JRC TECHNICAL REPORT

Higher Education for Smart Specialisation: The case of Lithuania

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2. Abstract

This technical report presents the findings of the case study carried out in Lithuania on the role of Lithuanian Higher Education Institutions (HEIs) in the design and implementation of the Smart Specialisation Strategy (S3). It is one of the case studies undertaken in the project Higher Education for Smart Specialisation (HESS), an initiative of the European Commission's Joint Research Centre (JRC) and the Directorate General for Education, Youth, Sport and Culture.

The research shows that the Smart Specialisation Strategy in Lithuania has constituted an important framework to coordinate research and innovation policies and investments with a significant improvement from past experiences, creating a space for a participatory process of innovation stakeholders. The higher education institutions are actively participating in the S3 process, with a good correlation of the S3 selected priority areas and the higher education research capacities, but with no significant changes in the internal decision-making. The higher education system presents an unbalanced funding model, with most incomes devoted to education activities rather than research and innovation.

The research and innovation system of Lithuania is highly dependent on European Structural and Investment Funds, as national funding is comparatively very small, creating specific challenges in the implementation of the Smart Specialisation concept. Too narrowly defined priority areas can create a lock down effect in terms of broad support to innovation with limited funding sources to counterbalance. There is a growing demand of the productive sector of skilled students in engineering/STEM fields. This has increased demands of discussion spaces between public authorities, business and higher education to re-balance the attraction of students from social sciences to STEM studies, as well as a stronger policy to attract international talent. A long-term agreement between the Government and HEIs regarding the future HE educational offer, research priorities and resources could strengthen the contribution of higher education to S3, building on the experience of this case study and bringing forward its recommendations.

3. Executive summary

This report presents the results of the HESS case study on the role of Lithuanian Higher Education Institutions (HEIs) in the design and implementation of the Smart Specialisation Strategy (S3). It is part of the Higher Education for Smart Specialisation (HESS) project, carried out by the European Commission's Joint Research Centre (JRC) in cooperation with its Directorate General for Education and Culture.

The case study focuses on the following four issues:

1. How are HEIs contributing to S3 via implementation of skills and human capital mission?

2. How and to what extent are HEIs rebalancing the activities aimed at the three missions to support implementation of S3?

3. Which issues are hindering the retention and attraction of highly skilled talent?

4. Which are the opportunities and strengths of the innovation system to be promoted?

Methodology

The implementation of the case study followed the logic of action research. Hence it strongly relied on active collaborations with HEIs and national authorities, particularly the Government Strategic Analysis Centre (STRATA). Key methodological steps were as follows:

*   Exploratory workshop with key stakeholders: policy maker, representatives of HEIs, and experts. The workshop was carried out on 24 October, 2018. The list of participants is provided in Annex 1.

*   Desk research, which covered previous studies, reports as well as statistical data.

*   15 interviews with HEIs' pro-rectors/directors, researchers and other stakeholders. The list of interviewees is provided in Annex 1. Semi-structured interviews relied on questionnaires, tailored for each group and lasted 45-90 minutes. The interviews were carried out between June and September 2019.

*   Workshop with experts and policy makers to discuss preliminary findings as well as ways for addressing the identified challenges. The workshop took place on the 27th of September 2019 and involved 18 participants (see Annex 1).

*   Final event with all stakeholders: policy makers, representatives of HEIs, and experts. The event aimed to present the findings and stimulate lively discussion on ways forward. The event took place on the 19th of February 2020.

Main messages

Some of the main messages from the interviews and workshops discussion include:

*   Overall S3 has proved to be a step forward in coordinating R&I policies and allocating respective funding in Lithuania. Nevertheless, there is a number of tensions and challenges that should be addressed in the future

*   The multiple policy shifts and lack of long-term vision investments for HEIs in the past has considerably eroded the trust and capacity for agreed coordinated responses with Government. The seven year framework provided by S3 has tried to overcome this trend, however there is still the need to develop a stable long-term "contract" between HEIs and Government.

*   The balance between the three HEIs' missions is strongly tilted towards education (of undergraduate students). This is due to the structure of public funding, which historically favoured massification of HE at the expense of research

and third mission activities. As the number of students decline due to demographic trends, Lithuania faces an opportunity to rebalance the three missions of HEIs.

- One of the core challenges in developing skills for S3 relate to the declining HEIs capacities to provide ICT and engineering education. To address the complex roots of this problem, the Government in coordination with key stakeholders should develop and implement a comprehensive strategy for STEM education covering all stages of education.

- There is a growing number of knowledge intensive start-ups and the scale of research – business collaborations has increased. However, the scope of such activities remains limited by international standards. Hence, there is a need to develop structural capacities of HEIs to support technology transfer, manage intellectual assets, and promote entrepreneurial culture.

- Attracting and retaining talented academic staff remains challenging for Lithuanian HEIs. To maintain its competitive position Lithuania should ensure that the level of wages for academic staff is close to the EU average and careers in research are attractive to top talents. To improve its competitive position Lithuania should provide long term investment in attracting top talents from abroad, through shared responsibility of the Government and the HEIs.

4. Introduction

Higher education institutions (HEIs) are key players in the regional/national innovation systems. They focus on three missions – education, research as well as engagement with the society and knowledge transfer. This puts HEIs in a pivotal role to connect all the elements of the 'Knowledge Triangle', which are needed for successful implementation of Smart Specialisation Strategy (S3).

The European Commission's Joint Research Centre (JRC) is carrying out the project 'Higher Education for Smart Specialisation' (HESS). The project has two overall objectives. First, it aims to develop a knowledge base of the role of higher education (HE) in Smart Specialisation Strategies (S3). Second, the project seeks to help countries/regions develop partnerships with local Higher Education Institutions (HEIs) for the design and implementation of the strategies. The project includes development of a number of territorial case studies. The current one is focused on the role of Lithuanian HEIs in the design and implementation of S3.

The HESS Lithuania case study three main general objectives:

- To improve the national partnership between HEIs and national authorities managing S3 and ESI Funds to increase the impact of S3 implementation;
- To boost the engagement of HEIs in S3, through a more coordinated response of their three missions;
- To understand the main challenges of HEIs to actively engage in S3, and identify potential actions that could be taken, proposing a number of policy recommendations.

This report presents the results of the case study on the role of Lithuanian HEIs in the design and implementation of the Smart Specialisation Strategy (S3). In particular, it focuses on four questions:

1. How are HEIs contributing to S3 via implementation of skills and human capital mission?
2. How and to what extent are HEIs rebalancing the activities aimed at the three missions to support implementation of S3?
3. Which issues are hindering the retention and attraction of highly skilled talent?
4. Which are the opportunities and strengths of the innovation system to be promoted?

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- Exploratory workshop with key stakeholders: policy maker, representatives of HEIs, and experts. The workshop was carried out on 24 October, 2018. The list of participants is provided in Annex 1.
- Desk research, which covered previous studies, reports as well as statistical data.
- 15 interviews with HEIs' pro-rectors/directors, researchers and other stakeholders. The list of interviewees is provided in Annex 1. Semi-structured interviews relied on questionnaires, tailored for each group and lasted 45-90 minutes. The interviews were carried out in in June – September, 2019.
- Workshop with experts and policy makers to discuss preliminary findings as well as ways for addressing the identified challenges. The workshop took place on 27 September, 2019 and involved 18 participants (see Annex 1).
- Final event with all stakeholders: policy makers, representatives of HEIs, and experts. The event aimed to present the findings and stimulate lively discussion on ways forward. The event took place in February, 2020

The rest of the report is structured as follows. Sections two and three provide background information on the Lithuanian Higher Education system and S3, respectively. Section four presents the results of fieldwork, while the last section concludes and provides recommendations.

5. The HESS case study: Methodology

Lithuania has been selected as a case study to pursue 'action research', with the objective of understanding how HEIs have been involved in the design and implementation of S3, and to help develop a closer partnership between national authorities managing S3 and ESIF funds and its HEIs.

The context of Lithuania constitutes an interesting ground for a case study, as Lithuania has achieved a high level of participation in tertiary education and good progress in innovation performance. However, these assets have not been fully exploited to meet labour market needs and to link with smart specialisation of the country. The case study has been conducted in close coordination with STRATA (formerly MOSTA), in charge of the monitoring and evaluation of S3, which has been closely working with the JRC since early S3 definition and peer review activities. This has provided them with a capacity to generate knowledge on the S3 process based on evidence, and with a strong capacity to influence on policy development.

The country is a moderate innovator with a considerable progress in innovation policy over the last years (European Innovation Scoreboard, 2019). The innovation performance index has experienced a very strong increase of 25.7% points between 2011 and 2018 (EU average 8.8%), however with a low attractive research system and employment impact (European Innovation Scoreboard, 2019). Despite Lithuania has done considerable progress, fragmentation of R&I system and lack of coordination persists, limiting the efficient implementation of S3 strategy. The funding for R&I in Lithuania is twice lower as EU average both in terms of total funding (0.89% of GDP vs 2.03% of GDP) (European Innovation Scoreboard, 2019). The low state budget funding for R&I is hindering competitive wages for researchers and having a negative impact on participation in Horizon 2020 and other international programmes.

The population with tertiary education is well above the EU average, however Lithuania has important challenges to retain and attract highly skilled talent and suffers from brain-drain that can severely hinder economic growth. In addition, employment in knowledge-intensive activities is well below the EU average, with a low percentage of business with innovation capacity. Therefore, raising the quality of education, increasing researchers' attraction and highly skilled personnel, and collaborations between higher education and business to increase knowledge transfer to market is among the major current challenges of Lithuania.

The methodological approach for the HESS Lithuania case study has been driven by action-research, mobilising the main key stakeholders in the region to discuss and reflect on the major challenges faced in HEIs involvement in S3 and ways forward. First, an exploratory meeting was organised involving STRATA, the Ministry of Education and Science and the main higher education institutions in Lithuania. It served as a first step to present the HESS case study aims and have a first dialogue on the HEIs involvement in S3. Second, a detailed background analysis has been carried out with an overview on its higher education system, R&I ecosystem, S3 design and implementation process, policy mix and use ESI Funds for higher education. Third, a fieldwork has been driven with a number of selected stakeholders from the public administration, HEIs and cluster associations to have a deeper understanding on the underlying factors and challenges of the R&I system and HEI involvement in S3. It was followed by a workshop to share and discuss main findings. Finally, an overall report with the case study findings was presented in Vilnius with the main stakeholders involved, the participation of EU experts from other regions and international experiences.

5.1 Exploratory workshop and self-evaluation exercise

An exploratory meeting took place in Vilnius on the 24th of October 2018, with the participation of JRC researchers, STRATA, Ministry of Education and Science, Ministry of Finance and higher education institutions.

The exploratory meeting served to launch the HESS case study, explain its aims and methodologies, explore the challenges in terms of HEIs contribution to S3, and to understand the topics of interests of the participating stakeholders.

The main findings of the exploratory meeting regarding the role of HEIs in Lithuania S3 are summarised as follows:

HEIs role in S3- Challenges	HEIs role in S3- Opportunities
• Unbalanced quadruple helix participation in S3, with low engagement of the private sector • Insufficient R&I human resources and attraction of talented researchers • Weak R&I intensive business and employment • Slow S3 implementation performance	• Strong engagement in S3 and broad involvement of stakeholders • High growing innovator country, with highly educated population and strong universities • Unbalanced participation of quadruple helix in S3, with low engagement of the private sector • Part of key initiatives such as EU Baltic Sea Region Macro regional strategy

The following main issues were raised during the presentation and discussions:

- In 2018 Lithuania had 14 universities, 12 colleges, 13 public research institutions and 8 private, with 117.000 HE students.

- There are 18.000 researchers, however only a small number of them are employed in the business/private sector.

- The S3 initially defined 6 priority areas and 20 sub-priorities, with EUR 788 million for R&I envisaged under TO1, distributed more or less equally between the Ministry of Economy and Innovation and the Ministry of Education and Science measures. The dependence of R&I activities on ERDF funding is considered high.

- The S3 has undergone an interim evaluation in 2019 and an international benchmarking exercise by external experts. The S3 interim evaluation has concluded that the implementation is slow, with some areas showing slower progress than others and pointing to the need of improved participation in H2020, with a success rate of 12% (vs EU average – 13,6%).

- From December 2017 to June 2018, the EDP Expert discussions were organised in each of the Smart Specialisation areas, involving around 130 stakeholders from business, science, academia, government and society. The results of the discussions were reflected in the 2019 interim evaluation report.

- The international benchmarking analysis sought to promote anumber of changes in Lithuania, including: a broader range studies on offer, specialised education; and the development of an improved framework for RTO and research institutes to evolve towards the Fraunhofer institute model.

- In 2018, S3 implementation has progressed slowly, with only 35% of the programmed funds allocated to priority areas. Five selected priority technologies out of 20 were considered not sufficiently performing. Other priority areas have funded less than 100 projects (STRATA, 2018a) due to the low quality of project ideas and lack of compliance with the technological priorities set in the call for proposals.

- The EDP has involved the participation of HEIs and the S3 policy mix is distributed between investments to infrastructures (25%), private R&I (50%), with an increase in competence centres, targeted research, and centres of excellence. However HEIs are under-represented in the S3 governance system and do not sufficiently participate in monitoring activities, with a lack of ownership and interest in S3 results.

- The 2014-2020 period has doubled the investments in R&I infrastructures compared to the previous period, with important investment in connecting R&I infrastructures internationally, including Lithuanian participation in CERN, EMBL, ELI EuroHPC, BBMRI-ERIC. However, there is a need to boost the use of research infrastructures for joint reasearch and business projects, as well as to strengthen international participation. Finally, research infrastructure investments need to be accompanied by the support to achieve a critical mass of researchers.

- Lithuania is the EU leader in tertiary educational attainment (European Commission, 2018). However, the quality of education has not been as satisfactory, leading to a programme of HE reforms. Lithuania has launched its HEI reform starting in 2019 with the aim of optimising the number of HEIs and linking funding to results. It plans to decrease the number of state funded universities from 14 to 9, through mergers of universities. The Ministry of Education has presented as well a plan to optimise research institutes and consolidate colleges.

- The main current trends in the Lithuanian HE system include:

  - Introduction of HE performance-related funding
  - Internationalisation of R&I
  - Quality assurance of studies
  - University mergers
  - Need to balance HE funding to education 70% and research 30%

The main S3 areas of improvement highlighted during the exploratory visit are:

- Need for more targeted groups to participate in S3, with a better quadruple helix representation, particularly addressing the challenge of strengthening industry participation;
- Increasing need to concentrate R&I teams and research potential around S3 priorities, encouraging an interdisciplinary approach;
- Increasing the number of initiatives for private sector engagement in scientific excellence areas;
- Greater emphasis needed on capacity building for researchers in the context of S3;
- Addressing the delay in calls, which is the main reason for results in S3 calls implementation lagging behind;
- The number of R&I intensive businesses is low, with important difficulties in establishing university-business collaborations due to a lack of efficient knowledge transfer and IPR management;
- Need to increase the participation in international research, collaborations and participation in Horizon 2020;and
- Insufficient human resources for R&I, with an increasing need to attract talent and researchers.

5.2 Research questions

Following the exploratory visit, discussions with the national authorities and key stakeholders were held, coming up with four main research questions selected for the case study:

1. How and to what extent are HEIs rebalancing the activities aimed at the three missions to support implementation of S3?

2. How are HEIs contributing to S3 via the implementation of the skills and human capital mission?

3. Which issues are hindering the retention and attraction of highly skilled talent?

4. Which opportunities and strengths of the innovation system should be promoted?

5.3 Semi-structured interviews

An interview guide was prepared and sent to the interviewees in advance. The interviews were conducted between May and December 2019, both face to face and by phone. Additional written feedback was provided by the Ministry of Education and Science and the Ministry of Economy and Innovation, both strongly involved in the implementation of S3 and ESI funding schemes. The list of interviewees and interview questions can be found in Annexes 1 and 2.

5.4 Workshop and final validation

The final event brought together policy makers, higher education institutions and international experts to discuss how HEIs are contributing to the implementation of Smart Specialisation Strategy (S3) in Lithuania.

The findings of the HESS Lithuania case study were presented during the event, with a special focus on the four following topics:

1. How are HEIs contributing to S3 through their from skills and human capital mission? Which are the lacking skills/competencies for S3, demanded by companies?
2. How can researchers become more engaged in S3? Which are their main challenges to participation and which initiatives could be promoted to make them more active?
3. Which issues are hindering the attraction and retention of highly skilled talent?
4. Which opportunities and strengths of the innovation system should be promoted?

The event provided the opportunity to reflect on the current challenges addressed by HEIs to engage in Smart Specialisation Strategy, exploring potential ways forward and actions that could be taken to address them. The presentation of experiences from other European regions and member states provided an interesting context for discussion on learning and replication possibilities in the context of the research and innovation system of Lithuania.

The discussions were intended to help integrate important elements on Higher Education engagement in S3 for the next Smart Specialisation Strategy of Lithuania within the Multi-annual Financial Framework 2021-2027.

6. Overview of the Higher Education system in Lithuanian

6.1 Structure, autonomy, students and funding of Higher Education institutions

HEIs in Lithuania carry out three traditional missions. According to the Law on Higher Education and Research:"a higher education institution shall organize and carry out studies, award higher education qualifications set in this Law, conduct research, pursue experimental (social, cultural) development and/or artistic activity, apply results of the research and experimental (social, cultural) development, accumulate scientific knowledge, develop creative activity and culture, foster values and traditions of the academic community." (LR Seimas , 2009).

Lithuania has a binary system of HEI's, composed of universities and colleges. The latter award professional bachelor degrees (ISCED 2011- level 6; 3 years of study) and are in charge of preparing students for the labour market and implementation of the third mission activities. The universities award bachelor, masters and doctoral degrees, carry out research and development (R&I) and are responsible for the third mission activities.

As of March 2019 there are 19 universities (12 public, 7 private) and 22 colleges (12 public, 10 private).[1] Figures 1 – 3 provide basic information on the student numbers.

The autonomy of HEIs is established in the Constitution. Key governance bodies of HEIs include:
- **The council,** which is responsible for electing the Rector and overall strategic management of an HEI. Councils are composed of 9 or 11 representatives of the academic community and 'external' stakeholders.
- **The senate (in Colleges – Academic council),** which is composed of members of the academic community and responsible for the academic affairs.
- **The rector (in Colleges – director)**, who is responsible for the implementation of the strategic action plan of a HEI (LR Seimas , 2009).

While HEIs enjoy broad autonomy, the Government can steer them by setting overarching legal framework, establishing standards (such as quality assurance, and minimum requirements for entering), and setting the rules for allocation of funding for studies and research.

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[1]   AIKOS, Register of HEI's in Lithuania. <https://www.aikos.smm.lt/Registrai/Svietimo-ir-mokslo-institucijos/SitePages/Pagrindinis.aspx?ss=62e9150b-6ca1-42a4-8dc5-2383ebd2c22b> [retrieved 2019-04-03].

Figure 1. Number of students in Universities and Colleges (academic year 2017-2018)

35433

82345

- Enrolled in Universities
- Enrolled in Colleges
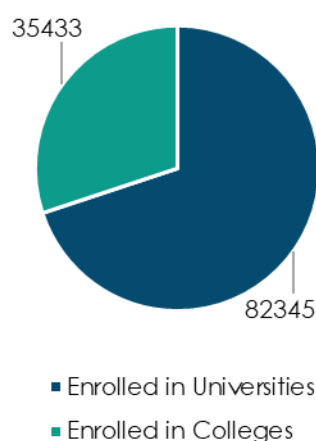
Source: Statistics Lithuania

Figure 2. Number of students in Universities by type (academic year 2017-2018)

3905

78485

- Enrolled in public Universities
- Enrolled in private Universities
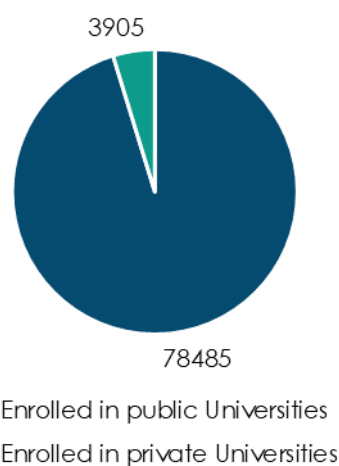
Source: Statistics Lithuania

Figure 3. Number of students in Colleges by type (academic year 2017-2018)

6542

28939

- Enrolled in public Colleges
- Enrolled in private Colleges
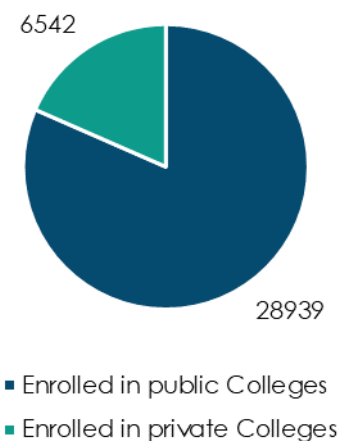
Source: Statistics Lithuania

In 2000 – 2008 the Lithuanian HE system witnessed a strong expansion in terms of student numbers (see Figure 4). This was driven by two factors. First, the returns to higher education have been (and remain) very high, with those possessing a HE diploma earning on average twice as much as those with only secondary qualifications. This increased the demands on HEIs, which reacted expanding their teaching actvities. Second, since 2000 selected vocational schools were transformed into colleges awarding tertiary qualifications. The key motivations behind the reform included political impetus to meet the growing demand for HE while curtailing the rapid expansion of university programmes and associated budgetary pressures (studies in colleges are significantly cheaper than in universities), and ensuring close links between education and short-term needs of the labour market.

The number of students has declined 44% between 2008 and 2017 (from 210,400 students to 117,778). Part of the decline can be attributed to the increasing popularity of studies abroad, which became accessible after Lithuania joined the EU in 2004. However, the largest share of decline is the result of the significant drop in fertility rates since Lithuania regained independence in 1990 (eighteen-year-olds born after 1990 started entering HEIs in 2009).

Figure 4. Number of enrolled students in Colleges and Universities in the beginning of the academic year
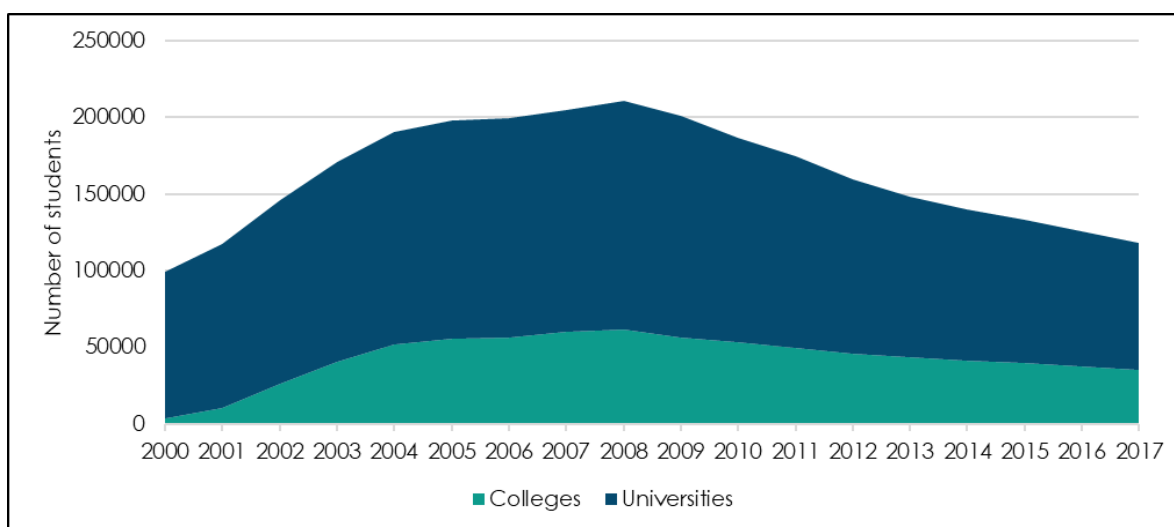
Source: Statistics Lithuania

Over the past decade the gross income of HEIs has fluctuated around EURO 400 – 500 million. (see Figure 5). The following stylised facts explain the composition and changes in income (also see Figure 5):

- Universities receive over 80% of the aggregate HEIs income. This is due to the larger number of (government funded and self-paying) students, higher income per student as well as additional funding for R&I activities.

- Government budgetary appropriations constitute the largest share of income for HEIs (close to 60% for universities and colleges). While HEIs receive basic funding to cover maintenance and administration costs, the bulk of Government appropriations are allocated on a competitive basis. Public funding for studies relies on a quasi-voucher scheme, whereby the funding for HEIs is allocated on the basis of the number of state-funded students they manage to attract. Research funding relies on a combination of: a) formula-funding based on the results of external evaluation of R&I activities, and b) competitive grants allocated by the Research Council of Lithuania.

- There are two additional sources of HEIs' income. First, approximately 30% of HEIs income is from national natural and legal persons. This is primarily composed of income from fee-paying students. Second, the remaining income is from overseas institutions and international organisations, which is primarily composed of EU Structural and Investment Funds (ESIF) and a small share of income from Horizon 2020, Erasmus+ and similar programmes. Funding from ESIF is primarily focused on investments in infrastructure and implementation of research activities. The latter funds are allocated on a competitive basis as part of grant schemes managed by the Research Council of Lithuania.

- There are significant fluctuations in aggregate HEIs' incomes. The first dip in HEIs' income occurred in 2009. It resulted from austerity measures introduced by the Government in response to the fiscal challenges caused by the recession. The second dip occurred in 2016 and was largely the result of a gap between two programming periods for the allocation of ESIF. The funds for 2007-2013 programming period were used until 2015. However, the new financial instruments supported from ESIF 2014-2020 programming period were launched with delay. This resulted in a dramatic drop of income from international organisations as well as government (the latter co-finances ESIF investments). This highlights the importance of ESIF funding in the HEIs income structure.

- In 2019-2022 HEIs' incomes are expected to grow. This will be driven by the Government plans to increase funding per student. Furthermore, in the second half of 2014-2020 programming period all ESIF supported financial instruments are in place, which will result in larger scale of ESIF co-financed investment in the HEIs.

Figure 5. Income of HEIs' by institution type and source of funds
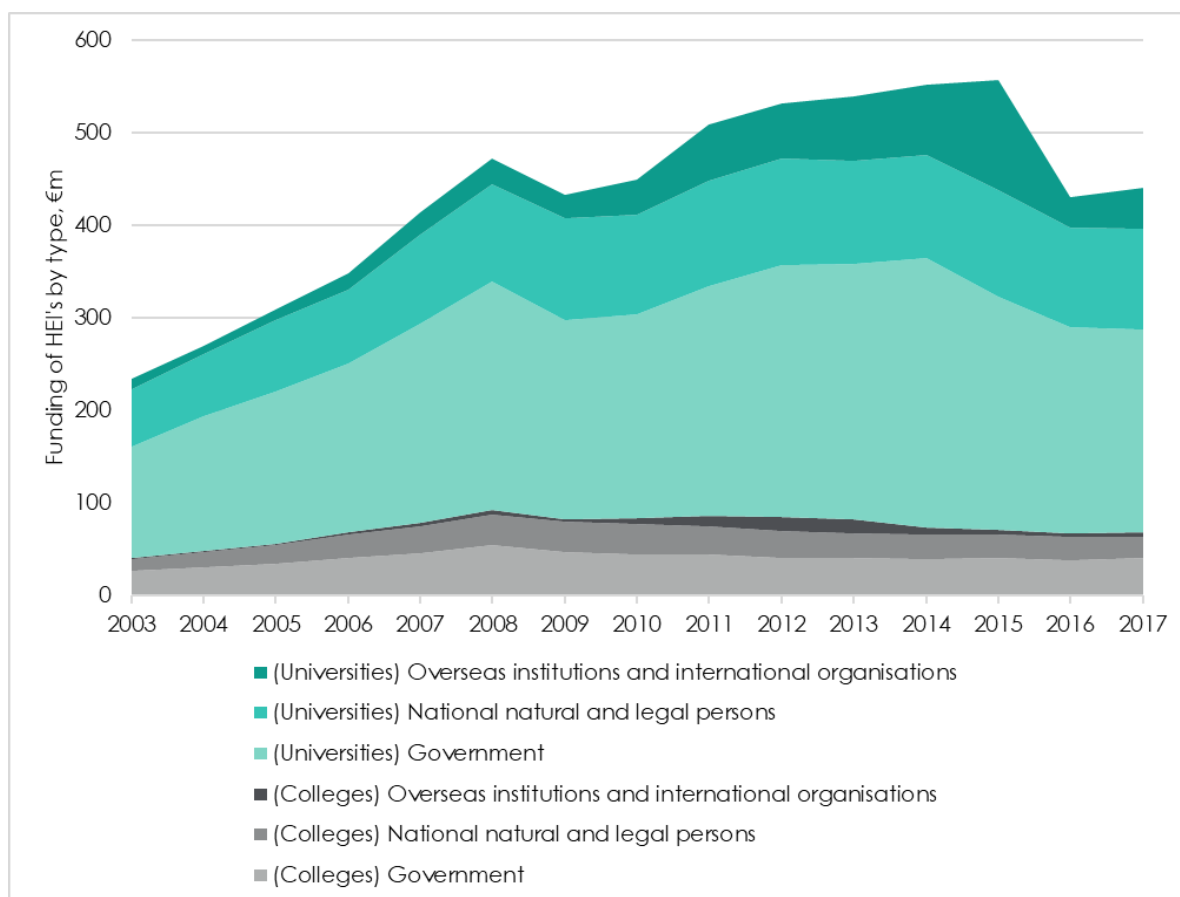
Source: Statistics Lithuania

6.2 Key national strategic documents setting out future directions / goals of HEI's

The long term national strategy "Lithuania 2030" outlines three objectives related to HEIs:
- Develop favourable environment for conducting research, ensuring Lithuania's appeal for top researchers.
- Create world-class centres for studies and research by strengthening the existing national infrastructure and mobilising the human potential. The centres would bring together study opportunities in the interdisciplinary network, providing for interdisciplinary research and development, and opening up the research infrastructure for business-science interaction.
- To enable Lithuania's HEI's students to study at foreign universities for at least one semester, particularly focussing on Nordic-Baltic student exchanges.

Progress towards these objectives is measured by four key performance indicators (KPIs) – see Table 1. The target related to tertiary education attainment has been already achieved. However, little, if any progress has been made in terms of other KPIs – if the current trends continue the targets for 2020 are not likely to be achieved.

Table 1. Objectives outlined in the Lithuania's Progress Strategy for the years 2020 and 2030

Indicator	Baseline value (year)	Latest value (year)	Targets for 2020	Targets for 2030
Tertiary education attainment among 30-34 year-olds	8th place in the EU (2009)	1st place in the EU (2017)	8th or higher place in the EU	8th or higher place in the EU
Research and development expenditure in private sector (GDP%)	20th place in the EU (2009)	25th place in the EU (2017)	15th place in the EU	10th or higher place in the EU
University-industry collaboration (World Economic Forum)	14th place in the EU (2009)	14th place in the EU (2017)	12th place in the EU	10th or higher place in the EU
University rankings Academic Ranking of World Universities (ARWU)	N/A	One University in the top 800 (2018)	At least one Lithuanian university in the top 500	At least one Lithuanian university in the top 300

Source: Lithuania's Progress Strategy "Lithuania 2030"

The National Strategy of Education 2013 – 2022 sets out four priorities cross-cutting all levels of education:

- Strengthening of human capital in education;
- Developing quality culture;
- Ensuring accessibility;
- Empowerment and lifelong learning.

Table 2 outlines KPIs related to HE as set out in National Strategy of Education 2013 – 2022.

Table 2. National Strategy for Education: KPIs related to HE

Indicator	Baseline value (year)	Latest value (year)	Target for the year 2022
Number of Lithuanian HEI's that are among the 500 top institutions according to Academic Ranking of World Universities	0 (2013)	0 (2018)	1
A ratio between incoming mobility degree students from the Bologna process region and the number of outgoing degree students in the same area. (Eurostat)	0,09 (2009)	0,27 (2014)	0,6
Tertiary education attainment among 30-34 year-olds (Eurostat)	48,7% (2012)	58,0% (2017)	No less than 48,7%

Share of study programs accredited for the longest period possible among all accredited study programmes.	47% (2011)	57,1% (2014)	80%
University-industry collaboration (World Economic Forum), rank among the EU countries	13 (2012)	13 (2018)[2]	11
Ratio of the number of granted loans and total number of loan applications for the National Studies Fund (LT – *Valstybinis studijų fondas*)	0.85 (2012)	0,80 (2014)	0.99

Source: National Strategy for Education

In 2017 the Government has launched structural reforms in HE. Table 3 outlines the rationale for the reforms and key steps taken / planned.

Table 3. Structural reforms initiated in 2017.

Challenges	Objectives	Steps taken / planned
Due to demographics the number of students has declined. To fill in the funding gap, HEIs accept students, who are not sufficiently prepared for studies. Furthermore, HEIs spend an increasing proportion of budgets to cover fixed costs related to maintenance of infrastructure. The quality and international competitiveness of HEIs is not sufficient, infrastructure, talent and funding is spread widely, but thinly across HEIs. Research careers are not attractive due to low wages. Significant share of academic staff is working part time or have jobs in several HEIs.	Merge HEIs with the view to concentrate resources, improve quality of teaching and research	Lithuanian University of Educational Sciences and Aleksandras Stulginskis University were merged with Vytautas Magnus University in 2018. After the merger the former two will maintain the status of autonomous academies within Vytautas Magnus University. There are plans to merge Šiauliai University with Vilnius University. Furthermore, Mykolas Romeris University are in talks with Vilnius Gediminas Technical University regarding a potential merger.
	Improve attractiveness of research careers	In 2019 the Government allocated EURO 8.2 million for PhD studies, which allowed increasing scholarships for PhD students by 83%. Due to growth in funding, the average salaries for academic staff within HEIs have grown by 17.9% in 2018.
	Provide free of charge undergraduate education	Although this is one of the priorities of the current Government, concrete steps have not been taken yet.

Source: Zilvinas Martinaitis

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[2] The Global Competitiveness Report 2018

6.3 Key challenges for Lithuanian HEIs

Lithuanian HEIs face five intertwined strategic challenges: a declining student population, low attractiveness of academic careers, an inadequate balance between teaching and research, and the scale of impact of research activities.

After a rapid expansion between 2000 and 2008, the number of students in Lithuanian HEIs has dramatically dropped since 2009. Demographic change is the main reason for this decline (see Figure 6). Universities face a larger decline in student numbers than colleges. This is due to Government intervention, which aims to incentivise studies in colleges by providing more publicly funded study places relative to the demand.

Figure 6. Number of entrants to bachelor studies
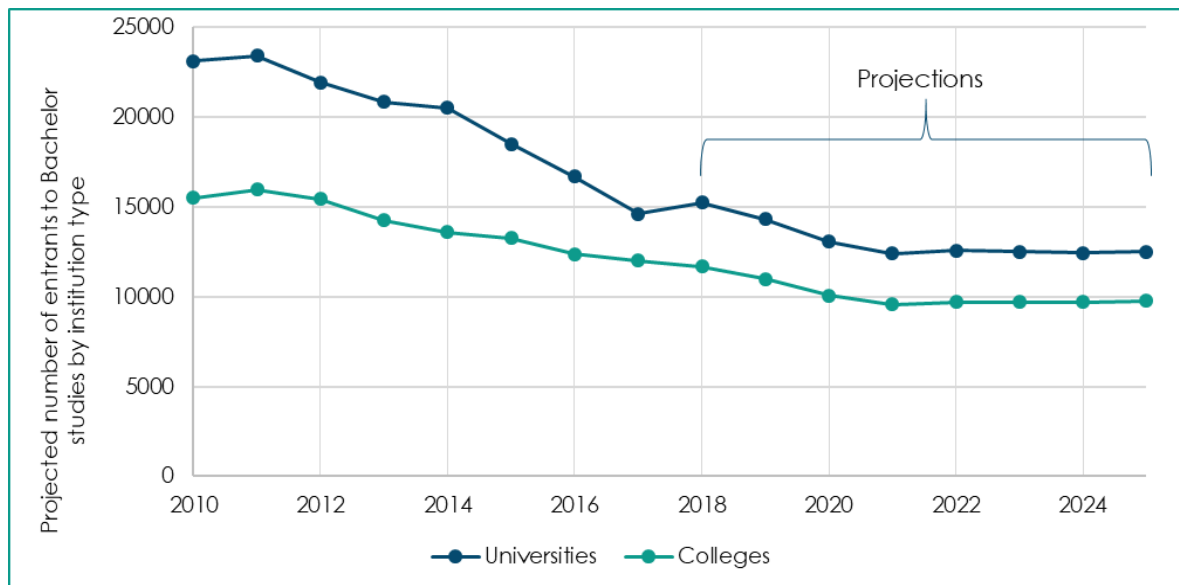
Source: Statistics Lithuania for historical data covering 2010 – 2018. Forecasts covering 2019 – 2025 by STRATA.

Furthermore, Lithuanians often choose to study abroad and the number of incoming degree students is significantly smaller than outgoing ones. As a result, Lithuania has one of the lowest ratios of incoming to outgoing degree students in the European Higher Education Area (see Figure 7).
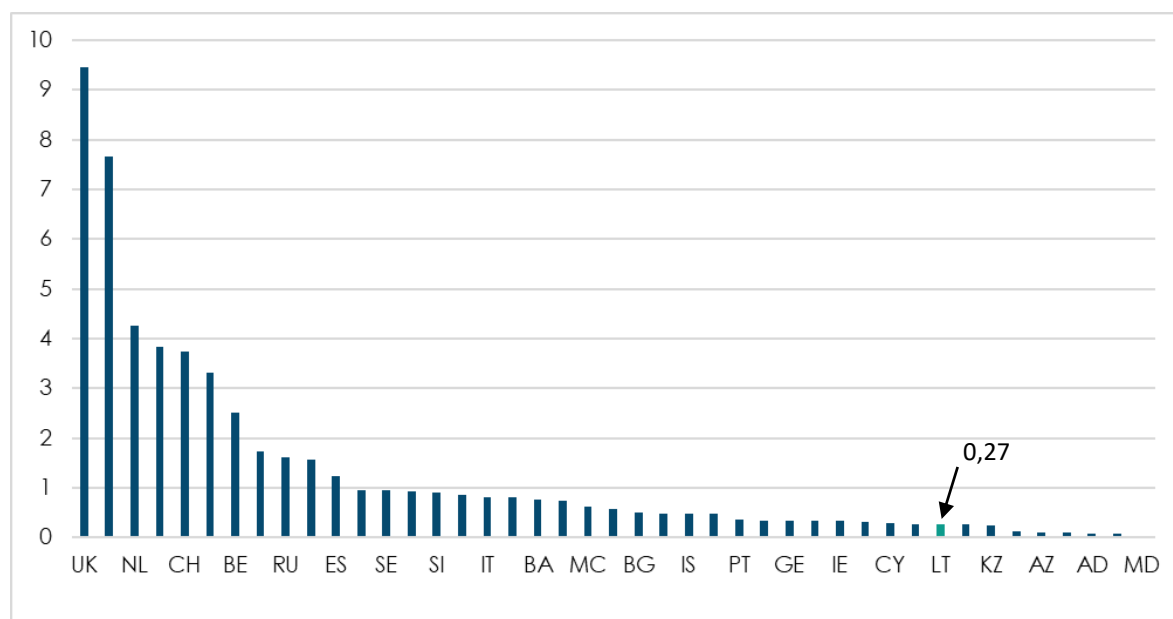
Source: Bologna Process Implementation Report 2018, Eurostat

The declining student population gives rise to a number of problems for HEIs. As the student population grew between 2000 and 2008, HEIs heavily invested in expanding infrastructure and developing new study programmes. This, however, proved to be short-sighted. As student numbers started to decline, HEIs found it harder to maintain the existing infrastructure and bloated administrative apparatus (OECD, 2017). Furthermore, a number of study programmes failed to attract sufficient numbers of students and were closed or merged. Some of the HEIs aimed to compensate the shortfall of students (and income) by lowering admission standards (OECD, 2017). However, the Government intervened by establishing minimum thresholds. According to the Council of Higher Education, which is an advisory body to the Minister, the combination of these problems provides an opportunity for HEIs to[3]:

- Review their strengths and strategic orientation. The new programmes created during the boom years of 2000 – 2008 did not necessarily reflect the HEIs' core strengths. Faced with declining student numbers, some of the HEIs have reviewed their offer, carried out restructuring of their departments and concentrated the existing infrastructure and human capital in a smaller number of academic disciplines / research fields.
- Avoid overly narrow specialisation of bachelor studies. In the face of growing student numbers in 2000 – 2008, HEIs aimed to differentiate their offer by developing highly specialised niche programmes. However, given the decline in the number of entrants, HEIs can merge the existing programmes so as to ensure sufficient student numbers and offer broad education.

The second challenge concerns the low attractiveness of academic careers in Lithuanian HEIs. In 2017 PhD students comprised 2% of all students in tertiary education – the EU average is twice higher. This evidence suggests that the level of competition to enter the PhD studies is very low and some positions remain unfilled. To address this problem, the Government allocated additional funding for scholarships for PhD students, which have increased by 83% in 2019. An analysis (STRATA, 2019) of career trajectories of 2012-2017 graduates of PhD studies revealed that only 37% of them were employed in the academic sector (HEIs and/or research institutes), while 43% worked outside academia (the remaining 20% had two jobs, one

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[3] Aukštojo mokslo taryba, Aukštojo mokslo tarybos išvados ir rekomendacijos dėl aukštojo mokslo būklės Lietuvoje 2016 metais. Vilnius, 2017. https://www.smm.lt/uploads/documents/darbo%20grupes/AMT-Isvados16%20%20(17-02-24).pdf [retrieved 2019-04-03].

of them in academia). The same study suggests that the average incomes of the said cohort of PhDs in 2018 were twice as high as the average wage in Lithuania. However, this is only slightly higher than the average wage of persons with higher education. In 2009 – 2017 the nominal wage levels of academic staff within HEIs have largely stagnated, but grew by 18% in 2018, with further 16% increase projected for 2019.

The third challenge concerns the inadequate balance between the teaching and research missions. The income and activities of HEIs are strongly biased towards teaching at the expense of research. When compared to the EU, in 2018 Lithuania had the highest share of population with tertiary qualifications[4] (71% higher than the EU28 average) while the number of admitted PhD students was nearly 50% lower than the EU28 average (STRATA, 2018b). Furthermore, a survey revealed that academic staff in Lithuanian HEIs had one of the highest teaching loadscompared to peers in the EU (European Commission, 2017) (see Figure 8). Furthermore, over 60% of academic staff would like to dedicate more time to carrying out research activities, according to a survey carried out by STRATA in 2016 (see Figure 9).

Figure 8. The level of teaching load on researchers in the EU
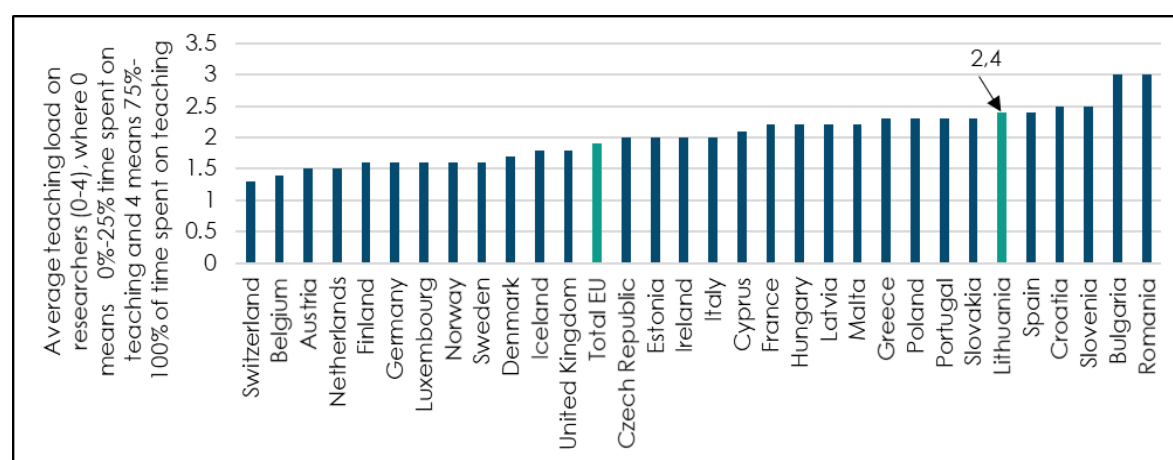
Source: MORE 3 database.

The HEI funding structure provides a good explanation of the imbalances: HEIs receive most of their income (from the Government budget and fee paying students) for studies rather than for carrying out research. Furthermore, funding for the latter tends to significantly fluctuate depending on the cycles of ESIF programming periods (see discussion on p. 6). This provides strong incentives for HEIs to focus on maximizing student numbers rather than increasing the scope and impact of research activities.

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[4] Eurostat, 40% of 30-34 year-olds have tertiary education. Brussels, 2019. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20190124-1 [retrieved 2019-04-03].
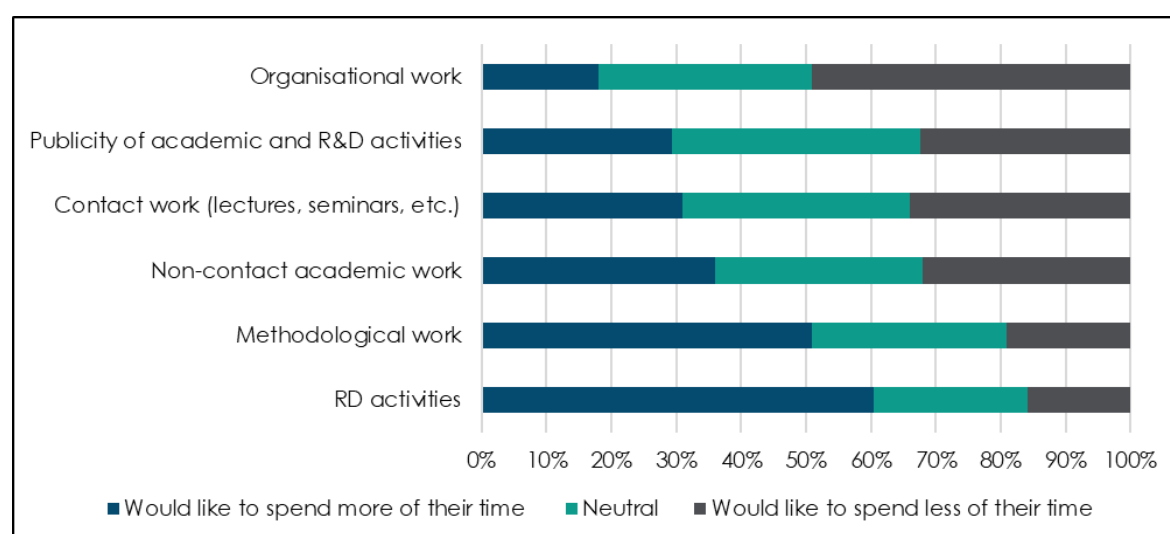
Source: STRATA, 2015

The fourth challenge concerns the impact of research activities and the scale of international cooperation. The number of international co-publications and the share of scientific publications among top 10% most cited has significantly improved over the past eight years. As a result, Lithuania has demonstrated fast convergence towards the benchmark of average EU performance in 2010 (see Figure 10). Nevertheless, significant gaps remain. Furthermore, the leading EU countries (Denmark, the Netherlands, Sweden and others) in some areas (e.g. nº of international co-publications) have demonstrated faster growth than Lithuania – hence, the actual gaps with the lead countries has widened in terms of the scale of international collaboration.

Figure 10. Performance relative to the EU, where EU in 2010 = 100
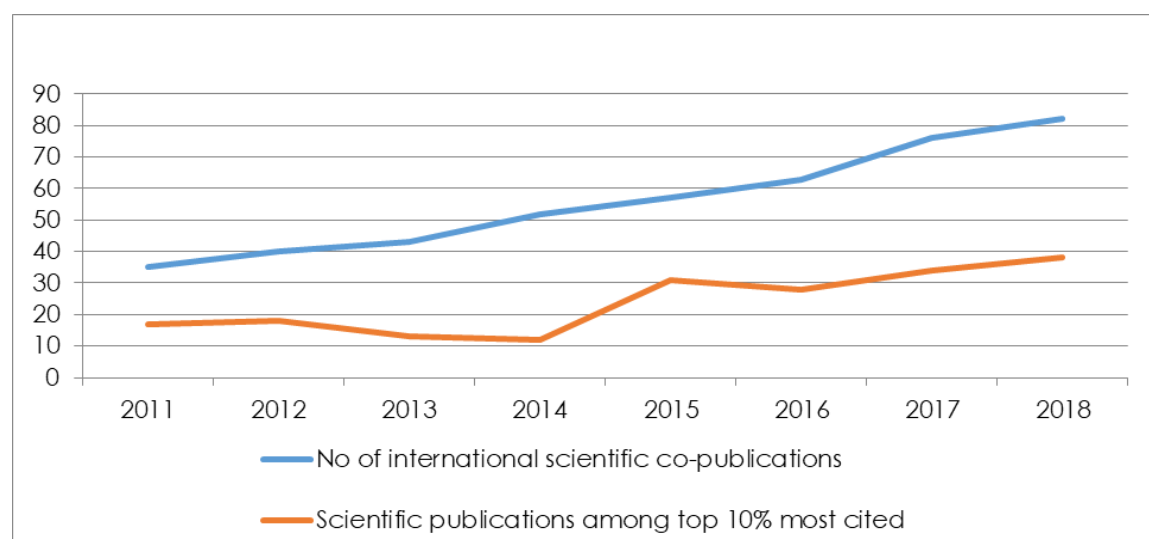
Source: European Innovation Scoreboard, interactive tool. Data retrieved in July, 2019.

The fifth challenge points to the insufficient scale and unsatisfactory outcomes of collaboration between HEIs and businesses. On the one hand, there is a limited number of highly innovative knowledge-intensive enterprises that could be natural

partners for HEIs. This is also indicated by the low levels of business investment in R&I, which fluctuates below 0.3% of GDP. On the other hand, businesses face shortages of R&I personnel and engineers, which hampers innovative activities. For example, a study conducted in 2014 suggests that "one third of companies in manufacturing industries agree that they lack engineers, technology designers, etc. for their RDI activities" (Paliokaitė et al., 2017).

7. Context: smart specialisation strategy in Lithuania

7.1 Smart Specialisation Strategy in Lithuania

The overall objective of Smart Specialisation Strategy (S3) is to concentrate resources in a limited number of areas (priorities), where public intervention could boost knowledge-driven growth and competitiveness. The S3 was introduced as part of the Cohesion policy for 2014-2020 programming period as an *ex ante* conditionality for Member States / regions to access ESIF dedicated for R&I. To comply with the conditionality, Lithuania initiated the development of S3 in 2012. The process was structured around two phases:

- Definition of six broad priority areas, which relied on the analysis of future challenges, existing strength in research and innovation system, and competitiveness of the economic sectors.

- Definition of specific S3 priorities within the broad six areas and development of implementation roadmaps. This was achieved through an inclusive participatory process structured around six thematic groups. Representatives of HEIs, research institutes and business engaged in the entrepreneurial discovery of areas of economic activities / bundles of innovations that could have significant potential to transform the Lithuanian economy. The discussions followed an elaborate methodology and were supported by analytical reports.

According to the Ministry of Education and Science, S3 design involved from the very beginning researchers and higher education representatives. They were engaged in defining the most suitable S3 programmes' structure and identifying potentially strong fields for science-business cooperation. HEIs have been strongly interested in participating in the S3 implementation, with an important share of EU structural funds (S3 funding source) from all R&I funding, comparable to the percentage from state funding.

As indicative, the Enterpreneurial discovery process in 2018 involved 76 HEIs out of 130 participants, with the main HEIs having taken part in developing renewed S3 priorities and thematic fields. In addition, 6 out of 7 thematic working groups to identify potential S3 priorities were moderated by HEIs representatives. In 2019, the revised S3 has been approved, in the light of the results from the analysis of S3 monitoring data, interim evaluation and the entrepreneurial discovery process. The S3 interim evaluation coordinated by STRATA and the Ministry of Economy and Innovation has shown interesting results regarding the potential of science and business within the selected S3 thematic fields.

Figure 11. HEIs and business performance on S3 priorities

Šaltinis: ŪM skaičiavimai
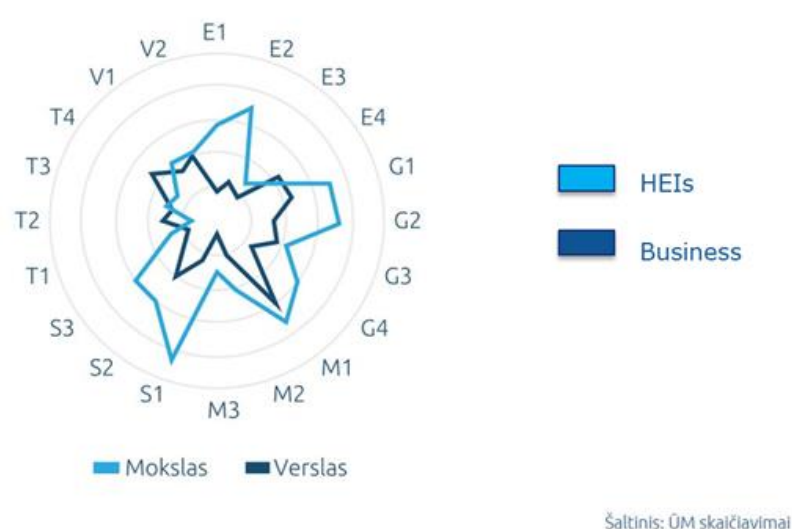
Source – S3 interim evaluation report made by Ministry of Economy and Innovation. (See Figure 13 for ESIF S3 thematic priorities terminology)

The outcome of the priority setting exercise – 20 specific S3 priorities– as well as an overarching framework for implementation, monitoring and evaluation were legally established in 2014 by the Government Resolution No. 411 (LR Vyriausybė, 2014a). The mid-term evaluation of the S3 priorities carried out in 2018 revealed the drawbacks of the initial ambition to develop narrowly defined concrete technology-based priorities:

- the creation of a significant administrative burden;

- the imposition of unjustified thematic limitations on the publicly supported R&I projects;

- the emergence of new promising avenues of economic activity (e.g. fin-tech), which do not fall within the scope of the narrowly defined priorities.

As a result, in 2019 the previous six broad priority areas were transformed into seven priorities and the previous 20 priorities were reviewed and relabelled into 22 themes that fall under the seven priorities (RL Decree of 2019, July 24, No 760). These changes are illustrated in Figure 11.

Figure 12. S3 priorities before and after the 2019 interim evaluation

Before	*After Revision*
Energy and sustainable environment	**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 equipment and technologies for its use for the production of electricity, heat and cooling	Strengthening the interoperability of distributed and centralized generation, network and energy efficiency systems Meeting the needs of existing and new end users, enhancing energy efficiency, intelligence Development of the use of renewable biomass and solar energy and enhancing recycling for energy
Health technologies and biotechnologies	**Health technologies and biotechnologies**
• Molecular technologies for medicine and biopharmaceutics • Advanced applied technologies for individual and public health • Advanced medical engineering for early diagnostics and treatment	Molecular technologies for medicine and biopharmaceutics Advanced applied technologies for individual and public health Advanced medical engineering for early diagnostics and treatment
Agro innovation and food technologies	**Agro innovation and food technologies**
• Sustainable agro-biological resources and safer food • Functional food • Innovative development, improvement and processing of biological raw materials (bio-refinery)	Sustainable agro-biological resources and safer food The recycling of bio-raw materials into valuable components
New production processes, materials and technologies	**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	Photonic and laser technologies Advanced materials and constructions Flexible product development and production technologies
Transport, logistic and ICT	**Smart, clean, connected transport**
• Smart transport systems and information and communication technologies • Technologies/models for the management of international transport corridors and integration of modes of transport • Advanced electronic contents, content development technologies and information interoperability • Information and communications technology infrastructure, cloud computing solutions and services	Smart transport systems Technologies (models) for the management of international transport corridors and the integration of transport modes.
	ICT
	Artificial Intelligence, Large and Distributed Data Technologies Internet of Things Multimodal analysis, processing and implementation Cybersecurity technology Financial technologies and block chains
Inclusive and creative society	**Inclusive and creative society**
• Modern self-development technologies and processes • Technologies and processes for the development and implementation of breakthrough innovations	Modern self-development technologies and processes Technologies and products for design and audiovisual media Social and cultural innovations to create products and services for the development of society, innovative business models Flexible and adaptive process control technologies

Source: New priorities based on the Republic of Lithuania Decree of 2019, July 24, No 760

7.2 Human capital and skills for S3

The analysis of skills fields needed in S3 priorities was not an integral part of the recent S3 monitoring report and interim evaluation. However, in the process of preparing the S3 for 2021-2027 higher emphasis is going to be given to skills and qualification mismatch.

The current S3 action plan includes the following group of five measures:

1) *Creation of a critical mass of scientific potential* – including activities relating to the creation of the conditions necessary to search for new ideas and solutions, technologies, the creation of prototypes, and the preparation for the execution of these activities (education, training, skills, R&I infrastructure…);

2) *Finding new ideas and solutions* – including basic research of a general and targeted nature for the implementation of the S3 priorities;

3) *The development of technologies and their prototypes* – shall include applied research and experimental development necessary to implement the S3 priorities;

4) *Market Introduction* – including activities related to the market introduction of new products (science-business cooperation);

5) *The creation of a critical mass of business potential* - including activities related to the transfer of knowledge and innovation, dissemination to society and widespread use (knowledge-based private sector development).

HEIs are considered to have an important role in providing training for a broad range of researchers' competences within all S3 group of measures, particularly in providing specific skills for the implementation of different R&I activities (2nd and 3rd group). In addition, the 4th group of measures would benefit from various forms of integrated entrepreneurship training for students and researchers. However, even more important is the provision of training for innovation management, and the establishment of a wider pool of efficiently and effectively working innovation management specialists. Finally, the 5th group and knowledge-based private sector expansion benefits mainly from industrial doctorates, training through involvement in clusters activities, and targeted courses for CEOs.

The S3 action plan contains measures for supporting education and training, skills development in (but not limited to) S3 priorities. Those measures are:

- Development of doctoral studies (EURO 23.2 million (EU funding) and EURO 65.656 million (state budget 2019 – 2020))

- Cooperation and research competences development through knowledge exchange actions (EURO 3.9 million EU funding)

- Students' education through R&I activities (EURO 2.3 million EU funding)

- Promotion of post-doctoral traineeships (EURO 10.4 million EU funding)

- Training of scientists and other researchers to participate in international research programmes (EURO 1.3 million EU funding)

- Promotion of innovation and technology transfer centres for HEIs (EURO 5.7 million EU funding)

- Improving the qualification of scientists through a high level international and national R&I projects (EURO 47.6 million EU funding)

- Practice in the workplace promotion and strengthening of partnership with social partners (EURO 1.8 million EU funding)

7.3 Governance of Smart Specialisation Strategy

The Ministry of Education, Science and Sport and the Ministry of Economy and Innovation share the overall responsibility for implementation of S3 in Lithuania. Perhaps the most important function of these ministries is the design of the policy mix to provide financial support for the implementation of R&I projects. Other bodies involved in the governance of S3 include:

- **Council for research, development and innovation,** which is an advisory council to the Government on strategic issues related to governance of R&I. The Council is composed of the Prime Minister, 11 ministers and eight representatives of business and academic associations (LR Vyriausybė, 2014b).

- **Group for coordination of implementation of research, development and innovation priorities** is in charge of ensuring inter-institutional coordination of the S3 (LR Švietimo ir mokslo ministerija, 2014). The group has

been set up by the Ministry of Education, Science and Sport and the Ministry of the Economy and Innovation. It consists of the representatives of relevant ministries, agencies, business and academic associations.[5]

- Ongoing analysis, monitoring, interim and final impact assessment of Smart Specialisation is made by the Government Strategic Analysis Center STRATA (formerly MOSTA) in partnership with the Ministry of the Economy and Innovation.

The role of HEIs in the governance S3 has somewhat shifted. The representatives of HEIs actively participated in identification of S3 priorities. The work was structured around six thematic groups, whereby representatives of academia and businesses discussed the existing R&I potential as well as future opportunities and challenges. Each group was co-chaired by representatives of academia and businesses. Five of the six co-chairing representatives from academia were distinguished researchers or deans/vice-rectors of universities.

Once the priorities were formally adopted, the role of HEIs in the governance of S3 started to decline. The Council for research, development and innovation, which advises the Government on strategic issues related to R&I, was originally (i.e. in 2014) composed of 29 representatives from ministries, universities and business. Five of them were from HEIs' rectors. However, following a 2017 reshuffle, instead of individual HEIs, a representative of the University Rectors' Conference participates in the Council. The reasons for this change of composition of the Council was an attempt to avoid the perception that the interests of only selected HEIs were represented in the decision-making process. After further changes in April 2019, the Council is currently composed of the Prime Minister, 11 ministers and eight representatives of business and academic associations.

7.4 Funding and policy mix for implementation of Smart Specialisation Strategy

The implementation of the S3 priorities is funded by ESIF, with an allocation of EURO 788 million to achieve the following specific objectives:

- Increasing the intensiveness of RDI activities in the private sector;
- promoting more active use of the existing and new R&I infrastructure;
- strengthening the skills and capacities of the public sector researchers;
- increasing the extent of knowledge commercialization and technology transfer.

Figure 12 illustrates the policy mix to reach these goals. The financial instruments dedicated to Smart Specialisation Strategy implementation relate to priority measures 1 and 9 of the Operational Programme (OP). Thus, the policy mix encompasses the promotion of R&I activities and the reinforcement of human recourses. The financing for the period of 2016–2018 consisted of 21 measures. The largest amounts, targeted at research and higher education, are dedicated to the development of RDI infrastructures and its integration into European structures, as well as the development of research competences of scientists and other researchers.

It is important to note, that nearly half of the funds of Smart Specialisation are designed to promote R&I in the private sector. Five policy measures implemented by the Ministry of the Economy and Innovation are targeted at attracting foreign direct investments and internationalisation. In addition, the Ministry of Education, Science and Sport also pays attention towards the international aspect in developing R&I infrastructure and competences. In general, the policy mix tends to finance R&I, internationalisation as well as investment attraction activities of the private sector. It is a result of a natural reconstruction and adaptation process in order to meet the actual needs of target groups.

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[5] As of 2019 June, the Group consists of representatives of the following institutions: Chancellery of the Lithuanian Government, Ministry of Education, Research and Sport, Ministry of Economy and Innovations, Ministry of Finance, Lithuanian Business Support Agency, Academy of Sciences, Research Council of Lithuania, Research and Higher Education Monitoring and Analysis Centre, Research, Innovation and Technology Agency, Central Project Management Agency, Lithuanian University Rectors' Conference, Association "Knowledge Economy Forum", and Lithuanian Innovation Centre.

Figure 13. Operational Programme investment by specific objectives and measures (policy mix)

Development of RDI infrastructure and its integration into European infrastructures
€188m
TG: RHE, PSI

Development of competences of scientists and other researchers
€41,94m
TG: RHE/ PSI

Development of research competences of scientists, other researchers and students through applied research activities
€69,8m
TG: RHE

Promoting more active use of the existing and new RDI infrastructure
€188m

Strengthening the skills and capacities of public sector researchers
€111,74m

SMART SPECIALISATION
€788,37m

Increasing the intensiveness of RDI activities in the private sector
€395,94m

Increasing the extent of knowledge commercialisation and technology transfer
€92,69m

Smartinvest LT+
€4,31m
TG: P

Inopatent
€3,04m
TG: P/RHE/PSI

Intellect/Intellect LT-2
€174,21+47,76m
TG: P

SmartPark LT
€24m
TG: P

Precommercial procurement LT
€29,36m
TG: P/RHE/PSI

Inocluster LT
€23,71m
TG: P

Smartinvest LT
€7,12m
TG: P

Innovation vouchers inovouchers
€1,1+5,0m
TG: P/PSI

Technoinvest
€22,6m
TG: P

Inoconnect
€1,45m
TG: P

Inogeb LT
€16,04m
TG: PSI

Smart FDI
€26,84m
TG: P

Inostart
€9,40m
TG: P

Facilitation of RDI results commercialisation and internationalisation
€13,05m
TG:P/P+RHE

Targeted RDI in the smart specialisation fields
€53,67m
TG: RHE/ PSI

Facilitation of activity of Competence centres and Technology transfer centres
€25,97m
TG: RHE/ PSI

⬤ RDI infrastructure
⬤ Venture capital
⬤ RDI support services
⬤ RDI grants

⬤ RDI based FDI, internationalisation
⬤ Public-private RDI collaboration, public sector RDI commercialisation
⬤ RDI demand building
⬤ RDI human resources (grants)

Target group (TG):

P: private sector

RHE: research and higher education

PSI: public sector institutions

However, a significant part of the investments (24%) is devoted to public R&I infrastructures development. So, as mentioned above, investments in infrastructure in Lithuania are still relatively high.

There are three measures of the S3 policy mix implementation that promote knowledge commercialisation and technological transfer. Yet, because of certain obstacles their implementation has been delayed.

Furthermore, the policy mix is very much oriented towards supporting experienced and mature innovators, while actual funding for start-ups is low. This is related mainly to the specificity of Lithuanian R&I companies: they tend to be small, few in number, innovating in a narrow range of areas such as life sciences, physics and engineering. Consequently, there is a continued need to support the innovation process in enterprises as well as to facilitate and accelerate their activities.

According to the S3 Evaluation Report, in 2018 funding was allocated for 816 projects under 6 priority fields (20 different priorities), with none of the priorities reaching 100 projects funded (see Figure 13). It is also important to note that 9 out of 20 priorities have attracted more than EURO 10 million investment ("Advanced Electronic Content", "Smart Transport Systems and ICT", "Advanced Medical Engineering", "Public Health", "Molecular Technologies", "Flexible Technological Systems", "Functional Materials", "Photonic and Laser Technologies", Smart Systems for Energy") (STRATA, 2018a).

Figure 14. Distribution of ESIF funding (including number of projects) according to S3 priorities
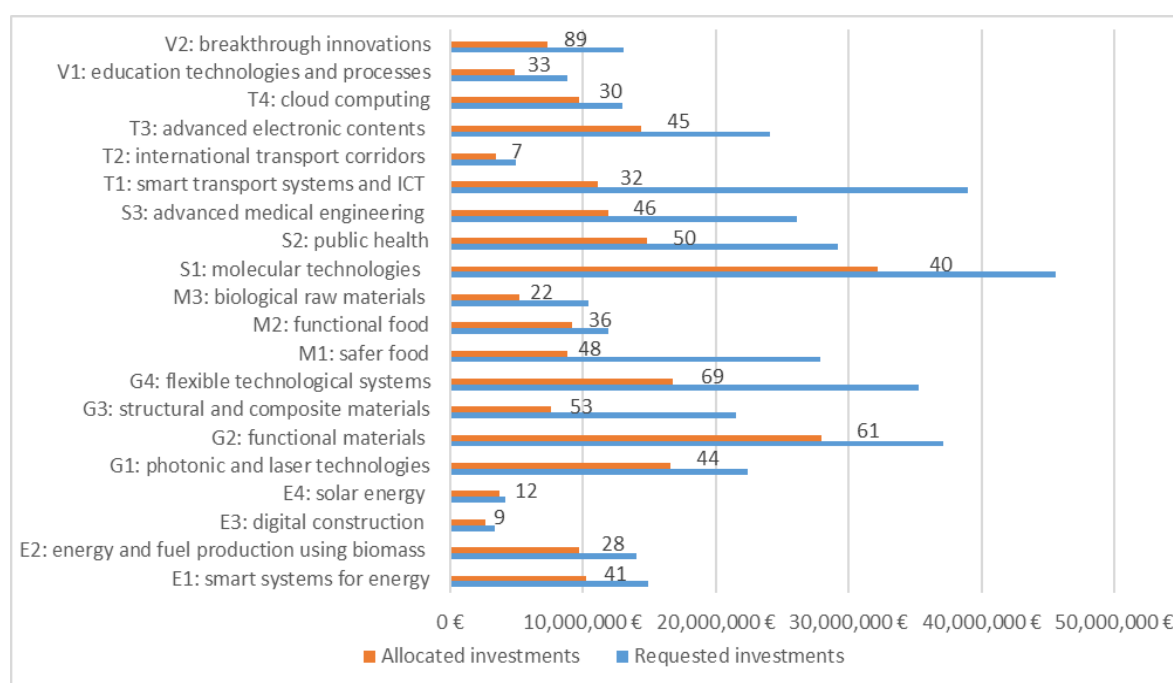
Source: LR Ūkio ministerija ir STRATA, Sumanios specializacijos įgyvendinimo pažangos vertinimas, 2018

Table 4 outlines specific ESIF measures where HEIs are eligible beneficiaries as well as the amounts allocated to projects that include HEIs (data refers to October 2019). It includes measures funded under Operational Programme (OP) objective 1 (all of these measures should at least in principle be closely linked to implementation of S3) as well as measures under objective 9 (the measures should be complementary in implementation of S3). Overall the policy mix covers key needs and challenges faced by the HEIs. However, there are ongoing discussions regarding:

- the "optimal" share of investments allocated to infrastructures. In the 2007 – 2013 programming period, a significant share of ESIF investments were targeted towards the development of R&I infrastructures in HEIs. This was well justified, given the needs of HEIs and the lack of investment in infrastructure in the preceding decade. To fully utilise the newly developed infrastructures, HEIs need funding to carry out R&I activities as well as for attracting top-talents who could lead cutting-edge research. Within this context it is not clear whether further significant investments in R&I infrastructures are optimal, and whether the funding allocated to R&I activities is sufficient.

- The extent to which the investments under OP objective 1 are in fact closely linked to the implementation of S3 priorities. Investments in RDI infrastructures have more varied and horizontal purposes and thematic coverage than S3 priorities would suggest. For instance, investment in Marine valley at Klaipėda University appears to be only loosely connected to S3, which does not include priorities related to Marine economy, biology or similar fields.

Table 4. ESIF investments in HEI's (M EUR)

	Measure	Funding (planned alocation) per measure/State planned	Funding contracted per measure	Funding contracted for HEI's	Types of actions relevant for HEIs
1. 1	OP objective 1. Development of RDI infrastructure and its integration into European infrastructures*	188	143.2	111,3	• Development of RDI infrastructure • Joining R&I infrastructures that are part of European Strategy Forum on Research Infrastructures (ESFRI) • Facilitating access to electronic resources (publications databases, repositories).
2.	OP objective 1. Facilitation of activity of Competence centres and Technology transfer centres	25.97	12.89	12,89	• Support for competence centres • Support for Innovation and technology transfer centres.
3.	OP objective 1. Inopatent*	3.04	0.57	0.12m	• International patenting of inventions • International design registration
4.	OP objective 1. Intelect LT –2*	12,46	12.46	N/A	• Fundamental research • R&I activities • Large scale R&I projects
5.	OP objective 1. Targeted RDI in the smart specialisation fields*	53.67	28.49	28,10	• R&I carried out by high-level research teams • Attraction of foreign researchers • Development of parallel labs that closely work with partners abroad

	Measure	Funding (planned alocation) per measure/State planned	Funding contracted per measure	Funding contracted for HEI's	Types of actions relevant for HEIs
6.	OP objective 9. Internationalisation of studies*	21.28	17.93	6.09	• International cooperation of HEIs • Support for students' mobility • Promotion of studies in Lithuania
7.	OP objective 9. Providing formal and informal training services for various groups of learners*	25.92	24.6	8.65	Lifelong learning and continuous Professional development of academia (among other target groups)
8.	OP objective 9. Development of research competences of scientists, other researchers and students through research activities*	69.79	43.41	41.23	• Support for research projects • Post-doc studies • Mobility of academic staff
9.	OP objective 9. Concentration and improvement of study environment and infrastructure, development of information systems*	66.23	47.38	46.85	• Merger and concentration of HEIs infrastructures • Upgrading of HEIs infrastructures
10.	OP objective 9. Improvement of study quality*	3.69	3.69	1.18	• Development of student's entrepreneurship and creativity. • Fostering of cooperation with social partners • Internships and traineeships

	Measure	Funding (planned alocation) per measure/State planned	Funding contracted per measure	Funding contracted for HEI's	Types of actions relevant for HEIs
11.	OP objective 9. Improvement of the network of higher education institutions	15.10	6.89	6.89	• Improvements in organisation of study processes • Modernisation of studies and curriculum • Development of HEIs governance • Improvement of teaching competences of academic staff

Source: Zilvinas Martinaitis compilation, based on publicly available information from *esinvesticijos.lt. Data extracted in October, 2019.*
Notes:* Other institutions (in addition to HEIs) are also eligible beneficiaries
** Funding per measure – total funding per measure.

*** Funding for HEI's refers to contracted funding to projects that include HEIs as project leaders or partners (the amounts refer to total funding for projects rather than allocations exclusively to HEIs). Please also note that the list of measures includes only the ones, where HEIs are eligible as project leaders, but does not include the measures, where HEIs can participate as project partners (e.g. measure "Joint research-business projects Intelect LT"). The amounts are correct as of April 2019, but could increase, if new contracts are signed and additional funding is allocated.

The success in the implementation of the measures outlined in Table 4 has been uneven. A mid-term ERDF impact evaluation report is expected to be available, which will be essential to have the insights of the current financial period and introduce the relevant changes during the preparation for the new programming period. Yet, there were some challenges in the implementation of certain measures. For example, the OP objective 1 measure "Joint research-business projects Intellect LT" was planned to be implemented jointly by two ministries, but due to the lack of cooperation, uncertainties in the application of state aid rules and difficulties in joint management, the Ministry of the Economy and Innovation has become the sole responsible for the measure. The measure funds only SMEs as eligible applicants while HEI's can participate as partners. Moreover, approved contracts under some measures (eg. OP objective 1 measure "Promoting Commercialization and Transnationality of R&I Results") have not been signed yet due to the unattractive funding conditions, such as unacceptable (too small) fixed grant amount, unwillingness to engage in economic activities, etc.

The distribution of ESIF among HEIs is uneven (see Figure 14). Seven universities receive the bulk of the funding, 50% of which goes to Vilnius University. The activity of colleges is very low, receing only 5% of ESIF funding for HEIs. When interpreting data in Figure 14, one should note that:

- It does not include all the ESIF funding. For instance, the funding allocated on a competitive basis through the Research Council of Lithuania is not covered by the data; and
- It covers the ESIF funding that is not necessarily allocated for implementation of S3 priorities.

Figure 15. HEI's participation in ESIF

Participation in ESIF* (M Eur)
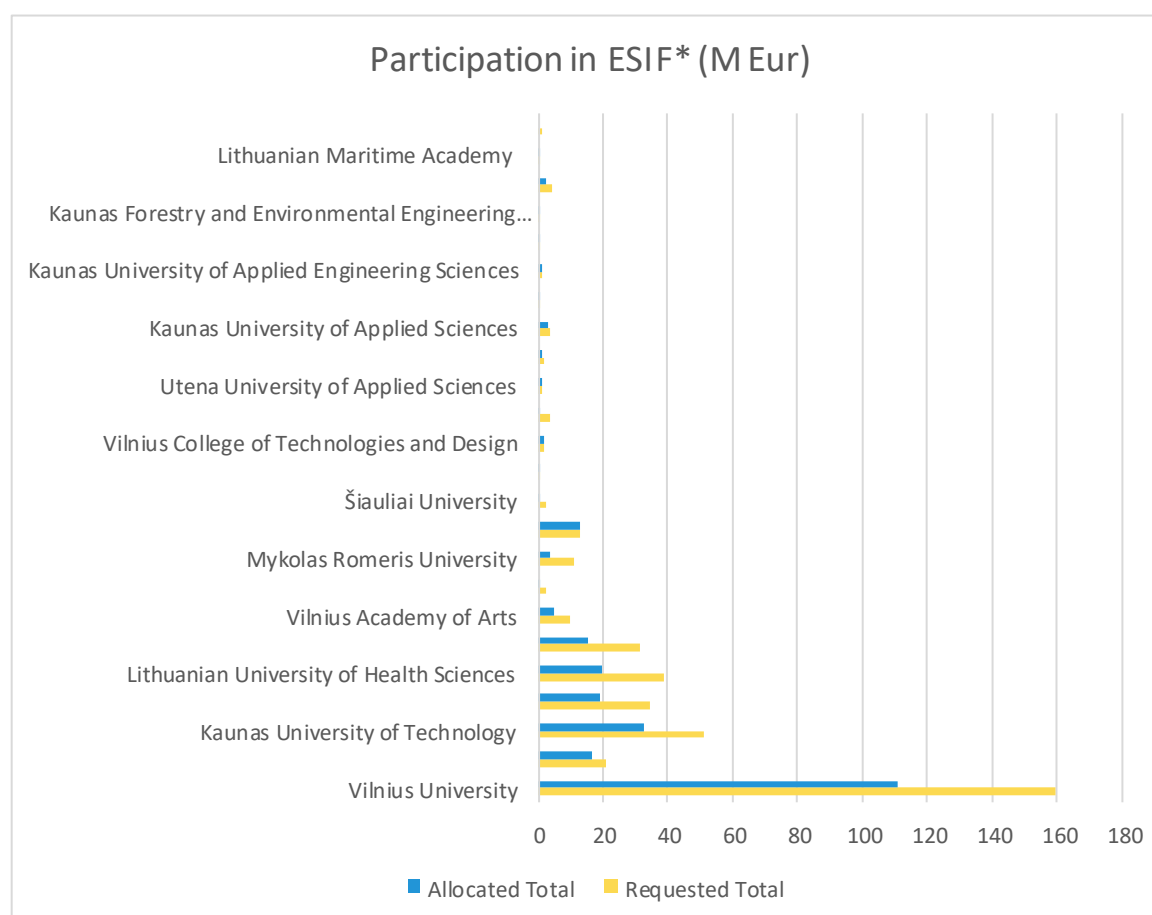
Source: www.esinvesticijos.lt   Note: data extracted in August, 2019

*Chart data on participation in ESIF covers relevant measures of the OP Priorities 1, 2, 5, 8, 9, 10.

Due to different activity profiles, colleges did not receive any funding under Priority 1. Furthermore, four colleges (Vilnius College of Technologies and Design, Šiauliai State College, Kaunas University of Applied Sciences, Klaipeda State University of Applied Sciences), out of 12 examined, share 70% of the total ESIF funding received by colleges. The most active HEI among colleges is Kaunas University of Applied Sciences with nearly one quarter of ESIF funding for colleges.

More than 90% of the total ESIF funding for HEIs go under Priorities 1 and 9. The share of each priority is balanced (around 45%) in terms of requested amounts (see Figure 15), while slight difference in terms of funding is being observed. More than half (52%) of the funding goes under Priority 1 and 38% goes under Priority 9. (see Figure 15). When interpreting data in Figure 15, one should note that:

- The data does not cover all ESIF investments, such as grants allocated by the Research Council of Lithuania.
- It covers the ESIF investments that are not necessarily allocated for implementation of S3 priorities.

Figure 16. HEI's participation in ESIF
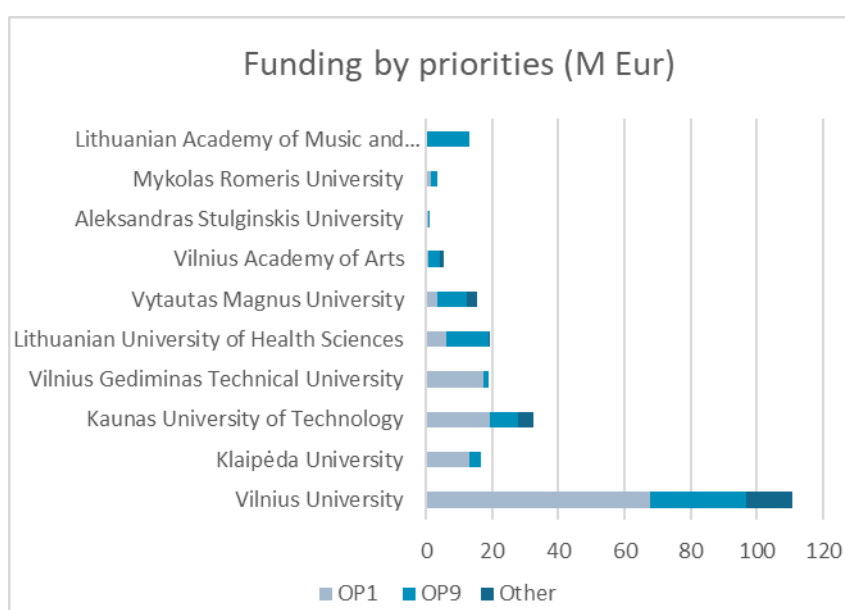
Source: www.esinvesticijos.lt

Note: data extracted in August, 2019. "Other" refers to the funding from Priorities 2, 5, 8, 10.

7.5 HEIs participation in centrally managed EU programmes

Eleven Lithuanian HEI's participated in 104 projects funded by Horizon 2020 (H2020). The net EU Contribution was EURO 19.34 million. The largest numbers of projects were carried out by: Kaunas Technical University (30), Vilnius University (27) and Vilnius Gediminas Technical university (17) (see Table 5)[6]. While the numbers of participations are growing (compared to FP7), they remains significantly lower than in the majority of the EU Member States.

Table 5. Lithuanian HEI's participation in H2020 programme

HEI	H2020 Net EU Contribution, €	H2020 Participations
General Jonas Zemaitis Military Academy of Lithuania	131 600	1
European Humanities University	16 353	1
Lithuanian University of Health Sciences	506 318	6
Vytautas Magnus University	1 143 566	7

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[6] Single Electronic Data Interchange Area (SEDIA)

Mykolas Romeris University	511 247	4
ISM University of Management and Economics	81 625	1
Klaipeda University	848 265	5
Aleksandras Stulginskis University	344 361	5
Kaunas University of Technology	7 702 308	30
Vilnius University	6 882 649	27
Vilnius Gediminas Technical University	1 169 427	17
TOTAL	19 337 721	104

Source: Visionary Analytics, based on based on publicly available information from *Single Electronic Data Interchange Area (SEDIA)*

The monitoring of implementation of S3 carried out by STRATA in partnership with the Ministry of Economy and Innovation included the analysis of the extent to which H2020 projects contribute to the implementation of S3 priorities (STRATA, 2018c). Overall, 181 (out of 217) projects funded by H2020 were closely linked to S3 priorities (this covers all projects carried out by Lithuanian legal entities, including HEIs, research institutes and businesses). The estimates of H2020 funding per Lithuanian S3 priority are problematic, as some projects can be attributed to more than one priority. The data provided in Figure 16 provides estimates according to two scenarios: a) distribution of H2020 funding per priorities, if a project is assigned to more than one priority (it includes double counting); b) if a project is assigned to a single priority, which comes closest to the objectives of the project. Figure 9 suggests, the largest amount of EU contribution was allocated to projects falling under "break-through innovations" priority and "molecular technologies" priority.

Figure 17. Distribution of funding for H2020 projects according to smart specialisation priorities

Distribution of funding for H2020 projects according to smart specialisation priorities

Priority	Amount allocated for project (more than 1 priority)	Amount allocated for project if assigned to 1 priority
E1: smart energy systems	520,932 €	2,094,646 €
E2: energy production from biomass	385,018 €	1,633,821 €
E3: digital construction	11,700 €	54,900 €
E4: solar energy	103,458 €	1,039,850 €
G1: laser technologies	2,500 €	472,568 €
G2: functional materials	71,531 €	795,279 €
G4: flexible systems	518,085 €	
M1: safer food	12,500 €	282,350 €
M3: creation of bio-raw materials	184,167 €	634,204 €
S1: molecular technologies		4,299,096 €
S2: public health		98,895 €
S3: medical engineering		179,745 €
T1: transport and ICT systems	55,096 €	1,657,207 €
T2: transport corridors	148,034 €	1,873,754 €
T3: electronic content	682,975 €	2,569,679 €
T4: cloud computing	527,851 €	1,878,471 €
V1: education technologies	735,419 €	1,541,425 €
V2: break-through innovations	787,775 €	4,740,699 €

Source: STRATA, 2018

Lithuanian HEIs are active participants in the Erasmus+ programme. The data in Figure 17 suggests that the intensity of participation tends to grow over time. An Erasmus+ evaluation[7] revealed that the programme has enabled students from Lithuanian HEI's to improve their knowledge by participating in mobility programmes and has greatly facilitated access to internship positions all around Europe.

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[7] Factus „Erasmus+" tarptautinio mobilumo poveikis aukštojo mokslo ir profesinio mokymo projektų dalyviams. Tyrimo ataskaita", 2018, Vilnius, p 12–13

Figure 18. Allocation of European funds for Erasmus + Key Action 1 – Higher Education Students and Workers Mobility Activities in Program Countries
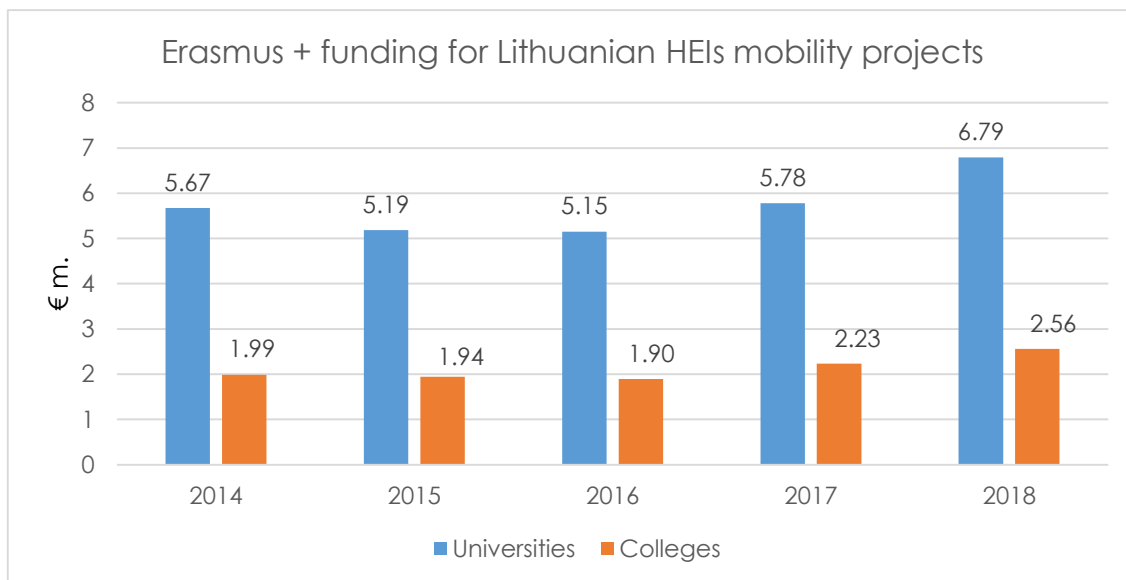
Erasmus + funding for Lithuanian HEIs mobility projects

Source: Zilvinas Martinaitis compilation, based on publicly available information from http://ec.europa.eu/programmes/erasmus-plus

Over the last ten years, Lithuanian HEIs have witnessed significantly larger numbers of outgoing than incoming Erasmus+ students and staff. Nevertheless, the number of incoming students has been growing over the past 5 years (see Figure 18). The low international attractiveness of Lithuanian HEIs remains one of the main factors behind the imbalances. A recent study argues that international students do not found a suitable study programme in English language (STRATA. 2017a). In 2017, there were 535 programmes taught in foreign languages, but students chose only 210 (STRATA, 2018d). The most attractive study programmes were in science, technology, engineering and mathematics (STEM).

Figure 19. Number of outgoing and incoming students and academic staff in Lithuania
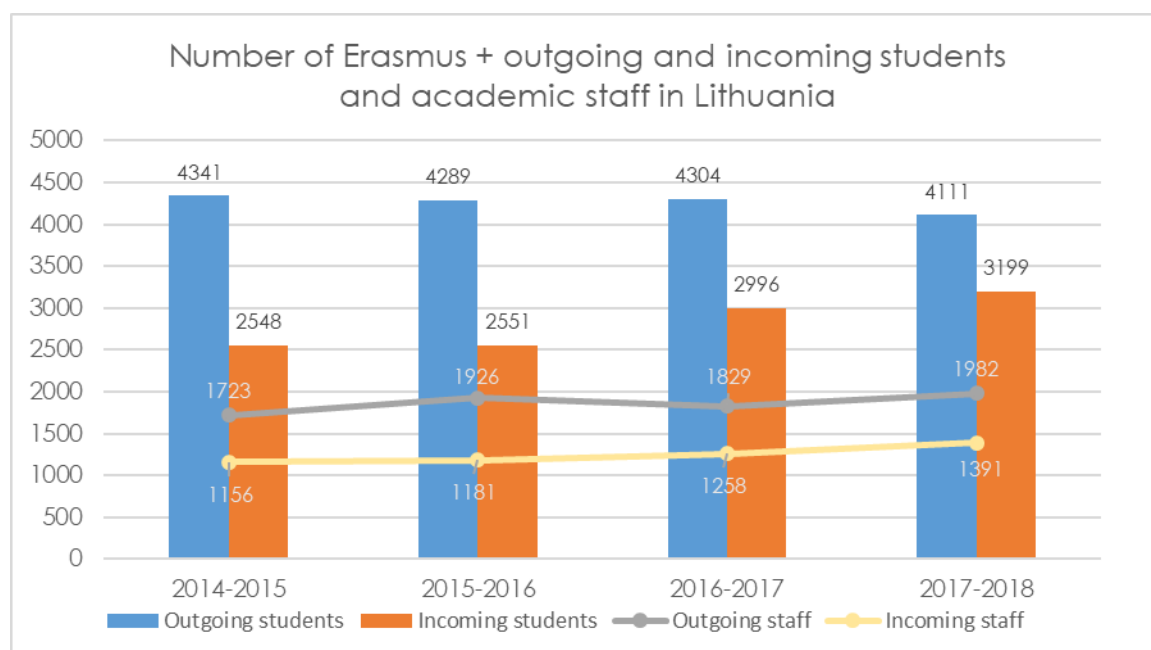
Source: own compilation, based on publicly available information from Erasmus-plius.lt

7.6 HEIs contribution to social and economic development through the three missions. Strengths and challenges

HEIs contribute to the socio-economic development of Lithuania primarily through the implementation of the teaching mission. As a result 58% of 30-34 year-olds have tertiary qualifications (highest share in the EU). This is predominantly due to the massification of HE, which took place at the turn of the century (for more in-depth discussion see sub-sections 2.1 and 2.3).

The impact of R&I activities on socio-economic activities is significantly lower, due to the insufficient resources for R&I in HE (see sub-section 2.3) and the structural barriers for research – business collaboration (see sub-section 3.4 below). A benchmarking of the R&I activities carried out in 2018[8] included an assessment of the extent to which HEIs and research institutes contribute to the socio-economic development. The benchmarking was carried by an international panel of experts and focused on the performance of research units (typically HEIs departments). The results (see Figure 19) are provided on a scale from 0 to 5. The scores for most units range from 2 (i.e. unit conducts significant research, but has a low level of engagement with the stakeholders) to 4 (unit conducts significant research and is engaged with the stakeholders). There are no significant differences across areas of science: average scores fluctuate between 3 and 3.5. However, there is a significant variation of the impact of research units within research areas.

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[8] STRATA, Palyginamasis ekspertinis MTEP vertinimas. Institucijų suminiai įverčiai.
<https://mosta.lt/images/vertinimas/Benchmarkingo_ataskaitos/2018/Palyginamojo%20tyrimo%20vertinimo%20rezultatai.pdf?v=6>

Figure 20. Assessment of the impact of R&I activities on economic and social development by area of science.
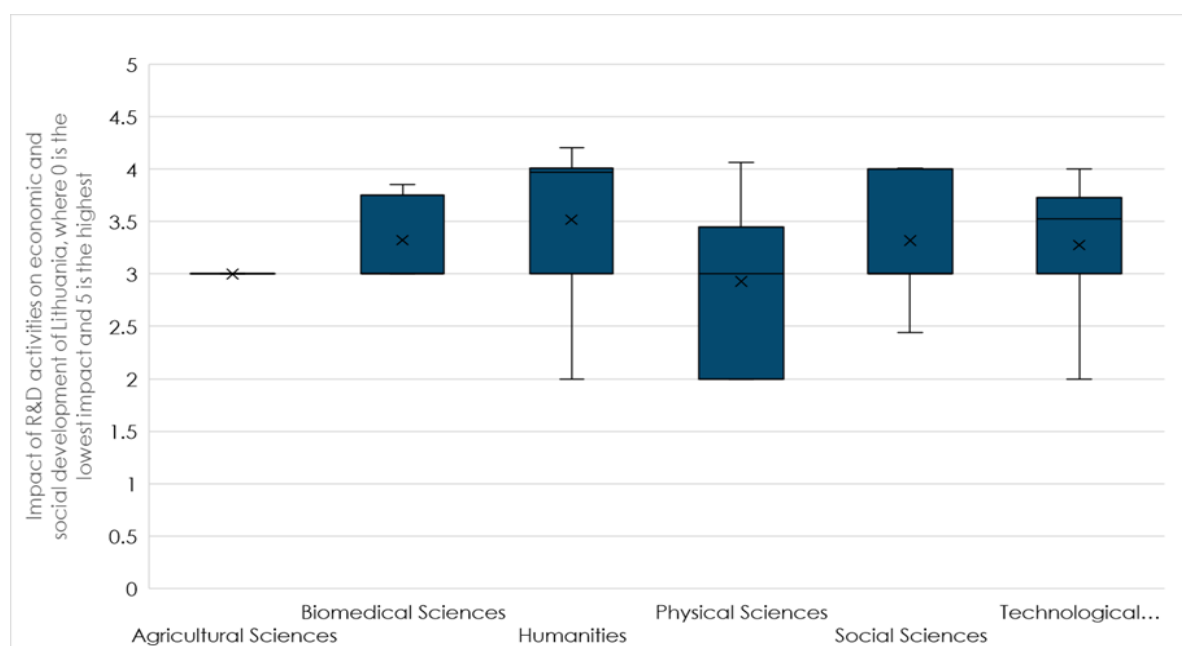
Source: STRATA, 2018.

The unbalanced interplay between a strong emphasis on teaching and lower efforts geared towards research R&I gives rise to a number of challenges:

- To what extent is the growing supply of skills matched with the demand? On the one hand, returns on education remain high – this signals that there is no oversupply of HE graduates. On the other hand, employment levels in knowledge and technology intensive sectors remain significantly lower than in most of the EU countries. This signals that the economy might face challenges in "absorbing" highly skilled workers. Similarly, the International Adult Literacy Survey carried out by the OECD suggests that Lithuania "has one of largest shares of workers who have higher literacy skills than those required for their jobs" (OECD, 2016).
- To what extent is the education available matched with areas of research excellence and S3 priorities? To date there is a lack of evidence, whether HEIs have attempted to ensure closer coordination between the numbers of accepted students or the curriculum of the study programmes in line with the priorities of S3.

7.7 The 'State of play' of HEIs' collaboration with the larger R&I ecosystem stakeholders

Overall, there is a rather broad consensus among policy makers and practitioners that the scale of cooperation between HEIs and other actors of the R&I ecosystem is not sufficient. According to the Global Competitiveness Index[9], compiled by the World Economic Forum in 2018, Lithuania ranked 37th out of 151 participating economies in terms of university – industry collaboration in R&I[10]. Furthermore, only 0.8% of research publications in Lithuania in 2017 were co-authored with industry representatives (the EU28 average is 2.1%) (STRATA, 2017a).

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[9] World Economic Forum, University-Industry Collaboration in R&D, 2017.
<https://tcdata360.worldbank.org/indicators/h4247b4d7?country=BRA&indicator=603&viz=line_chart&years=2007,2017> [retrieved 2019-04-03].

[10] The index relies on the survey of business executives. The question asked: "In your country, to what extent do business and universities collaborate on research and development (R&D)?"

The national averages conceal important cross-sectoral variation. On the one hand, the fastest growing knowledge intensive sub-sectors in Lithuania – optics and lasers, biotech, advanced medical engineering – initially emerged as spin-offs from research institutes and HEIs. Here research – business collaboration is very extensive and intensive, leading to fast economic growth of enterprises and cutting – edge research. On the other hand, these sub-sectors remain relatively small in absolute terms and similar success stories have not yet been emulated elsewhere. Key structural factors behind low level of research – industry cooperation include:

- Limited demand: the largest sectors of the economy (transport, construction, retail trade and similar) focus on technological upgrading as means to boost productivity and competitiveness. The dominant firms significantly invest in acquisition of (readily available) new equipment, and improvements in business model and processes, rather than the development of new knowledge with partners from academia. This might well change in the future, when the dominant sectors will reach technological frontier and will need to innovate in order to remain competitive in the face of growing labour costs.
- Limited incentives for academia to pro-actively engage with the industry. As discussed in sub-section 2.1, the largest share of HEIs income depends on the capacity to attract students and, to a lesser extent, on the excellence in R&I. The evaluation of R&I outputs includes the assessment of the engagement with the industry (particularly for technological sciences). However, this appears to be insufficient to alter the strategies of HEIs and the incentives for individual researchers.

A study carried out by STRATA (STRATA, 2017b) relied on a survey of enterprises and researchers to assess micro-level factors behind insufficient levels of coordination. The key findings are as follows:
- Businesses that were engaged in joint R&I projects in 2012 -- 2017 most often collaborated with Lithuanian universities (82% of respondents), followed by Lithuanian research institutes (42%) and other Lithuanian (25%) and foreign (16%) enterprises.
- Research-industry collaboration strongly relies on personal ties: researchers and enterprises carried out joint projects because they have already known each other already professionally or personally (Figure 20). The impact of public institutions (Invest Lithuania, Enterprise Lithuania, Lithuanian Innovation Centre or Science and Technology Parks) appears to be rather modest in initiating research – industry collaborations.
- The largest share of business representatives mentioned the following barriers to collaboration with researchers: insufficient internal budgets for R&I activities and high administrative burden of carrying out joint R&I projects.
- The largest share of research representatives mentioned the following barriers to collaboration with businesses: insufficient funding for joint R&I projects and lack of time due to other duties and commitments.

Figure 21. Survey: what were the most important intermediaries for starting joint R&I projects
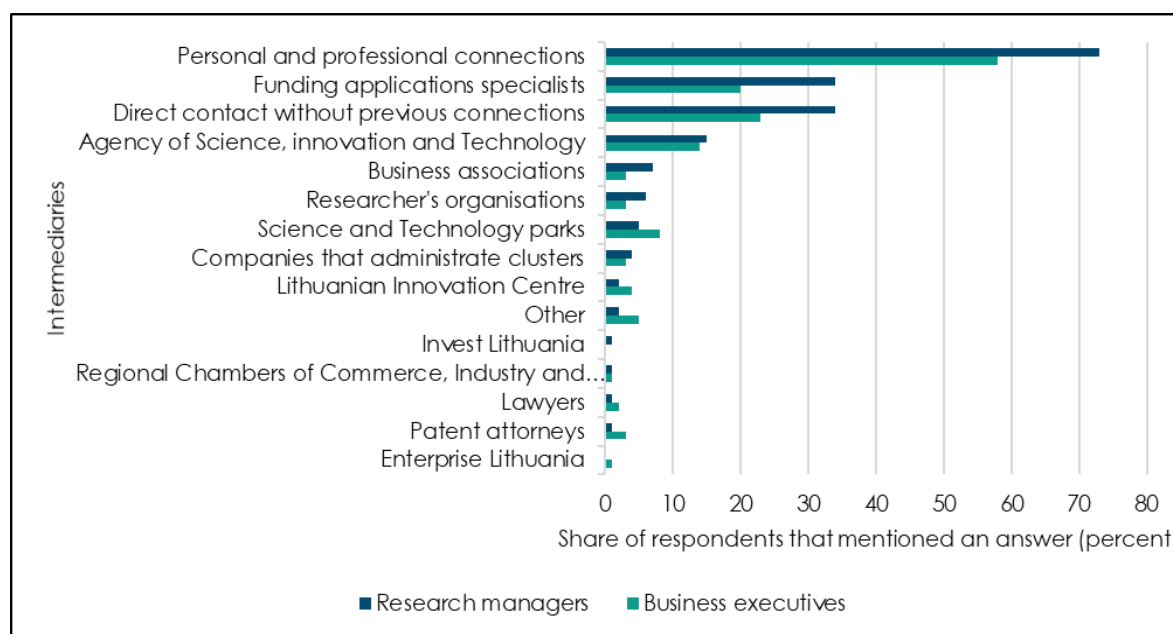
Source: STRATA, 2017. Questions: for businesses – "which of enlisted intermediaries got you involved into joint R&I projects with universities of research institutes?", for researchers – "Which of the enlisted intermediaries got you involved into joint R&I projects with private companies?"

Public policies aimed at strengthening collaboration between HEIs and other actors within the R&I ecosystem rely on two logics of interventions. First, the Government initiatives and reforms carried out over the past 10 years have focused on strengthening HEIs' capacities to increase the quality of studies and research. This is based on an implicit assumption that a strong base in studies and research is an essential precondition for fruitful engagement with the broader civil society and R&I ecosystem.

The second stream of interventions aimed at increasing interactions between HEIs and other actors. This included the following:

- Regulatory interventions. External stakeholders participate in the governance of HEIs as members of Councils, which are tasked with electing the Rector and overall strategic management of a HEI (see sub-section 2.1 above). This is the result of the reforms in governance of HEIs that started in 2009. Furthermore, over the past decade some of the previously independent public research institutes have been integrated with HEIs, thus bringing unique research capacities closer to education.
- Investments in R&I infrastructures. In the 2007 – 2014 programming period, significant ESIF investments were allocated to the establishment of Integrated Science, Studies and Business centres (Valleys). This included the creation and/or upgrading of R&I infrastructures in universities. It was expected that the infrastructures would act as focal points for research – business collaboration. However, this has not led to a huge growth of contracts with businesses. According to the report of the Auditors office, the equipment is primarily used for research purposes and the equipment stands idle 56% of the time (Valstybės kontrolė, 2017). In the 2014 – 2020 programming period approximately EURO 188 million are programmed to be invested in RDI infrastructures and its integration into European infrastructures (EURO 91.76 million have been already contracted to be invested in HEIs, as of April 2019). These investments have not yet been subject to a thorough evaluation.
- Supporting capacity building of intermediaries. During the past decade public investments have been targeted at setting up innovations and technology transfer centres, competence centres, incubators and accelerators within HEIs and research institutes. An in-depth evaluation of impacts of these interventions has not been carried out.

- Facilitating mobility of researchers between academia and businesses. To this end schemes such as industrial PhDs and subsidies for employment of R&I personnel in private enterprises have been launched. However, the uptake has not been as high as expected.
- Facilitation of joint R&I projects between research and businesses. To this end two groups of instruments have been used:
  - Innovation vouchers (measure Inočekiai) aim to provide small scale vouchers for firms that can use this when procuring R&I services from HEIs and other research institutions. Previous evaluations suggest that this is a highly popular and successful measure. Recently the size of the vouchers have been significantly increased (it ranges between EURO 7,000 for novice innovators and EURO 27,000 for experienced innovators). However, it is not clear, whether the scheme has resulted in structuring effects, i.e. led to larger scale joint activities.
  - Subsidies for joint research – business projects. The initial ambition behind the scheme was that public research institutions and businesses should be project coordinators for different phases of joint projects. However, according to the interpretation of ESIF rules and requirement that public research organisations, including HEIs, provide co-financing made this scheme not feasible for HEIs. Therefore, the existing measure (Intelektas) provides subsidies for enterprises that may or may not include HEIs and other public research organisations as partners.

8. HESS case study: field research

8.1. Data collection methods

Fieldwork was carried out between June and September, 2019. It consisted of interviews and a workshop. The 15 interviewees included HEIs' pro-rectors/directors, researchers and other stakeholders. The list of interviewees is provided in Annex 1. Semi-structured interviews relied on questionnaires, tailored for each group and lasted 45-90 minutes. The interviews revolved around four groups of challenges that provide the core of this case study:

1. How are HEIs contributing to S3 via the implementation of the skills and human capital mission?
2. How and to what extent are HEIs rebalancing the activities aimed at the three missions to support implementation of S3?
3. Which issues are hindering the retention and attraction of highly skilled talent?
4. Which are the opportunities and strengths of the innovation system to be promoted?

While discussing the results of interviews, the potential biases that could occur due to sample selection should be kept in mind. First, most of the interviewees represent the largest HEIs. They have the most resources to invest in implementation of all three missions. Second, a number of interviewees are beneficiaries of grants that contribute to implementation of S3 priorities. Additional interviews with non-beneficiaries might have provided different views on the value and role of S3 strategy.

The workshop aimed to bring together expert policy makers to discuss how to address challenges in the four key areas as per above. The workshop took place on 27 September, 2019 and involved 18 participants (see Annex 1).

8.2. HEIs and S3

8.2.1 S3: steps forward and remaining challenges

HEIs are well aware of the Lithuanian S3. Interviewees, by and large, view S3 as a significant step forward in coordinating research and innovation (R&I) policies and allocating respective funding. The existing arrangements stand in sharp contrast to past experience, when each funding scheme had a set of "own" thematic priorities that were inconsistent, short lived, and collectively covered all fields of R&I. Furthermore, stakeholders welcome recent decisions to forego thematic specificities (LT *tematiniai specifiškumai*) as overly bureaucratic approach to defining the scope of each priority.

Nevertheless stakeholders also point to challenges and tensions inherent in the design of S3. On the surface, the tensions are manifested as a discussion on the scope of priorities. Some argue that the existing list of priorities is too long and each priority is too broad – to achieve significant breakthroughs Lithuania needs to further concentrate its limited resources. Others suggest that Lithuania should diversify its R&I capacities as well as support fields of knowledge that do not necessarily lead to new products, but are important for the sustainable development of society. However, it appears that this discussion stems from the differences in the way S3 was originally conceived by the EC and then how it was implemented in Lithuania:

- Stakeholders perceive that national smart specialisation in Lithuania does not sufficiently grasp the needs of different regional territories as it should be constrained to a limited number of priorities. The S3 policy framework includes different levels of governance: national, regional, sub-regional. The level of governance depends on the size of the country and administrative capacities of territorial units. Further multilevel coordination would be needed to adequately reflect the regional level within the national strategy.
- The support for implementation of S3 from the European Regional Development Fund (ERDF) was designed to top-up national funding for research. However, funding of research from national budget is rather limited in Lithuania. This implies that the knowledge fields not covered by the S3 priorities receive very low funding. There is a fear that a further reduction of the scope of the S3 priorities could result in the degradation of multiple research areas.

The stakeholders interviewed also pointed out to a number of additional concerns regarding the design and implementation of S3:

- Priorities could be reformulated as concrete challenges to be addressed rather than R&I areas or groups of specific technologies. A challenge – driven approach would be instrumental in clearly communicating the objectives and expectations that R&I activities should address. Furthermore, it would foster creativity and inclusiveness, since addressing a societal challenge requires interdisciplinary and inter-sectoral efforts of multiple teams. This also echoes the view of some stakeholders that the current priorities are too focused on specific technologies that might demonstrate their viability only in the medium-long term. Therefore, the priorities instead should emphasise in addressing solutions for societal challenges with the help of technologies.
- HEIs are averse to a revision of S3 priorities that dissuades them from reallocating internal resources (e.g. funding of a new research team or developing new study programmes that are not based on existing research capacities) in line with the S3 priorities.
- Historically R&I excellence has been concentrated in a limited number of areas that received public investments from multiple schemes. As a result, research has flourished and knowledge intensive enterprises grew in number and scale. This poses a question: when should public interventions declare "mission complete" and refocus resources on other emerging fields?
- There is a need for better coordination of multiple support schemes. Successful implementation of S3 priorities requires concerted actions by multiple stakeholders that are supported by a myriad of public interventions. For example, support for research projects should be matched with the availability of adequate infrastructure (and vice versa): lack of one could cancel the potential benefits of the other. To address this coordination problem, the stakeholders suggest fewer support measures that cover larger scope of HEIs needs. Allocation of funding between different expenditure categories should be more flexible, and control and accountability should focus on results, rather than rigid rules for use of resources.

8.2.2 Impact of S3 priorities on HEIs' strategies

S3 priorities closely correlate with the HEIs' current strengths as well as education/ research fields, which HEIs aim to further foster in the future. However, the level of "ownership" of S3 is rather weak, i.e. S3 is not perceived as "our" strategy. Hence, S3 does not have a significant impact on strategic decision making within HEIs. The key reasons include:

- HEIs are not willing to commit to long-term investments in the alignment of education / research fields without the certainty that S3 priorities will remain stable. S3 priorities are subject to revision after evaluation of monitoring results. HEIs lack incentives for close alignment. Instead, HEIs have developed two complementary strategies. The first one aims to invest in current strengths and enlarging the existing pockets of excellence. The second approach is based on redeployment of existing capacities to meet newly emerging challenges / opportunities, which arise due to R&I breakthroughs, shifts in the structure of national economy, etc.
- However, the list of S3 priorities is quite broad and HEIs education and research programmes could match at least some of the priorities without the need for more focused alignment.
- Colleges have been largely side-lined in the development and implementation of S3. Until recently colleges did not receive public funding for (applied) research. Hence, colleges contributed to S3 on their own initiative, through external funding (contracted activities).

8.3. Contribution of HEIs to S3 through implementation of skills and human capital mission

8.3.1. Context: challenges facing HEIs

Broader societal trends have significant impact on HEIs strategies and capacities. The discussion below focuses on three issues that interviewees emphasised: declining student population, sustaining education capacities in technology studies as well as attracting and retaining talented academic staff.

The first challenge refers to the declining student population. It is predominantly driven by demographic trends, although recent increases in requirements for entering students have also contributed. This has negatively impacted on all HEIs although to varying degrees: the less prestigious, less popular HEIs (particularly in smaller cities) and programmes (e.g. in engineering) have been particularly negatively affected. All HEIs have reacted by reviewing the number and range of courses offered. This includes the concentration of resources on programmes that are based on the core strengths of an institution, merging or closing of less popular programmes. HEIs have also developed unique responses to the challenge, depending on their profile and strategy. These could be grouped as follows:

- Focus on improving quality, competitiveness and sustainability. HEIs that rely on this strategy aim to identify and streamline the unique value they offer to students, develop and enforce common quality standards for all programmes, invest in developing pedagogical competences of academic staff, and strengthen financial viability of programmes by offering common modules, merging courses.
- Diversification of efforts to research and the third mission. Some HEIs and/or their units aim to counterbalance the drop in incomes from studies by more actively pursuing research grants and contracts from business. Others have refocused on the provision of training services for expanding local firms. Typically this does not fully compensate the loss of income from studies, but prevents the disintegration of academic / research units.
- "Wait and see" characterises lack of leadership and directionality of efforts in the face of declining student population, incomes and shrinking numbers of academic staff.

The second challenge refers to a rapid decline of entrants to technology programmes. While the overall number of students has declined across the board, this field of study has been particularly affected. Since 2010 the number of entrants has more than halved in universities and colleges. The Government, taking into account labour market demand, aimed to reverse this trend by allocating more publicly funded study places in respective fields. However, this intervention did not attract a sufficient number of entrants. This is closely related to the low attractiveness of STEM subjects in general education. Since a relatively small share pass Matura exams in the respective fields, the pool of potential future students is too small to fill up all publicly funded places. If these trends continue, changes could be irreversible due to a decline in the capcity of HEIs to offer such studies. Programmes are being closed and academic staff either diversify efforts towards research and third mission activities or leave HEIs altogether.

The third challenge concerns attracting and retaining academic staff. During the past recession, funding for HEIs has been significantly cut and remained stagnant for nearly a decade. The funding levels have somewhat increased over the past two years. This resulted in the growth of salary levels of academic staff. Nevertheless, over the past decade wages of highly qualified employees grew substantially faster and wage differentials remain. The discrepancies are particularly large for ICT and engineering – these sectors were very successful in attracting FDI – which lead to accelerated growth in wages. As a result, the wages of academic staff are slightly higher than the national average. However, they are uncompetitive, when compared to wages of highly qualified workers. The challenges are particularly large in ICT studies. Although the programmes are increasingly popular among entrants and there is a large unmet labour market demand, HEIs cannot significantly expand their supply.

8.3.2. S3 priorities and education programmes

The stakeholders interviewed argue that S3 is predominantly understood as a research and innovation strategy. Hence, so far there have not been significant deliberations on how HEIs could contribute to the implementation of S3 through the skills and human capital mission. Nevertheless, several HEIs have launched new BA and MA programmes that closely correlate with S3 priorities. The programmes were developed because HEIs identified areas of research excellence that have not yet spilled over to the education process, rather than due to the adoption of the S3 priorities.

HEIs' leaders argue that HEIs are open to structured dialogue with key stakeholders regarding the priorities and the design of the study programmes. Stakeholders participate in HEIs Councils as well as programme committees. The Government can influence on the studies through regulations (e.g. establishing minimum standards) as well as funding decisions.

Looking at the future, HEIs have expressed interest in establishing a strategic dialogue regarding the alignment of education offer and S3 (or other national) priorities. However, time horizons matter (see also section 2):

- HEIs seek to adopt a long term view of the development of new study programmes. Universities emphasise that new programmes should be based on research excellence. Colleges are concerned with the availability of necessary infrastructures for the development of practical skills. Both groups of institutions aim to avoid the mistakes of the 2000s, when a plethora of new very similar programmes were launched without due regard for the human and structural capital to ensure the quality of studies. At the same time HEIs are concerned that Government priorities, as expressed in the decisions regarding allocation of publically funded study places, keep shifting on an annual basis.
- It is very likely that the first cohort of graduates will enter the labour market in six/seven years, given the time needed to develop and launch a new study programme as well as the duration of BA studies. S3 priorities are defined for the upcoming programming period, i.e. seven years (with a possible review after three to four years). There are fears about the lack of synchronisation, however, recent experience shows that, after the S3 evaluation, priorities are not changing drastically. In 2019 only some technical amendments of priorities were applied, with the same priority domains remaining.

Given the above considerations, it is unlikely that without a joint dialogue HEIs will significantly change the number and range of courses offered with the aim of ensuring a closer alignment with the S3 priorities. However, more incremental changes may occur in a bottom-up manner, i.e. due to emergence of new islands of R&I excellence, shifts in the structure of the economy and labour market demand, advocacy efforts of the stakeholders, etc. Researchers and representatives of HEIs argued that the following Government actions could support HEIs in implementing the skills and human capital mission:

- Setting a long-term vision and objectives as well as ensuring consistent implementation. These should be set on the basis of broad consultations with key stakeholders. The objectives and targets should go beyond the rankings of HEIs in international rankings. Some of the strategic questions that the vision should address include:
  - How do we define the quality of studies beyond the minimum standards? To what extent is quality an important policy objective and if so, why does the current funding system focus on quantity of students rather than quality of studies?
  - What should be the structure of awarded degrees? To what extent does massification of undergraduate and graduate studies point towards shifting labour market structure or inflation of degrees?
  - How should colleges contribute to S3 implementation? Should some of them evolve towards universities of applied sciences and what would that imply?
- Increasing flexibility and decreasing regulation of the study process. For example, several HEIs argued that there is a growing demand for interdisciplinary education. While in principle HEIs can award inter-disciplinary degrees, in practice this is hardly possible, since they should be defined according to the main discipline.
- Adequate pricing and funding of the studies. This is the key to ensuring long term sustainability and quality of education. If the funding is not sufficient to attract and retain top academic staff, short-term measures cannot have any significant impacts. For example, several interviewees argued that past measures aimed at increasing internationalisation of studies and the development of new study programmes failed. They lacked ambition and offered short-term financial boost while ignoring the absence of enabling conditions, i.e. sufficient funding to carry out the newly developed programmes.

Furthermore, workshop participants suggested that HEIs could contribute to the development of skills for S3 by:

- Offering life-long learning opportunities for persons in the labour market. Modules or short courses could provide a relatively fast and inexpensive approach to addressing skills bottlenecks. This, however, requires an effective scheme funded by ESIF that could cover some of the costs for the learners or their employers.
- Developing short-cycle or MA level programmes so that the first graduates could enter the labour market in a relatively short period of time. However, the success of such efforts depends on a well-designed public intervention. In the past, schemes that provided subsidies for developing new study programmes have not achieved tangible results.

8.4. Balance between the three missions of HEIs to support implementation of S3

8.4.1 Balance between teaching and research

The Law on Research and Higher Education establishes unity between research and studies. Nevertheless, the HE system is strongly tilted towards education:

- HEIs receive most of the incomes (from the Government budget and fee paying students) for studies rather than for R&I activities. As one interviewee put it: "we get what we fund – large quantities of undergraduate students".
- Society at large and businesses predominantly perceive HEIs as education institutions, responsible for alleviating skills shortages. As an interviewee argued: "businesses are primarily interested in our graduates, whereas demand for scientific breakthroughs is limited due to low knowledge intensity of our economy".
- HEIs academic staff spend very large share of time on teaching compared to other EU countries.

A number of interviewees argued that the existing **balance between studies and research is not optimal** – significantly more human and financial resources should be allocated to research activities. In this regard some progress has been made over the past decade, as witnessed by the growth in the scale and quality of research outputs. According to the interviewees this was driven primarily by:

- Introduction of competitive funding schemes;
- Increasing standards for the quality of publications;
- Evolution of the strategies of some of the universities, which increasingly support and reward international excellence in research, emphasise research capacities as one of the preconditions for high quality studies, encourage internal and external collaboration;
- Past investments in research infrastructures;
- Demographic shock: as the numbers of students declined, some academic staff re-focused on research to fill-in the income gaps;
- Since 2019 colleges have become eligible for research funding.

Nevertheless, further rebalancing is hindered by the following inter-related factors:

- Underfunding of research activities. Over the past decade the total intramural expenditure (GERD) for R&I performed in HE sector fluctuated around 0.4% of GDP., which is comparable to the EU average. However, a significant share of this funding was allocated to the development of R&I infrastructures. As a result the funds for actual research activities have been rather limited.
- High volatility and fragmentation of research funding. Predictability of funding is essential for building research teams, development and implementation of ambitious research agendas. However, the cycle of the calls for competitive research funding is very volatile. For example, a large number of calls were launched in 2013 and 2014, followed by the virtual absence of calls in 2016 and 2017. Hence, research teams that finished projects in 2015 – 2016 faced a "financial drought". The fluctuations can be explained by the different cycles of programming and implementation of European Structural and Investment Funds (ESIF), which provide most of the resources for competitive research funding. This creates precarious working conditions for researchers, whose wage levels usually (to a large extent) depend on the number of grants attracted. Furthermore, most of the measures (with some notable exceptions) provide funding for small-scale projects to be carried out in two to three years. This implies that researchers are involved in a perpetual application process, while the scale of ambition of each project is limited by short project duration. Hence, larger grants for longer projects would facilitate the development and implementation of more ambitious research agendas, building of larger teams, more stability in researchers' incomes, attraction and funding of doctoral students, etc.
- Lack of skilled researchers. The number of new doctoral graduates is well below the EU average. Only 37% of these graduates continue working at research or higher education institutions after graduation on a full time basis (STRATA, 2019). Furthermore, the quality of doctoral training is highly variable. As one renowned researcher argued: "the biggest problem is that only a small share of work is published in good journals. <...> So I assembled my team and their first task was to learn writing publications for highly cited journals – this is essential, because none of them had such experience in the past".
- Low level of wages. While this is important on its own right in attracting and retaining the best researchers, it also hinders participation in international R&I programmes (see below).

- International collaboration and participation in the European Framework Programmes (FP) remains limited. This is due to multiple reasons, which include:
    - Insufficient engagement in international networks, limited HEIs' capacities to support researchers in developing innovative project ideas, drafting excellent proposals and managing large partnerships.
    - Lack of financial incentives to engage in fierce competition at the European level. Success rates in FP are significantly lower than in national schemes. However, the level of wages paid to researchers for participating in national and European schemes is the same. This could be justifiable on the grounds that similar work should be remunerated similarly, irrespective of the source of funding. However, at the same time this creates a sense of dilution of the value of work. As one interviewee put it: "our researchers earn half the wage of their peers from EU-15 in the same project doing the same kind of work: this is not fair. The problem lies with inadequately low national funding of research <…> additional funds for projects with the seal of excellence is an interesting idea, but the Government would do better, if they used these resources to increase the wage levels – this would offer a more serious incentive to participate in FPs".

To what extent has the concentration of R&I funding according to the **S3 priorities** structured research efforts? The experience of researchers varies significantly. Some argue that it is relatively easy to ensure a good fit between their research agenda and S3 priorities, because there are many broadly defined priorities. As a result, some researchers suggest that S3 priorities had no significant impacts on the objectives and scope of their R&I projects, funded by competitive grants, i.e. the projects would be largely similar in the absence of S3 priorities. However, others argue that the successful application for grants required the realignment of research agendas. This created unique challenges, such as stepping out of ones "academic comfort zone", assembling and managing an inter-disciplinary research team, and establishing new contacts with businesses. While the challenges made the implementation of the project more difficult, it was largely viewed as a positive experience.

A distinct question concerns the **position of colleges in the research system**. The legal framework establishes that they should carry out applied research. However, until only recently colleges were not eligible for competitive research funding. Hence, while some colleges have in the past carried out contract research that mostly contributes to the third mission, basic research capacities in most of them remain under-developed. This poses substantial questions regarding the structure of research performing organisations: to what extent should the colleges invest in developing research capacities (including acquisition of infrastructure), how to differentiate applied research, whether to distinguish the largest colleges with ambitions of becoming universities of applied sciences from the rest?

8.4.2 Technology transfer, entrepreneurship and research – business cooperation

Interviewees argue that the scale of technology transfer, entrepreneurship activities and collaboration with businesses has significantly improved since the start of the implementation of the S3 strategy. The number of knowledge intensive firms has grown, entrepreneurship has become increasingly popular, and HEIs have started building capacities, necessary for the identification, development and commercialisation of knowledge. The analysis below focuses on the achievements and remaining bottlenecks in three key areas: science-business collaboration, fostering support ecosystems for knowledge intensive start-ups and industrial PhDs.

Different measures have been promoted by the Ministry of Education and Science to strengthen science-business cooperation. The Industrial Doctorate programme want to reverse the fact that only 29% of all full-time equivalent researchers are working on the private sector (EU average 51%). In addition, from 2020 HEIs will receive a top-up funding of EURO 0.99 per EURO 1 attracted for R&I activities from the private sector. Other measures will include the promotion of innovation and technology transfer centres as one-stop-shops in every HEI, the promotion of competence centres to test R&I-based commercially–promising ideas, supporting the creation of spin-offs and the development of HEIs' market-adjusted R&I results.

In addition, a two stage benchmarking exercise is being carried out, coordinated by STRATA, to assess universities and research institutes. The exercise is carried out every five years by international experts and yearly by the Research Council of Lithuania. The main focus of the assessment is on the funding measures for scientific excellence, science-business cooperation, the social and economic impact of R&I and activities for internationalisation of R&I programmes.

The interviewees argue that the intensity and scope of **science – business collaboration in carrying out R&I activities** has significantly increased over the years. However, a number of bottlenecks persist:

- Interviewed researchers claim that low knowledge intensity within the existing economic structure is the main obstacle for more intensive science – business collaborations. Hence, fostering demand for R&I is viewed as essential. In this regard, researchers particularly welcome such measures as pre-commercial procurement and innovation vouchers. These enable businesses to purchase R&I services from HEIs or research institutes.

- For more than a decade, policy makers have aimed to provide support for large scale joint science – business projects. Yet, this scheme was not fully launched in the 2014-2020 programming period. The requirement that public research performing organisations should provide co-financing made the scheme unattractive to HEIs and research institutes. Hence, resources were allocated to business-led projects (measures Intelektas and Intelektas LT-2) that may include HEIs as partners. While overall this arrangement is considered as successful, it yet does not live up to the ambition of truly joint projects.

- There are well established collaborations between industry and HEIs in some sectors. In fact, these collaborations prove essential in sustaining the competitiveness of enterprises. However, quite paradoxically, these partnerships also impose natural limits on growth, as companies find it difficult to develop products that transcend the narrow research agendas of HEIs As one interviewee explained, embeddedness within local knowledge networks allows firms to access unique know-how, which is essential to lead in the respective global market niches. However, in order to grow beyond the current niches, firms need to tap into international networks, thus overcoming the natural limits of deeply specialised knowledge of local ecosystem. This has not yet happened to a significant extent.

- The internal knowledge management and transfer systems of HEIs remain under-developed. While most HEIs now have technology transfer offices, they are frequently under-staffed and under-funded. To address this challenge, a number of publicly funded schemes exist to support capacity building as well as identification, development and commercialisation of promising technologies. A potential funding gap exists in supporting development of prototypes, i.e. work at technology readiness levels (TRL) five and six. While some existing schemes provide support for large scale projects at these TRLs, there is a need for support for large number of small-scale projects so that researchers could experiment and test their ideas in relevant environments.

- HEIs play a key role in the S3 implementation, especially in strengthening a knowledge-based private sector in Lithuania, which still remains relatively weak with limited R&I absorption capacity by business. HEIs can play a stronger role in S3 context in the promotion of spin offs, industrial doctoral programmes, integrated entrepreneurship trainings should be even in wider use for stepping further towards changes in structure of economy.

- The lack of capacity of public research organisations to commercialise scientific knowledge and their research results being far from the market are identified as bottlenecks of collaboration. In addition, the demand for research services from business is limited to solving minor problems, testing product features and / or safety. The lack of revenue from business and other customers in public research organisations has created significant challenges for research organisations to maintain equipment, qualified staff and quality of research. These challenges will remain unless the incentives for more attractive researchers' career, collaboration with business, and commercialisation of scientific results are created.

- Business lack information on R&I services provided by research organisations, which have inefficient technology transfer systems and bureaucratic obstacles. A homogeneous innovation management system instead of fragmented project based efforts would help in this direction. Innovation demand instruments combining public, business and scientific efforts to promote public-private partnerships in addressing socio-economic challenges and strengthening SME innovation capacity through public procurement in smart specialisation.

- The public sector show a lack of innovative ideas (Evaluation conducted by consultants in 2019) (Visionary Analytics, 2019), with a high potential to foster demand for innovation and act as a catalyst for innovation which is not being used to its full extent.

- Some identify the lack of high-quality R+I project ideas as a systemic challenge. Even if the "Inogeb LT" measure is considered important for facilitating project flow, innovation support services are currently not fulfilling their potential. There is a lack of a coherent approach to the development of business absorptive capacity as well as a lack of a clear, unified and qualified framework for innovation support. Current projects under "Inogeb LT" are poorly interconnected, fragmented, and business innovation facilitation services account for only a small fraction of all support services. Therefore, the success of the measures will depend on further development of the innovation policy system (particularly the "soft" innovation support ecosystem) together with the ongoing Innovation Reform, R&I regulation, interpretation, etc.

- Although only a small proportion (21%) of the survey respondents identified failures in collaboration as an important factor adversely affecting the projects, there are three main systemic challenges to collaboration:
  - Lack of motivation to work with businesses, that is, to deliver business-relevant results, not only publications.
  - Lack of convenient and one-stop information on services provided by research and education institutions.
  - Lack of an efficient technology transfer system. Long decision-making time in research and higher education institutions.

Over the years the number of **knowledge intensive start-ups** has significantly increased. Several of them have already gained international recognition. For example, Oxipit, which uses artificial intelligence to automate reporting on chest X-ray images, has won the EIT Health InnoStars award in 2018. While HEIs played an important role in fostering entrepreneurship ecosystems, significant bottlenecks exist:

- HEIs' start-up incubation centres lack adequate funding. They organise entrepreneurship promotion events, provide pre-incubation and incubation services from "own" resources. Since these are inherently limited, the scope of activities and the number of supported (future) start-ups is sub-optimal. Previously a publicly funded measure Inoveks provided resources for HEIs to support incubation of start-ups. According to one interviewee, this resulted in 14 new start-ups a year (10 of them are still operating). However, after the scheme was discontinued, the number of successfully incubated start-ups dropped to two per year.
- Public support system for knowledge-intensive start-ups is fragmented. While the HEIs' incubators provide some services, they do not have the resources to cater for a broader range of needs (e.g. participation in international boot camps) or provide pre-seed and seed capital. Additional services and capital are offered by the programmes managed by the Agency for Science, Innovation and Technology (MITA). However, the measures are perceived as overly complex, time-to grant is long and success rates are very low. This creates a significant additional administrative burden, complexity and uncertainty. As one interviewee argued: "we incubated a promising start-up, which failed to get support from MITA, but then went on to win international awards. Such system creates a lot of confusion."
- Entrepreneurship education so far has not been successfully integrated across the HE curriculum. As a result, graduates of natural sciences may have deep understanding of technology, but lack inclination and skills to commercialise the knowledge, while graduates of management and business administration programmes lack the necessary technical skills. Hence, several interviewees strongly advocate inter-disciplinary education and streamlining of entrepreneurship programmes.
- HEIs internal processes for supporting spin-offs and managing intellectual assets are still under development. While the number of "official" spin-offs is small, HEIs are aware that a non-trivial share of academic staff has set-up new companies. According to some interviewed researchers, HEIs lack capacities in supporting entrepreneurial activities. Hence, researchers tend not to ask for support from HEIs when launching enterprises. On the other hand, HEIs are concerned that such entrepreneurship might be based on intellectual property developed while working at HEI. To change these practices, at least several HEIs have invested in the development of spin-off support systems as well as the introduction of incentives for researchers to collaborate with HEIs in setting-up spin-offs and the management of intellectual property.

Industrial PhD scheme provided funding for a few projects, but beyond that it failed to gain momentum. The key reasons discussed by the interviewees include:

- Lack of consensus among implementing agencies regarding the scope of the scheme. The Research Council of Lithuania (RCL) emphasised that the selected projects should have strong focus on research. As a result, potentially interested enterprises regard the pre-selected themes as too academic.
- Insufficient levels of funding for enterprises participating in the scheme. Firms that have long established collaboration with HEIs do not need the scheme: they regularly discuss prospective R&I areas, support the PhD students by providing infrastructure and access to know-how as well as employing PhD students or graduates. However firms that do not have similar experience of collaboration are concerned about high costs of PhD training and large risks regarding the potential benefits. Furthermore, the scheme implies significant risks for beneficiaries: if the student dropped out, the beneficiaries would have to reimburse the used up resources. Hence, the scheme failed to reduce the risks perceived by such firms.

- Lack of publicity – stakeholders claim that very few potentially interested firms are aware of the scheme.

Workshop participants suggested the following approaches for fostering technology transfer, entrepreneurship and research – business cooperation:

- Change the mode of intervention: from short term incentives to building structural capacities within HEIs. Technology transfer, the development of start-ups and collaboration with businesses in the medium-long term should become financially self-sustainable activities of HEIs, i.e. generate sufficient income to cover the operating costs of such activities. To achieve this status, HEIs need adequate capacities. However, these are not systematically developed; instead public interventions predominantly focus on short term grants. For example, in the area of entrepreneurship development this implies the need to: a) support capacity development of HEIs incubators, including co-financing of provision of incubation services; b) provide pre-seed capital through incubators/technology parks, rather than a centralised scheme run by MITA.
- Support research-business collaborations and joint projects through competence centres. While there currently is a scheme entitled "Competence centres", it is rather different from the notion of competence centre used in most EU countries. More specifically:
    - A competence centre should be an organisational unit or an independent organisation jointly managed by representatives of HEIs, research institutes and businesses. The existing scheme does not cover any institutional arrangements, but rather provides support for experimental development projects carried out by researchers;
    - Research and business representatives engaged in the management of a competence centre should jointly develop medium-long term roadmaps for investments, launch call for proposals, select and co-fund the most promising projects. None of these elements currently exist.

8.5. Attraction of top academic staff to HEIs

8.5.1   Attracting and retaining new PhD graduates

For years the level of competition to enter PhD studies has been low and the candidates were not necessarily amongst the top in their cohort of students. Some PhD positions did not manage to attract a single candidate. Furthermore, a large fraction of PhD students (particularly in social sciences) held jobs outside university, which had negative impacts on the time and effort allocated to PhD studies as well as the likelihood of successful completion of dissertations. The interviewees argued that these trends could be explained by the low level of PhD scholarships and the unattractiveness of academic careers (particularly salaries of academic staff).

In 2019 the number of PhD scholarships has significantly increased. There has also been an 83% increase in the monthly value of doctoral student scholarships. As a result, the entry to PhD studies has become increasingly competitive. In addition, the Ministry of Education and Science has also introduced a 40% increase in researchers' and lecturers' salaries between 2017 and 2019, and, as mentioned above, introduced important reforms for the consolidation of HE system in Lithuania, including merging universities, transforming the network of research institutes and the introduction of an international model for research organisations.

Nevertheless, a number of risks and challenges remain, including:

- Ensuring that academic work is the primary activity of PhD students. Several Universities are discussing formal requirements for PhD students to be engaged full-time in academic work, i.e. in PhD training, writing dissertations, teaching and contributing to R&I projects. The viability of this strategy depends on the availability of additional funds to pay salaries to PhD students for teaching and R&I work.
- Long-term attractiveness of academic careers. A number of interviewees argued that few recent PhD graduates continue working at HEIs (particularly in engineering, ICT and social sciences). Most leave to work in other sectors. Short term financial incentives are not sufficient to counterbalance the overall unattractiveness of academic careers. For example, several of the researchers interviewed pointed out that they employed their PhD students within ongoing R&I projects in order to make academic work more attractive. Despite this, students dropped out of the PhD programmes and took better paid positions elsewhere. Furthermore, if the current disparities remain, the boost in PhD scholarships will do little to attract graduates to HEIs. The value of PhD scholarships has grown faster than wages for academic personnel and as a result PhD students are likely to receive higher incomes than recent PhD graduates.

8.5.2   Attracting and retaining talent from abroad

Since the early 1990s Lithuanian HEIs have experienced a brain drain of academic personnel. To counter these trends, RCL launched a call for attracting researchers from abroad (activity – "Attraction and reintegration of brains – SMART"). 13 researchers (including 11 Lithuanian nationals) received grants to carry out research in Lithuanian HEIs and research institutes. Each attracted researcher received a grant worth nearly EURO 1 million.

Some important measures have been introduced by the Ministry of Economy to attract talent, such as the programme of "Attracting Foreign Talent Researchers for Research implementation".

The attracted researchers interviewed highlighted the following factors that drew them to Lithuania:

- "Vested" interest in working in Lithuania, which include desire to return to work in Lithuania under favourable conditions (for Lithuanian nationals) or long term interest in developing partnerships in the region (for non-nationals).
- Networks and long-term contacts with researchers in Lithuania.
- Sufficiently large grant and overall favourable conditions. For some, the grant provided an opportunity to start leading their own research teams.

Interviewees also outlined a number of reasons why Lithuania is not very attractive for top-notch researchers:

- Relatively low global visibility of the Lithuanian R&I system and institutions.
- Very diverse landscape of institutions and their research units. While some are perceived as being at the leading edge (e.g. having world class infrastructure and research teams, offering professional administrative support) others lack basic preconditions (such as teams with past experience in submitting papers to high impact journals, administrative staff capable of supporting researchers in managing the projects, etc.).
- Rigid and bureaucratic system for managing the grants. Public procurement procedures consume a lot of time and energy and do not necessarily result in the most cost-effective outcomes. A number of activities (such as conferences) have to be planned in advance and any changes produce high administrative workload. There are some limitations on the allocation of resources (e.g. some equipment can be rented, but cannot be bought), which constrain the flexible implementation of projects. Overall, interviewees suggest shifting the system of control from processes to results, i.e. researchers should have significantly more autonomy in allocating the resources, whereas their projects should be evaluated in terms of excellence of the results.
- Availability and quality of public services to non-nationals remains a challenge. Researchers typically relocate with their families. Hence, there is a need for international kindergartens and schools. While a few such facilities are available in Vilnius, this is not the case in other cities.

Interviewees and focus group participants provided the following suggestions on how to attract a larger number of leading researchers from abroad:

- Talents attract talents, hence Lithuania should:
  - Identify, systematically invest in and proactively promote a limited number of research units / research fields. Once they reach global excellence and recognition, attraction of other talents will be significantly easier (and less costly).
  - If Lithuania aims to catapult research units / emerging research fields to global excellence, it should target exceptional researchers and encourage them to hire research teams globally. This requires significantly larger scale of projects than the current allocation of EURO 1 milllion. per project.
  - Provide longer time-horizons for attracted researchers. The grants should be allocated for at least 5 years. This would facilitate the formation of stable teams, training of PhDs, development of a pipeline of Horizon Europe projects, etc.
- Ensure transparency and visibility of opportunities in Lithuania. For example, one of the interviewees learned about the scheme accidentally from the press. It is very likely that majority of potential applicants do not know about such opportunities.
- Reduce administrative burden for managing the projects and instead focus on results.
- Make strategic use of opportunities offered by EU Framework Programmes, such as the COFUND instrument of Marie Skłodowska-Curie Actions, ERA chairs, Teaming and Twinning actions. This would allow leveraging of national funds to obtain financing from the Framework Programme to attract researchers.
- There is a need to strengthen networks with Lithuanian researchers working abroad and/or foreign researchers who have interest in working in Lithuania. These networks could be used to disseminate information on funding opportunities in Lithuania as well as for the development of joint research projects. In practical terms this could include a mapping of researchers working abroad to obtain their contacts, as well as a better use of Futura Scientia, an association of Lithuanian researchers working abroad, and the Lithuanian RDI Liaison office LINO in Brussels.

It is crucial to ensure the long term sustainability of project impacts, by retaining the researchers and / or their teams after completion of RCL grants. Given that this depends on the availability of further funding, the attracted researchers should be incentivised to develop a pipeline of grant applications to the EU Framework and national programmes. To the extent that this already takes place, it relies on the initiative of researchers and host institutions rather than being requirements of the programme.

8.5.3 Bureacracy hindering attraction of talent

Bureaucracy, inconsistent, unclear or changing rules administrating talent attraction schemes can hinder reputation and discourage researchers to work in Lithuania. Following a State audit of the aforementioned activity "Attraction and reintegration of brains – SMART", some flaws were detected in respect of the methodology for calculation of fixed rates offered to the attracted researchers. As a result, the RCL reduced the hourly rates for the attracted researchers by approximately 40%. This also affected funding for laboratory materials and overheads, because these costs are calculated as a percentage of total budgets. Despite this reduction in funding, the objectives that researchers contractually need to achieve remain unchanged. This had two short-term implications: the salaries of attracted researchers were no longer internationally competitive and the reduced budget was not sufficient to achieve ambitious objectives set for the projects. After changing the initial conditions some researchers could consider termination of the contract and return to their previous institution abroad. It is important that state institutions assume the responsibility for administration failures and do not expose researchers to face increases in costs due to changes in the rules.

9. Final event

The final event of the HESS Lithuania case study took place in Vilnius on 19th February 2020. The event provided the opportunity to reflect on the current challenges addressed by HEIs to engage in the Smart Specialisation Strategy, exploring potential ways forward and potential actions that could be taken. Experiences from other European regions and member states were presented, providing an interesting context to exchange lessons and to consider the possibilities to tailor them to the Lithuanian research and innovation context.

The event gathered 50 participants from public administrations at European and national levels, higher education institutions, colleges and business representatives. The discussions held during the event highlighted a number of important messages, summarised below.

Current and future S3 developments

There is a broad agreement on the fact that S3 provides direction in deciding the type of activities for investment, avoiding the empty discussions that had previously been taking place. Although S3 implementation has been managed by the Ministry of Education and Science and Sport and the Ministry of Economy and Innovation, S3 in Lithuania has been focused more on developing technologies and applied research. As it was mainly limited to ERDF and TO1 objectives, human capital and skills agendas have not been explicitly considered within S3 strategy.

Research and innovation in Lithuania, as in other Baltic countries, is dependent on ERDF funding, as national funding is comparatively very small. This creates challenges and tensions in applying the S3 concept, which requires R&I investments to be focused on a limited number of priorities. S3 focuses on the most competitive sectors with highest potential for economic transformation. Although leverage needs to be found to include non-technological innovative activities in S3 strategies. In any case, S3 has been a facilitating model in Lithuania, fostering some sectors.

STRATA agrees that the S3 concept has been a game changer and has helped consolidate priorities which were fragmented in different economic, innovation, research and science policy documents. The S3 is considered as a very good mechanism for priority setting, and is a highly significant leap forward.

HEIs consider S3 as highly appropriate for introducing the right direction for R&I policy, but they think a more concrete definition of priorities would be benefitial. Some priorities will disappear naturally, while others will be leading and new ones will emerge.

Further narrowing down the S3 priorities is found to be very challenging. Stakeholders argue that this will endanger the funding provided to important R&I areas, considering the very low level of national funding available to compensate the funding going to such areas. Another tension is related to R&I public funding, which is heavily concentrated in Vilnius and on R&I companies and research institutions.

Lithuania has recently revisited its S3 strategy simplifying the priority system and reconsidering some priorities.

In view of the forthcoming 2021-2027 funding period, it is timely to rethink the S3 strategy, and to take into account the challenges that have been identified. New S3 strategy proposals are therefore currently under discussion.

HEIs studies quality and focus on STEM attraction

The *socio-economic sciences and humanities* have not been very active in S3 so far, showing low capacity for interdisciplinarity. More effort should be made to open them up to collaborations with other scientific fields. In this sense, stakeholders agree that a challenge oriented S3 priority setting could help in this direction. Thinking in how global challenges can be addressed from local perspectives would be of high interest.

However, the growing demand by the productive sector of Lithuania of people with *skills on engineering/STEM fields* is an important challenge given the shrinking capacity of HEIs to attract students in such fields. There are ongoing discussions between business and HEIS to explore ways to balance the STEM and social sciences fields' respective attraction of students, with a broad agreement on the allocation of student places.

Providing direction for students from school is considered to be key to make STEM fields attractive for students and select them when they arrive to university. Additional incentives are needed with scholarships and good salaries to attract talented lecturers from abroad. Initiatives should be introduced from school, with technological schools taking some steps in this direction. Strong and sustained government support would be needed, with the promotion of adequate incentives and programmes to balance this situation.

The bureaucracy around big goals it is considered to be very heavy, making it difficult to concentrate on the achievement of objectives. Different policies could be promoted in order to attract students from abroad, especially in the allocation of funds to attract students from India and China.

Stakeholders consider that the government has strongly focused on the number of HE students per area to allocate their funding. The focus should shift to the quality of studies offered, with more science-based studies funded. The universities of applied sciences describe themselves as universities doing very successful research. However, until very recently they did not receive public funding for research and were only able to do it through private funds. The change of situation from 2019, which makes them eligible to access competitive public funding for research projects, opens a new perspective for this type of HEIs to contribute to excellent research.

Research capacities: university-business collaborations and research infrastructures

Both research institutions and companies strongly agree on the fact that collaboration among them is an important challenge. The research-based business number is low in Lithuania, and HEIs have to spend time for teaching, with no time to establish collaboration with business. In addition, business sees HEIs as a cheap source of R&I results, therefore as a way to buy labour force to solve their problems. Lithuania therefore needs to find ways for business to see HEIs differently.

Some sectors show more successful university-business collaborations, such as laser and biotech. In these areas, research institutes are integrated into research organisations, and RTOs could increase innovation potential and bring business and science closer.

In this regard, promoting technology and innovation institutes within HEIs can create the spaces to bring together HEIs and business and facilitate collaborations. The next programming period should introduce some changes in this direction, strengthening the investments in HEIs- business collaborations, coordinating with the existing research infrastructures capabilities.

Creating research-based companies takes time, and the S3 perspective is considered by stakeholders to be short-term. There are some promising ways that have been put in place to boost students' entrepreneurship skills. For example, students working in R&I projects or following mandatory courses in interdisciplinary teams to solve real societal problems, are trying to successfully link HEIs and business. Nowadays, almost all study programmes include a project development activity, with an in depth course on how to solve problems from business.

In the case of applied science HEIs, there is strong cooperation with business in different science fields, obtaining funds to engage researchers.

Lessons from EU experiences

1.   Ikerbasque: attraction of international talent

Ikerbasque is a public foundation created by the Basque Government to attract talent to the Basque Country. Its success is partly due to the regularity in the publication of calls for researchers. These ensure financial stability and continuity for researchers, creating very close bonds with research fellows and taking care of them in a very personalized way.

The way in which talent is attracted is open to any research field, not only the S3 priority areas, with a return on investment that has been calculated to be EURO 32 million from EURO 17 million invested by Ikerbasque with regional government

funds. Ikerbasque is having a role as well in creating new research centres of excellence in areas closely linked to S3 priorities.

The attraction of international talent is having an impact on the whole scientific system, with a return on investment of EURO 2 of R&I funding attracted per EURO 1 invested by the government.

The key lessons for success are:

- Leadership and determination

- Stability in time and providing confidence and trust to researchers

- Continuity and adequate budget

- Independence in the evaluation

2.   UIT Artic University of Norway: partnership with government and Artic universities to address shortage of skills

The S3 in Norway is a region-based processes. The regions have gone through an intense merger of HEIs and education programmes, with different results since 2015. Among the most important challenges identified by Lapland are the weak university-industry collaborations, with industrial policy measures not having very good results. The UIT has made an important effort in connecting university and business, with 500 graduate candidates for north Norwegian industry every year.

In addition, there are important concerns on the shortage of skilled persons in the region, and small steps have been taken in order to address this problem. The region has a well established regional innovation system, with a good capacity to organise education programmes in new ways, with decentralized campuses being offered across the region to be able to reach broader number of students. An important investment has been done in the promotion of on-line courses (MOOCs), offering teaching and supervision of students.

The UIT has collaborated closely with the Norwegian Research Council to propose new university laws that help strengthen HEIs engagement in regional development, particularly focusing on human capital:

- Guaranteeing access of citizens to all education programmes

- Guaranteeing broad quality of education

- Guaranteeing professional independence of universities in regional governance

There is a strong discussion about HEIs contributing regionally, particularly through their stronger involvement in the regional committees and the regional competence forums.

The **Artic Five initiative** has been created in collaboration with other Artic HEIs, helping handle skill shortages in northern universities, offering flexible shorter education programmes in proximity of communities, with collaborations in:

- Research infrastructures

- Common education programmes

- Covering specialisation needs in modules in education programmes

- Applying position as European Universities

3.   Estonia: innovative funding schemes to boost university-business collaborations

The Ministry of Education and Research of Estonia has developed innovative funding schemes to boost university-business collaborations and increase the attractiveness of the educational offer on ICT fields. As an example, a programme has been launched to contribute to the cooperation between enterprises and R&I institutions in the field of applied research and product development. StudyITin.ee has been set up as a cooperation between universities, ICT companies, and the state. The collaboration programme contributes to educate future university graduates, creating highly qualified and valued specialists on the Estonian ICT labour market.

A programme to increase the number of students and graduates in S3 priority areas has been developed, in order to give impetus to the growth of the country in the form of highly educated specialists.

The innovative policy mix created to boost the contribution of HEIs to Estonian S3 through education and research is very inspiring for some of the challenges identified in Lithuania S3 context.

Finally, Peter Baur from DG Education, Youth, Sport and Culture presented the HEInnovate guiding framework developed by the Commission in collaboration with the OECD. The guiding framework comprises a self-reflection tool to explore the innovation and entrepreneurial capabilities of higher education institutions and help in the identification, prioritisation and planning around eight key areas. A second component of the HEInnovate guiding framework are the HEInnovate country reviews which aim to support policy makers in developing the innovative and entrepreneurial potential of their higher education systems and to strengthen the contributions of higher education to the innovation ecosystem.

10. Conclusions and recommendations

1. Overall, the S3 has proved to be a step forward in coordinating R&I policies and allocating respective funding in Lithuania. It provides a significant improvement in comparison to the past experience, when each funding scheme had its "own" set of thematic priorities that were inconsistent, short lived, and collectively covered all fields of R&I. Yet, a number of tensions and challenges persist:

   - What is an 'optimal' number and scope of S3 priorities? This refers to a trade-off between concentration of R&I investments, on the one hand, and balanced development of broad fields of knowledge, on the other.
   - How to strengthen HEIs' 'ownership' of S3 priorities? The S3 priorities closely correlate with the HEIs' current strengths as well as education and research fields, which HEIs aim to further foster in the future. This is because S3 was aligned with HEIs strengths, but S3 in its own right has not had a significant impact on strategic decision making within HEIs.
   - How to ensure better coordination between the multiple instruments deployed for implementation of S3?
   - What modes of public intervention would support / incentivise HEIs to more actively contribute to developing skills for S3?

> **Recommendation 1:** as the new programming period approaches, the Government should initiate a broad discussion on the future of S3 in Lithuania. More specifically, it should lay out its proposals and alternatives for addressing the above challenges. These should be subject to broad public consultation with HEIs and other key stakeholders.

2. The contribution of HEIs from their education mission does not need solely to be reflected in the alignment of their educational offer with the selected S3 priorities. Introducing entrepreneurship, innovation management or interdisciplinary research skills within the existing range of courses can make a differential contribution to S3 implementation. The current discussions to reinforce the quality of HEIs education offer could be an appropriate time to introduce considerations regarding transversal and soft skills inclusion in education.

3. The developments of the new S3 for the next programming period provides an ideal framework for a stronger alliance between public administrations and higher education institutions to respond to the needs of Lithuanian innovation ecosystem. The use of the HEInnovate guiding framework developed by the European Commission DG Education, Youth, Sport and Culture in collaboration with the OECD, which provides as well the opportunity to conduct a country review, can help structure a dialogue and identify actions for change on organisational capacity, entrepreneurial learning or knowledge collaborations, in which the case study has pointed out to barriers that need to be overcome.

4. A declining student population and talent drain from the country are two important trends that can have a strong impact on S3 implementation and R&I system progress. These trends should be clearly considered in the design of the current and future policy initiatives for R&I promotion and higher education system quality. Offering longer-term education and career paths to students and researchers could have a positive impact in retaining talent. The career plans could include a number of compulsory ECTS credits to be developed in companies to encourage the knowledge of the local fabric options, encouraging early career developments within local institutions and companies.

5. The capacity of Government strategies (including S3) to steer and coordinate long term investments and priorities of HEIs is limited. Frequent and unfinished HE reforms have eroded the trust between HEIs and the Government.

> **Recommendation 2:** There is a need of a renewed long term 'contract' between the Government and HEIs regarding the future HE education, research priorities and resources. The capacities and partnerships built within HESS case study can be taken as a "low hanging fruit" to continue collaborations between public authorities involved in S3 implementation and HEIs in the context of S3 and reinforcing long-term agreements.

6. The balance between the mission of HEIs is strongly oriented towards (undergraduate) education. This is due to the structure of public funding, which historically favoured massification of HE at the expense of research and third mission activities. As the number of students decline due to demographics, Lithuania faces an opportunity to rebalance all three HEI missions.

Recommendation 3: as the number of students decline, the Government should reallocate resources from higher education towards research, which has been historically underfunded. Attempts to counter the demographic trends by lowering requirements for entry and further expansion of the number of publically funded study places would be a step in the wrong direction.

7. One of the core challenges in developing skills for S3 relate to the declining HEIs capacities to provide ICT and engineering education. Since the number of entrants to engineering studies has dramatically dropped, HEIs are closing respective programmes and academic staff either engages in research and third mission activities or leave HEIs altogether. The ICT programmes are popular among entrants. However, high labour market demand means that a significant share of students start working in HEIs and subsequently drop-out, while HEIs face shortages of academic staff due to significantly larger wages outside academia.

Recommendation 4: the Government in coordination with key stakeholders should develop and implement a comprehensive strategy for STEM education covering all stages of education.

8. There is a growing number of knowledge intensive start-ups and the scale of research – business collaborations has increased. However, the scope of such activities remains limited by international standards. One of the bottlenecks refers to underdeveloped structural capacities of HEIs to support technology transfer, manage intellectual assets, and promote entrepreneurial culture.

Recommendation 5: the Government should invest in building HEIs capacities to systematically engage in knowledge transfer activities. The HEIs should ensure that in the medium-long term such activities are financially self-sustainable, i.e. generate sufficient revenue to cover operating costs and further investments.

9. Attracting and retaining talented academic staff remains challenging for Lithuanian HEIs. The wage levels are not competitive when compared to other high skilled professionals in Lithuania. Furthermore, remuneration and careers in Lithuanian HEIs are not attractive, when compared to those in the EU-15. Recent efforts in attracting researchers from abroad are likely to be nullified by policy reversals leading to significant wage cuts for the attracted researchers.

Recommendation 6: To maintain its competitive position Lithuania should ensure that the level of wages for academic staff is close to the EU average and careers in research are attractive to top talents. To improve its competitive position Lithuania should provide long term investment in attracting top talents from abroad. This is a joint responsibility of the Government and the HEIs.

10. National funding schemes promoting larger and more strategic partnerships could be reinforced as a step forward to enhanced positioning in European initiatives and platforms. The selection criteria of ESIF funded projects could require the explanation of the relevance for the EU level, contacts and collaborations with potential EU initiatives and partners in the field. The Seal of Excellence could be used as a downstream initiative, but upstream initiatives would have additional gains considering the low participation in EU programmes possibly due to the lack of experience and of international networks. This could also counterbalance the discouraging effect that easier national funding accessibility has over the participation in national programmes.

11. Working hand in hand on capacity building and talent generation and attraction to research infrastructures. Current ERDF funding devoted to generating research infrastructures can have a tremendous impact in boosting R&I capacities in Lithuania if it is well combined with measures for the use of these infrastructures in joint research-business projects. Research infrastructures funding could assess the attraction and retention of talent an integral part of their long-term sustainability plans.

References

European Commission/EACEA/Eurydice (2015). The European higher education area in 2015: Bologna process implementation report.

European Comission (2017). Survey on researchers in European Higher Education institutions. Brussels, 2017. Publications Office of the European Union, 2017. ISBN 978-92-79-81481-5 doi:10.2777/086377 KI-02-18-359-EN-N. http://ec.europa.eu/research/era/pdf/survey_on_researchers_in_european_higher_education_institutions.pdf [retrieved 2019-04-03].

European Commission (2018). Education and Training Monitor 2018: Lithuania

European Commission (2019). European Innovation Scoreboard 2019. Luxembourg. Publications office of the European Union, 2019

LR Ekonomikos ir inovacijų ministerija, LR Švietimo mokslo ir sporto ministerija (2019). Rezoliucija Dėl sumanios specializacijos koordinavimo darbo grupės siūlymo, Dėl sumanios specializacijos programos atnaujinimo. 2019 m. vasario 19, Nr. 252-22, Vilnius

LR Seimas (2009). Aukštojo mokslo ir studijų įstatymas, Vilnius, 2009.

LR Švietimo ir mokslo ministerija, LR Ūkio ministerija (2014) Įsakymas Dėl Mokslinių tyrimų ir eksperimentinės (socialinės, kultūrinės) plėtros ir inovacijų raidos prioritetų įgyvendinimo koordinavimo grupės sudarymo ir jos darbo reglamento patvirtinimo. 2014 m. birželio 20 d. Nr. V-576/4-409, galiojanti suvestinė redakcija nuo 2018-02-09, Vilnius

LR Vyriausybė (2014a). Lietuvos Respublikos Vyriausybės nutarimas Dėl Prioritetinių mokslinių tyrimų ir eksperimentinės (socialinės, kultūrinės) plėtros ir inovacijų raidos (sumanios specializacijos) krypčių ir jų prioritetų įgyvendinimo programos patvirtinimo. 2014 m. balandžio 30, Nr. 411, Vilnius

LR Vyriausybė (2014b). LR Vyriausybės nutarimas Dėl Lietuvos Respublikos Vyriausybės komisijos – Mokslinių tyrimų, eksperimentinės plėtros ir inovacijų strateginės tarybos sudarymo, 2014 m. rugsėjo 10 d. Nr. 944, Vilnius

OECD (2016). Skills Matter: Further results from the Survey of Adult Skills (Lithuania), 2016. <https://www.oecd.org/skills/piaac/Skills-Matter-Lithuania.pdf> [retrieved 2019-04-03].

OECD (2017). Education in Lithuania, Reviews of National Policies for Education, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264281486-en

Paliokaitė A.; Petraitė M. and Gonzalez Verdesoto E. (2018). RIO Country Report 2017: Lithuania, EUR 29159 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81214-9, doi:10.2760/11127, JRC111273

Republic of Lithuania Decree of 2019, July 24, No 760 on Amendment of Smart Specialisation domains and priorities implementation programme. Vilnius https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/c0ba9ee0b2a311e982dae1db4290b1a9?jfwid=-td2hf49z7

STRATA (2017a). Užsienio studentai Lietuvoje: ar gebame priotraukti mokytis, o įgijus išslavinimą išlaikyti Lietuvoje?, 2017, Vilnius

STRATA (2017b). Kaip paskatinti mokslo-verslo bendradarbiavimą. Vilnius, 2017. <https://mosta.lt/images/documents/atasakaitos/trumprastis-kaip-paskatinti-mvb.PDF> [retrieved 2019-04-03].

STRATA (2018a). Sumanios specializacijos pazangos vertinimas, Vilnius, 2018, https://strata.gov.lt/images/tyrimai/sumanios-specializacijos-pazangos-vertinimas.pdf

STRATA (2018b). Būklė 2018: Mokslo, studijų ir inovacijų būklės vertinimas. Vilnius, 2018. https://strata.gov.lt/images/tyrimai/20190415-mokslo-daktaru-uzimtumas-ir-pajamos.pdf [retrieved 2019-04-03].

STRATA (2018c) "Sumanios specializacijos įgyvendinimo stebėsena. Antroji ataskaita", Vilnius, 2018

STRATA (2018d). Lietuvos moklos, studijų ir inovacijų būklės apžvalga", 2018, Vilnius. p. 80

STRATA (2019). Mokslo daktarų karjera Lietuvoje: užimtumas, pajamos ir veiklos sektorius, Vilnius, 2019. https://strata.gov.lt/images/tyrimai/20190415-mokslo-daktaru-uzimtumas-ir-pajamos.pdf [retrieved 2019-04-03]

Strategy, L. P. (2012). Lithuania 2030. Lithuania: National legal Document.

Valstybės Kontrolė (2017). Valstybinio audito ataskaita. Valstybės investicijos į mokslinius tyrimus ir eksperimentinę plėtrą, siekiant inovacijų augimo, Vilnius, 2017 m. balandžio 10 d. Nr. Nr. VA-P-50-1-7.

Visionary Analytics (2019). 2014–2020 M. EUROPOS SĄJUNGOS FONDŲINVESTICIJŲ VEIKSMŲ PROGRAMOS 1PRIORITETO „MOKSLINIŲ TYRIMŲ, EKSPERIMENTINĖS PLĖTROS IR INOVACIJŲ SKATINIMAS" POVEIKIO VERTINIMO PASLAUGOS. <http://www.visionary.lt/reports-2/science-technology-innovation/evaluation-of-measures-fostering-business-rd-under-the-2014-2020-operational-programme>

Annex 1. List of informants and participants

List of participants of exploratory meeting (24 October 2019)

Participant	Institution
Tadas Juknevičius, Policy analyst	STRATA
Ieva Penelytė, Policy analyst	STRATA
Eugenijus Butkus, Adviser to the Minister	Ministry of Education and Science
Albertas Žalys, Head of Higher Education and Research Department	Ministry of Education and Science
Stanislovas Žurauskas, Deputy head of Research Division	Ministry of Education and Science
Vida Lapinskaitė, Head of Innovation and Research Department	Vilnius University
Leonas Balaševičius, Vice-Rector for Research	Kaunas University of Technology
Laima Taparauskienė, Vice-Rector for Studies	Aleksandras Stulginskis University/Vytautas Magnus University
Karolis Stašys, Project Manager	Center for Physical Sciences and Technology
Giedrė Adomavičienė, Director	Kaunas University of Applied Engineering Sciences
Eskarne Arregui	European Commission, Joint Research Centre
Lina Stanionyte	European Commission, Joint Research Centre

List of interviewees

No.	Interviewee	Position
		Leadership of HEIs
1.	Valdas Jaskūnas	Pro-rector, Vilnius University
2.	Jonas Čeponis	Pro-rector, Kaunas University of Technology
3.	Nerijus Varnas	Director, Kaunas University of Applied Engineering Sciences President of Rectors' Conference of Lithuanian University Colleges
4-5	Rita Liepuonienė Nijolė Zinkevičienė	Vice-Rector for Studies, Vilnius University of Applied Sciences Vice-Rector for Research and Partnerships, Vilnius University of Applied Sciences
		Researchers implementing research projects within the priorities of S3
6.	Vytautas Martinaitis	Professor, Vilnius Gediminas Technical University
7.	Birutė Mikulskienė	Professor, Mykolas Romeris University
8.	Arūnas Andziulis	Professor, Klaipėda University
		Researchers attracted to HEIs from abroad
9.	Rimantas Kodžius	Distinguished Professor, Kaunas University of Technology
10.	Aurelijus Burokas	Researcher, Life Science Centre, Vilnius University
11	Jari Roy Lee Kaivo-oja	Professor, Kazimiero Simonavičiaus University
		Representatives of intermediaries
12.	Arminas Varanauskas	Director, Knowledge economy forum
13.	Laima Kaušpadienė	Director, Sunrise Valley Technology Park

14.	Vilma Purienė	Director, Knowledge and technology transfer center, Vilnius Gediminas Technical University
		Government representatives
15	Ramojus Reimeris	Head, Innovation Policy Analysis Unit, Government Strategic Analysis Center

List of workshop participants (27 September, 2019)

Institution	Representative
Employment Service	J. Žemblytė
European Commission, Joint Research Centre	E. Arregui Pabollet
European Commission, Joint Research Centre	L. Stanionytė
Ministry of Education, Science and Sport	E. Remeišienė
Ministry of Finance	S. Miškinis
Ministry of Finance	I. Patapienė
MITA	E. Tauraitė
Research Council of Lithuania	S. Juciūtė
STRATA	G. Jakštas
STRATA	R. Juozapaitienė
STRATA	G. Lapinksas
STRATA	R. Reimeris
STRATA	R. Žemaitytė
STRATA	K. Masevičiūtė
STRATA	A. Malysis
STRATA	E. Mykolaitienė
Vilnius University	V. Jakutienė
Visionary Analytics	Ž. Martinaitis

List of final event participants (19th February 2020)

Institution	Representative
Ministry of Education, Science and Sports	J. Abdulskyté Jūraté
Vilnius College of Technology and Design	A.Aleknaviciene
Klaipédos University	A.Andziulis
European Comission, JRC	E. Arregui Pabollet
Alitaus College	J. Balčiuniené
European Comission, DG Education, Youth, Sport and Culture	P. Baur
Office of the Government of the Republic of Lithuania	J. Bočiaroviené
European Comission, JRC	J. Edwards
Artic University of Norway	S. Eikeland
Sunrise Valley Science and Technology Park	B. Laurynas
Kaunas University of Technology	Č. Jonas
Ministry of Education, Science and Sports	D. Denisoviené
Ministry of Education, Science and Sports	Z. Duchovskiene
Ministry of Education, Science and Sports	A.Gaidamavičiené
STRATA	J. Gintautas
Vilnius College	J. Žymanté Jankauskiené
Vilnius University	V. Jaskūnas
STRATA	R. Juozapaitiené
Ministry of Economy and Innovation	L. Kadys

STRATA	V. Klincevičius
Vilnius College	E. Kubilienė
Lithuanian University of Health Sciences	L. Kupčinskas
Vilnius University	V. Lapinskaité
Kaunas College	V. Macūnas
STRATA	A.Malysis
Visionary Analytics	Ž. Martinaitis
Vilnius Gediminas Technical University	V. Martinaitis
British Embassy Vilnius	M. Masaytite
Alytaus College	J. Merkevičiené
Marijampolés College	K. Miškiniené
Ministry of Finance	S. Miškinis
Ministry of Education, Science and Sports	V. Popoviené
Ministry of Education and Research of Estonia	K. Raudmäe
STRATA	R. Reimeris
MITA	R. Rubčinskaité
Klaipéda University	L. Saltyte-Vaisiauske
Klaipéda University	A.Senulis
European Commission, JRC	L. Stanionyte
Research Council of Lithuania	E. Stumbrys
Ministry of Economy and Innovation	T. Tuménas

Ministry of Education, Science and Sports	J. Vasiliauskas
Ministry of Education, Science and Sports	D. Vipartiene
Lithuanian University of Health Sciences	L. Yarukas
Ministry of Education, Science and Sports	A.Zalys
STRATA	R. Žemaityté

Annex 2. Interview questions

Common questions to all interviewees:

- How have HEIs been involved so far in S3 design and implementation (EDP, governance, monitoring, etc)? Have their research, education and innovation capacities been considered in priority setting, or in other ways (monitoring, evaluation, etc)?
- Which university staff has been involved in S3 governance and EDP – Deans, Vice-Rectors, researchers, managerial staff, other?
- How has the skills and human capital element considered so far in S3 implementation?
- How is the S3 policy mix considering the unique HEIs capacities in Lithuania? Which instruments not currently in place would be needed to strengthen HEIs engagement in S3?
- How are HEIs collaborating with other players of the R&I ecosystem? Which are the difficulties/barriers?
- How do research capacities of HEIs connect to the needs of the territory? Which trade-offs are faced in this regard?

Policy makers:

Key questions:

- Overall, to what extent is the implementation of S3 a success?
- What key changes to S3 Lithuania intends to adopt in 2021 – 2027?
- What measures dedicated for University and HEI involvement, linking science, education and development of skills with smart specialisation can be mentioned/ what worked well, what were the bottlenecks?
- How would you rate the involvement of Higher Education Institutions in S3? While Universities contribute to the implementation of S3 through research activities, how to develop skills in S3 through education and training?
- Were there any financial measures targeted at strengthening strategic governance of HEIs?
- To what extent would a better alignment between HEIs education offer and S3 priorities allow for concentration of resources?
- As the student population declines, does the Government plan allocate more funding for research so as to facilitate the transformation towards research-based universities?

Researchers implementing research projects within the priorities of S3

Key questions:

- Based on your experience, what is the value added of allocating competitive research funding according to pre-defined S3 priorities? Would your project be different, if there were no S3 priorities?
- To what extent has your institution generated a pipeline of research activities within the respective S3 priority or is your project one-of-a-kind? To what extent does your institution encourage PhDs to do research aligned with S3?
- Would you say that study programmes have been aligned with S3 priorities? Would you see any benefits / drawbacks in doing so?
- Most Universities and researchers in Lithuania predominantly focus on education at the expense of research. To what extent is this true in your research unit / faculty? As the number of students has overall declined in Lithuania, has your research unit / faculty rebalanced the resources from education towards research? Why?
- What policies / funding instruments would encourage Universities to achieve a better balance between education and research missions?
- Which are your incentives to work with business and other R&I actors in Lithuania?
- Are there specific programmes lacking to encourage such collaborations that you would welcome?

Higher Education managers

Key questions:

- To what extent are S3 priorities relevant in your institution, when designing long term strategy or reviewing the study programmes?
- Have you internally discussed ways/ means, how your institution could contribute to the implementation of S3 through its human capital mission?
- How does your institution aim to address the challenge of declining student numbers?
- Has the S3 been integrated in the university governance or long-term strategy? In which way?
- How does your institution engage in innovation activities with business and other R&I system actors? Which are the incentives for researchers? And for other HEIs staff?
- Are there collaboration and monitoring means to identify the needs of business sector in terms of demanded skills? Are there specific collaboration programmes with business, ie. Joint curricula definition, Industrial PhDs, business chairs, etc? Major benefits and challenges in implementing such programmes?
- Are there measures/initiatives/programmes put in place by your institution to attract international researchers (new researchers or attracting back Lithuanian researchers)?
- Are there measures to increase access to EU networks or R&I projects taken by your institution? Which are the challenges/difficulties to access EU/international networks?

Lithuanian researchers attracted back

Key questions:

- Overall, what are the key pull-and-push factors behind the attractiveness of HEI in the eyes of researchers?
- How has collaboration between the researcher and host university started? What were the key conditions for attracting researcher to Lithuanian HEI?
- To what extent is the implementation of the project running smoothly?
- What are the likely long-term effects of the project?
- Has attracting back of researchers helped to increase international collaborations/positioning of the university? Has the collaboration with previous research institution continued after moving back to Lithuania?

Business organisations

Key questions:

- How your organisation been involved in S3 design and implementation? Are S3 priorities relevant to business?
- To what extent S3 priorities are important when developing strategic projects in your organisation?
- Which are your incentives to cooperate with HEIs in Lithuania? Do you look for their research and innovation expertise or other?
- Which successful research and business cooperation instruments and projects can be mentioned?
- Which difficulties/challenges do you find in collaborating with HEIs in collaboration projects?
- Do companies have sufficient knowledge about S3 priorities, do they have enough skills to get involved into joint projects?
- What skills are most lacking implementing S3 projects?

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