procurement can help firms recuperate the sunk costs of risky and sometimes large investments) as well as indirectly (because as a lead consumer government can influence the diffusion of an innovation)
- the delivery of some essential public services might become more cost-effective if relevant forms of innovation succeed
- particularly when procuring from small innovative firms, public sector demand may help to counter problems of access to finance that such firms sometimes face, because the public contracts provide a degree of security for third-party lenders.

For some time public procurement has been used to facilitate the emergence of a number of high-tech sectors in countries such as the United States, Japan and France (where procurement has helped to develop high-speed rail and nuclear energy technologies). However, in recent years countries such as Australia, Finland, Germany, the Netherlands, the United Kingdom and also the European Commission have given new emphasis to public procurement as a tool to promote innovation and meet societal goals (see Box 5.12 on the discussion of the use of PCPs in Europe). Nevertheless, despite the existence of national strategies, a recent survey of firms in six OECD countries (Austria, Belgium, Finland, Germany, Portugal and Sweden) indicates that innovation requirements are relatively rare in procurement contracts (Appelt and Galindo-Rueda, 2014). Making innovation-oriented procurement a reality appears to be challenging. What are these challenges and what might they imply for Lithuania?

Box 5.12. **Pre-commercial procurement (PCP) in Europe**

The use of public procurement in innovation policy is now widely discussed in Europe. A large number of initiatives, pilot projects or studies have been launched to experiment with and implement such procurement. The use of PCP has been inspired by the SBIR programme in the United States. Programmes that followed this example include the United Kingdom's SBRI programme. This programme, co-ordinated by the then Technology Strategy Board, involved public procurers from the Department of Health, the National Health Service and the Ministry of Defence. The Dutch SBIR, with a strong focus on public procurement to tackle societal issues, also involved procurers from ministries responsible for environmental, health, public transport and infrastructure-related fields. A lesson learned from early programmes is that it takes strong political leadership and training of procurement officers to adopt PCP. Agencies running these programmes have expended considerable effort in supporting and coaching procurers in other public authorities on how to launch PCP calls. In the Netherlands an expertise centre for public procurement was set up that also contributed to the dissemination of expertise on PCP (see https://www.pianoo.nl/public-procurement-in-the-netherlands). The European Commission has also invested in support and expertise platforms for public procurement for innovation (see https://www.innovation-procurement.org).

Key challenges in effectively implementing innovation-oriented procurement include the following (see OECD, 2011b):

- Procurement is often fragmented across local, regional and national governments. The fragmentation of public demand limits the benefits of larger scale that can be helpful to innovative procurement. For many investments in a potential innovation, having a larger public market will improve the risk-return profile for firms.
- Lack of skills for innovative purchasing has also been an important challenge. Specialised procurement agencies are mainly responsible for the efficiency of purchasing, and expertise in innovation is often lacking. When award criteria include considerations other than economic value, this introduces a level of subjectivity in the decisions of procurement officials. If, for instance, the innovative character of a good is to be considered in an award decision, procurement officials will need to be able to assess this. A study in the United Kingdom found that only 14% of surveyed firms strongly agreed with the statement that "public procurers are knowledgeable about the market in which our product and/or service operates." Just 18% of firms strongly agreed with the statement "public procurers are knowledgeable about the technical aspects of our product and/or service" (Edler et al., 2012). Procurement officials sometimes lack guidance on how to take innovation criteria into account in public procurement.

- Linked to shortages of skills is that smaller procurement units appear to perform less well in implementing innovation-oriented procurement. For example, a survey in 2013 of public procuring units in Finland suggested that the capacity of procuring units influences the incidence of innovation procurement. Procurement units with 1 000 or more employees were more likely than smaller units to make purchases in which the public sector is the first user. The larger procurement units were also more likely to award contracts that require delivery work (which may entail some level of innovation).
- Procuring innovation entails risks additional to those present in all procurement procedures. These risks include:
  - *technological risks*, i.e. risks of non-completion stemming from technical features of new goods or services
  - *organisational and societal risks*, i.e. risks arising within the procuring organisation and/or risks related to uptake of the good or service by users
  - *market risks*: the main market risk is that suppliers do not respond to the tender.
- Mitigation options exist for all of the risks (although all the mitigation options require experience and skills in the procurement agency). For instance:
  - One mitigation option for technological risk is to use cost-reimbursement contracts, in case the procured technologies underperform. As a part of the bid submission, vendors might also be asked to analyse risks associated with their proposals and assess how these could best be managed. Another mitigation strategy is to use framework agreements or multi-stage procurement processes. The latter effectively give opportunities to screen out more risky bids during early stages of the procurement.
  - Risks related to the uptake by users of the good or service can be mitigated through early user involvement in the procurement process, for instance through structured consultations and foresight exercises. Sweden's national innovation agency, Vinnova, has worked along these lines.
  - Market risks take various forms and can be addressed in different ways, for instance through user training schemes.

The generic policy lessons from OECD experience also apply in Lithuania, namely:

- It is essential that competition in the tender process be preserved. The particular threat to competition in innovation-oriented procurement comes from the greater interaction and information exchange that can occur between the procurer and suppliers, relative to purely arms-length procurement.
- General government procurement can be made more innovation friendly with little additional risk simply by specifying the goods and services to be procured in terms of their functionalities – what they will do when used – rather than pre-determined technical characteristics. This will provide opportunities for markets to propose new products or services to fulfil the specified functions.
- Skills and capacities need to be developed to implement innovation-orientation procurement successfully. Any funding for innovative procurement is also probably best complemented by support services for procurers. Support services can advise the procurers, or manage the procurement process entirely. The United Kingdom's

experience with PCP shows that once the benefits become clear, procurers can develop the necessary competences and take over the procurement processes (the SBRI programme has developed into a challenge competition scheme supporting and complementing procurement processes managed by different public sector organisations).[18] Improving risk management capabilities is essential.

- Since procurement of innovation represents a significant change in public sector culture, it may be advisable to pilot the respective schemes before launching them in full scale. Launching should take place in sectors which show highest potential for these types of measures. For example, in Estonia the first step was to implement a feasibility study[19] to identify which types of demand-side policy measures would show the greatest potential in which sectors. Based on this analysis and further insight into the readiness of potential procurers in specific areas of smart specialisation, a pilot call was launched in 2016. The plans are to learn from the pilot, develop and fine tune the necessary resources and eventually launch the full scheme in 2017.
- Every effort should be made to ensure that procurement processes do not disadvantage SMEs. Procurement processes often favour larger enterprises, which have greater capacity to respond to government tenders. Engaging as broad a range of the enterprise population as possible is good for equity and expands the range of ideas proposed.
- Procuring innovative goods and services can also require stakeholder involvement and co-ordination. Involving stakeholders – both users and potential suppliers – early in the procurement process may help to write better tender documents (i.e. documents that clearly guide innovative effort and solicit feasible innovation but do not preclude innovative solutions) and to forecast what the likely response from the market will be. A number of examples of early stakeholder engagement exist. For example, in the early 1990s, the Swedish National Board for Industrial and Technical Development (NUTEK) identified an opportunity to lower household energy consumption by developing more energy-efficient refrigerators. It was expected that public procurement of such refrigerators would have a catalytic effect. NUTEK created a purchaser group made up of an association of housing co-operatives, companies in insurance and real estate, the Swedish National Board for Consumer Policies and the Swedish National Energy Administration. This group convened seminars and visited factories to develop the specifications for the product to be procured (Vinnova, 2009). It is essential, however, that the closer engagement with potential suppliers be accompanied by practices which safeguard competition (for instance, any information provided about the process to one supplier should be made available to all, possibly through a website).

Developing challenge prizes

Challenge prizes appear not to have been used in a significant way in Lithuania. But challenge prizes can help to influence public perceptions, mobilise talent and capital, strengthen problem-solving communities and educate. Prizes are likely to be most effective in tackling problems which can be defined in an abstract, standardised way and which can be addressed by a relatively wide range of experts possessing tools with which to implement solutions. However, prizes are likely to be less effective and efficient than other incentive regimes when considerable effort is required to formulate the challenge and validate, test and implement possible solutions. International good practices can be used to give direction on how to introduce challenge prizes across different government bodies and agencies.

5.6. Investing in public research and related infrastructure

Increased competitive funding for research

With the introduction of competitive funding for research in 2009, LMT started to allocate competitive research grants in many different disciplines and with different characteristics. Currently, LMT runs about 20 programmes for research and scientific activities, funded through the national budget, EU Structural Funds and contractual arrangements with third parties. Around 40 calls for research funding are announced every year. The programmes can be broadly categorised as:

- programmes funding large-scale research projects
- programmes funding research in national priorities
- programmes to promote the integration of Lithuanian researchers in Europe
- bilateral programmes with selected countries
- programmes supporting young researchers
- funding schemes for specific research activities (European Science Foundation [ESF], 2014).

The main funding instruments of LMT are:

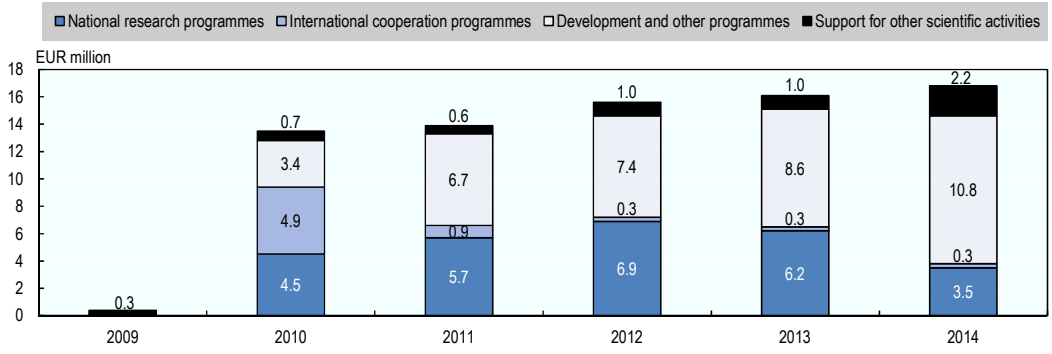
- The *Global Grant Programme*, supported by EU Structural Funds, with the aim to support world-class scientists and research projects. Each grant can be awarded for research projects from two to four years long. The Global Grant Programme does not prioritise any research field.
- The *National Research Programmes* with the aim of funding research projects to solve specific applied technological and societal challenges and to focus on national research potential.
- The *Researcher Teams Project* with the aim to develop world-class research in the following areas: humanities, social sciences, physical sciences, biomedicine, technological and agricultural sciences.
- The *National Lithuanian Studies Development Programme* (2009-15) funding academic research on Lithuanian studies, the promotion of interdisciplinary research and its digital dissemination.
- The newly-established *Open Partnership Programme* supporting Lithuanian researchers conducting research projects with researchers abroad. The duration of each research project can be two to three years.
- The *Breakthrough Idea Projects* to allow researchers to verify research ideas, undertake feasibility studies and support competition in national and international programmes.
- *Post-doctoral fellowships* funded on a competitive basis for up to two years.
- Other financing programmes supporting early-stage researchers through doctoral fellowships, academic associations, PhD students' academic trips, research visits, events, and the publication of scientific articles and books.

In addition to these programmes, LMT participates in and co-funds a number of international programmes, such as the Lithuanian-Swiss Co-operation Programme on Research and Development, bilateral partnerships with Belarus, France and Ukraine and a partnership with Latvia and Chinese Taipei.

A recent evaluation of LMT by the ESF (2014) recognised the well-managed transition to a more competitive funded system by LMT, but highlighted several weaknesses in the way some of the programmes are designed, funded or managed. The evaluation found that programmes funding larger research grants (such as the Global Grant and the Researcher Teams Projects) are more appealing for Lithuanian researchers with higher numbers of demands, and as a consequence a lower acceptance rate. These schemes allow researchers to develop the capacity to manage larger projects in an independent way. The evaluation highlighted the very high number of programmes and calls managed by the council every year, often distributing grants of smaller size, in a way that does not steer the research system towards excellence.

Another issue highlighted relates to the lack of, or very limited, funding for industrial research and academia-industry collaboration. Such programmes could be developed and managed jointly with MITA to avoid duplication of efforts and resources. However, it has to be noted that over time there has been a shift of attention towards more needs-driven research (with topics proposed by ministries) including technological development (EUR 495 000 allocated in 2015/16). Other weaknesses relate to the limited use of the English language in grant applications, which in turn limits the set of potential international reviewers essentially to Lithuanian speakers. Finally, the evaluation stressed the importance of increasing investments in programmes to support young, early-career researchers as well as the international mobility of scientists of all seniorities and in all research areas. To promote the internationalisation of the Lithuanian research system, LMT manages EU Structural Fund measures to attract distinguished researchers from abroad. LMT's funding portfolio is presented in Figure 5.3 and shows a decline in national programme funding and a growth in development and other programmes.

Figure 5.3. **Allocated funding by Research Council of Lithuania**



Note: For 2009, support for other scientific activities was negligible (EUR 0.1 million).

Source: Research Council of Lithuania.

The evaluation committee of the ESF (2014) evaluation of LMT (or RCL in English) also noted the high degree of complexity of the funding system for HE and research:

> The Evaluation Committee was struck by the complexity of the various national mechanisms for funding and setting policy for HE and research in Lithuania. We recognise that particular national circumstances govern the development of such systems, that international norms may not be appropriate within those circumstances (…) However, we also note that the complexity of the system is likely to hinder in certain respects the ability of the Lithuanian research system, and the RCL, to compete internationally, and constrains to a large extent the freedom of operation of the RCL (Evaluation Committee of the ESF, 2014).

The ESF evaluation recommended that there should be more formal and regular interaction between LMT and other agencies such as MITA. It found that LMT so far was hardly involved in the Ministry of Science and Education and the Ministry of Economy objectives to focus more on innovation. It also recommended that its National Research Programmes should be better linked to the development of the Valleys and the Smart Specialisation Strategy.

A review of the funding mechanisms of Lithuanian HEIs and research and technology organisations (RTOs) based on stakeholder consultation found that there is rather broad agreement on the fact that there are too many institutions and that most of them are too small (Arnold, Angelis and Nausėdaitė, 2016). Neither the HE nor the research funding system contain elements that militate against fragmentation. And the system as a whole suffers from insufficient research funding. Lithuanian research relies too greatly on European Structural Funds as opposed to national funding. These will diminish over the years. In addition, the presence of the dual voucher and fee system and the existence, therefore, of a quasi-market in degree courses as well as research has to some extent allowed the system to avoid a strategic decision about how much capacity to dedicate to academic, university-based HE and how much to the more professionally-oriented HE provided in the colleges. The report suggested that the student voucher system should be reviewed as well as the complex funding system which lacks the appropriate incentives to modernise and improve the public research sector. However, it concludes that without institutional change addressing bottlenecks, such as fragmentation and lack of strategic capacities, changes in the funding models alone are not sufficient to address the issues in the research system.

The Valleys Programme

The Integrated Science, Studies and Business Centres – commonly referred to as the "Valleys" in Lithuania – were one of the main public investments in STI during the 2007-13 programming period and were renewed in 2014. The Valleys Programme was started by the Ministry of Education and Science and the Ministry of Economy, and funded by EU Structural Funds (with more than EUR 200 million over 2007-13). The Ministry of Economy is supporting the development for R&D infrastructure by allocating about EUR 35 million of EU Structural Funds to the Valleys. The Ministry of Education and Science finances STPs, technology transfer centres, technological business incubators, open access laboratories, cluster laboratories, and similar infrastructure development projects within the Valleys.

The Valleys Programme created networks of research centres, linking universities and research institutes. As a major STI programme, the Valleys pursued multiple objectives: to promote the generation of a high-level research base, to encourage national and international collaboration among researchers, to promote the development of knowledge-intensive sectors of the economy, to upgrade research infrastructure and the

commercialisation of research results, to enable public researchers to effectively co-operate with the business sector, and to strengthen technology development and transfer.

While it was conceived as an initiative based on closer co-ordination between the Ministry of Education and Science and the Ministry of the Economy, it gradually moved into the domain of the Ministry of Education and Science although the Ministry of Economy participates in coordination and monitoring processes. As the Valleys were intended to develop around strong centres of scientific excellence, universities were leading actors in the programme and instead the business sector did not show strong interest in engaging in the consultation processes when the programme started.

Initially only two Valleys were planned, in Vilnius and Kaunas, but five Valleys were finally established. The Valleys are located in the three cities with the highest concentration of HEIs in Lithuania: Vilnius, Kaunas and Klaipeda. The Valleys are now seen as the foundation and an integral part of Lithuania's strategy for smart specialisation. The research focus and HEI participants of the five Valleys are presented in Table 5.3.

Table 5.3. **Integrated Science, Studies and Business Centres (Valleys) and participating universities in Lithuania**

Name	R&D focus	HEIs participating the Valley's activities
Saulėtekis Valley	– Laser and light technologies – Materials science and nanotechnologies – Semiconductor physics and electronics – Civil engineering	– Vilnius University – Vilnius Gediminas Technical University
Santara Valley	– Biotechnology – Innovative medical technologies molecular – medicine and biopharmacy – Ecosystems and sustainable development – Informatics and communication technologies	– Vilnius University – Vilnius Gediminas Technical University
Santaka Valley	– Sustainable chemistry (including biopharmacy) – Mechatronics and related electronic technologies – Future energy (including environmental engineering) – Information and telecommunication technologies	– Kaunas University of Technology – Lithuanian University of Health Sciences
Nemunas Valley	– Agrobiotechnology, bioenergy and forestry – Food technology, safety and health	– Lithuanian University of Agriculture – Aleksandras Stulginskis University – Lithuanian University of Health Sciences – Kaunas University of Technology
Marine Valley	– Marine environment – Marine technologies	– Klaipeda University – Lithuanian University of Health Sciences

Source: Ministry of Education and Science (2014), Integrated Science, Studies and Business centres (Valleys), www.smm.lt/web/en/science1/science_1.

Lithuania's Valleys eventually became development projects for the science infrastructure, deviating from the original idea of their being business and science co-operation centres. The limited public-private co-operation in the Valleys can be attributed to a number of factors: complicated procedures for the use of public R&D infrastructures, researchers' career regulations (high dependence on academic publications and low attention to collaboration), orientation towards "pure" research, the narrow definition of R&D (largely only research), lack of involvement by business players in the governing structures and decision-making processes of the Valleys (Visionary Analytics, 2014; Baltic Legal Solutions, 2015). On the other hand, it is difficult to assess the potential impact of the Valleys, due to the fact that they are just at the inception stage. For example, the annual progress assessment report on joint research programmes and interim report on joint performance monitoring prepared by Ernst & Young and the Technopolis Group in 2014

noticed initial positive effects of three Valleys-related projects with the expectation of positive impact in the future, if certain conditions are met. It should also not be forgotten that industry had little absorptive capacity and appetite to engage with the Valley initiative. As the history of successful high-tech Valleys shows, it takes a long time for these initiatives to develop into economic success stories. In addition, political endurance is needed to provides some form of policy support to enable the Valleys to become self-sustaining. See Box 5.13 for a description of success factors in public-private co-operation around STI in OECD countries.

Box 5.13. **Success factors for strategic public-private partnerships (P/PPs): Evidence from OECD countries**

Whilst there is no one-size-fits-all model for P/PPs, several factors recurrently appear as fundamental in the design and implementation of successful P/PPs schemes. In particular, good governance and public leadership are key factors ensuring the success of P/PPs. These include setting clear objectives and activities/responsibilities well defined for each participant; the existence of operational rules and implementing regular monitoring and evaluation; transparency; consultation with stakeholders; and the establishment of dispute settlement and exit strategies.

Other important factors are:

- a clear identification of failures
- long-term (open-ended) stable commitment by the government
- careful selection of participants and definition of their alignment/complementarity
- appropriate planning, task/responsibility definition, and information-sharing mechanisms
- inclusion of an education objective and equal emphasis on all four major objectives (research, collaboration, education and outcome application)
- a clear management structure
- a board of stakeholders chaired by an independent industry/research sector actor
- partnership scale and resources
- personnel stability, etc.

The success of P/PPs in many cases also depends on complementary regulatory frameworks shaping interactions between public organisations (e.g. academia) and industry. Examples of regulatory measures to incentivise P/PPs in innovation include tax incentives, performance-based funding (and metrics), rewards systems for researchers, and intellectual property legislation (e.g. Bayh-Dole Act). Recently, Belgium increased the wage-withholding tax credit for highly qualified researchers involved in industry-science research collaboration. In 2013, the Netherlands introduced the Rules of Play for Public-Private Collaboration jointly defined by a large number of STI actors. The code of practice seeks to make the connection between fundamental research and the top sectors more transparent, among other things. Starting in 2017, Norway will introduce a "third-party" indicator in funding metrics of HEIs. This indicator will help define performance-based components in block grant funding.

Source: www.innovationpolicyplatform.org.

As an attempt to increase public-private co-operation and shift the excessive focus on the development of research infrastructure for universities, the requirement to make all R&D resources located in the Valleys available to the public on the basis of open access

principles has been recently introduced. Universities and research institutes are obliged to provide non-academic actors access to their research infrastructure. Other entities not belonging to the Valleys are also eligible to become open access centres. However, the impact of open access centres so far has been rather limited, as very few companies use them.

5.7. International linkages

As illustrated in previous chapters, international linkages in STI are not well developed. For example, the share of foreign researchers and doctoral students in Lithuanian organisations, international co-publication (although increasing) and innovation-related linkages between Lithuanian companies and organisations abroad remain weak.

The success rate of Lithuanian organisations in applications to the 7th Framework Programme (FP7) was 20%, similar to the European average of 20.5%. The majority of Lithuanian participants in the FP7 project were public R&D institutions. However, SME participation has increased significantly compared to FP6 (Paliokaitė, 2015a). The FP7 Final Evaluation report (European Commission, 2015) shows that Lithuania receives only 0.15% of the FP7 budget (EC contribution). This means that Lithuania received the second-lowest contribution per researcher (after the Slovak Republic) and one of the lowest contributions per inhabitant. Compared to the other Baltic states, in terms of number of participants and amount of funding, Lithuania performs better than Latvia but lags behind Estonia. Lithuanian participants are most successful in ICT, energy, health, nanotechnologies, materials, new production technologies, food and biotechnology.

Internationalisation is critical for the development of Lithuanian business and clusters. Fostering business and cluster participation in networks, such as the BSR Stars Programme initiative "Innovation Express", EUREKA, Eurostars, participation in Horizon 2020 projects, organising dedicated business missions and providing favourable conditions for business participation in matchmaking events are among the actions taken to improve business internationalisation by the Ministry of Economy. It promotes international co-operation in innovation networks, especially in the Baltic Sea Region. For example, since 2012, the Green Industry Innovation Programme has been launched in co-operation with Norway (Paliokaitė, 2015b). Other programmes to promote international linkages of clusters and SMEs in the Baltic region have been developed, with particular emphasis on green innovations.

In 2012, MITA and MATIMOP, two national innovation agencies in Lithuania and Israel, responsible for promotion of R&D development, signed the agreement, which aims to promote bilateral co-operation in industrial research and technology fields, notably in lasers, IT, biotechnology, nanotechnology and other areas.

Lithuania is currently seeking to strengthen integration within international research networks. Lithuania established relations with the European Space Agency (ESA) in 2010 by entering into a co-operation agreement. As Lithuania seeks to become a member of ESA, dedicated calls have been announced which will increases Lithuanian business capabilities to participate in international tenders. Furthermore, agreements for co-operation have been developed with the United States in the field of science and technology and with NASA on student internships.

However, despite these initiatives, policy actions to support international co-operation in the area of STI remains fragmented and the financial commitment remains limited.

Notes

1. This section is mostly based on Leichteris et al. (2015).
2. For more information see www.smm.lt/web/en/science1/-programme-for-development-of-studies-and-rd-for-2013-2020.
3. For example, it is not clear what the council's role is with respect to the State Progress Council overseeing the implementation of the National Progress Programme and Lithuania 2030 strategy.
4. Examples are the objective to raise GERD to 1.9% (below 1%), or BERD to 0.9% (0.24%) by 2020. Given that very little progress has been made over recent years, this objective appears overly ambitious.
5. www.arengufond.ee/upload/Editor/English/publications/Estonian-growth-vision-policy-brief-eng.pdf.
6. https://www.bmbf.de/en/bmbf-foresight-1419.html.
7. https://www.gov.uk/government/groups/horizon-scanning-programme-team#role.
8. www.tekno.dk/ydelser/?lang=en.
9. Leichteris et al. (2015), p. 48, based on data from the European Commission (2014).
10. Statistics Lithuania, see http://123.emn.lt/en/general-trends/migration-10-years-overview.
11. Visionary Analytics (2014), Lithuanian high technologies development feasibility study. Contracted by the Ministry of Economy of the Republic of Lithuania. www.ukmin.lt/uploads/documents/AT%20studija_santrauka_EN.pdf.
12. https://www.sbir.gov/about/about-sbir.
13. https://www.tekes.fi/en/funding/startup/young-innovative-companies.
14. www.eas.ee/service/innovation-voucher/?lang=en.
15. See www.mita.lt/en/general-information/innovations/clusters.
16. https://www.ffg.at/en/comet-competence-centers-excellent-technologies.
17. http://researchinestonia.eu/science-scene/competence-centers.
18. See https://sbri.innovateuk.org/#.
19. See https://www.mkm.ee/sites/default/files/final_report_part_2.pdf.

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