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Specific Support

Development of the Human Capital for Research and Innovation in Latvia

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Research and Innovation

Specific Support – Development of the Human Capital for Research and Innovation in Latvia

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EUROPEAN COMMISSION

Specific Support

Development of the Human Capital for Research and Innovation in Latvia

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2020 Directorate-General for Research and Innovation EN

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LIST OF ACRONYMS

ASR – administration of study and research

ALTUM – JSC Development Finance Institution Altum

BERD – business expenditure on research and development

CL – commercial law

CSCC – Cross-Sectoral Coordination Centre

DG RTD – Directorate-General for Research and Innovation

EC – European Commission

EU – European Union

ESIF – European Structural and Investment Funds

FDI – foreign direct investment

FTE – full-time equivalent

GDP – gross domestic product

GERD – gross expenditure on research and development

HE – higher education

HEI – higher education institution

ICT – information and communication technologies

ISSP – Institute of Solid State Physics

LIAA – Investment and Development Agency of Latvia

LIOS – Latvian Institute of Organic Synthesis

LMT – Latvian Mobile Telephone

UL – University of Latvia

MoE – Ministry of Economy

MoES – Ministry of Education and Science

NGO – non-governmental organisation

OECD – Organisation for Economic Cooperation and Development

PhD – Doctor of Philosophy

PSF – Policy Support Facility

R&D – research and development

R&I – research and innovation

RDI – research, development, innovation

RAE – research assessment exercise

RSU – Riga Stradins University

RTU – Riga Technical University

S&T – science and technology

SOE – state-owned enterprises

SME – small and medium enterprise

STEM – science, technology, engineering, and mathematics

TTO – technology transfer office

UL – University of Latvia

VC – venture capital

THE PSF SPECIFIC SUPPORT PANEL

Mariam Camarero is the Chair of the Panel. She is a full professor of Economics at the University Jaume I (Castellón, Spain) and holds an Ad Personam Jean Monnet Chair in European Economic Integration. An expert in time series econometrics and international economics, she is currently the academic director of INTECO, a joint research unit of the University of Valencia and Jaume I on Economic Integration. She has published more than 60 papers in peer-reviewed academic journals on topics related to international finance and open macroeconomics. In particular, exchange rate determination, economic convergence, external and fiscal sustainability and applied econometrics. She has led or participated in multiple research projects awarded in competitive calls. She holds a Master's degree from the College of Europe and a PhD from the University of Valencia.

A visiting scholar at the University of Nottingham, the Wharton School, the University of Göttingen and the Complutense College at Harvard, she has been an evaluator for scientific journals as well as for research agencies, both national and international, including the European Commission. Concerning public positions, she has been the regional Vice-Minister of University and Science in the Valencian Community and Secretary General for Universities in the Spanish Central Government. In these positions she has been responsible for the design and management of research policies and has participated in the proposal for the reform of the universities funding system in the Valencian Region.

Zsuzsa Jávorka is a principal consultant with Technopolis with 15 years' experience in the domains of research, innovation, science policy and education. Zsuzsa is an economist by training and also has a background in law. She is an experienced project manager. Her work predominantly focuses on the interactions of education, research and the business world, addressing topics on skills development and training, entrepreneurship, university-business collaboration and internationalisation of higher education both in Europe and in low- and middle-income countries. Zsuzsa manages HEInnovate, an online self-assessment tool that aims to foster the entrepreneurial and innovative nature of higher education institutions. It has been developed as a joint initiative between the European Commission and the OECD. She also managed a project that was aimed at developing an HEI assessment tool on ECHE compliance and internationalisation strategy for DG EAC. Zsuzsa contributed to a large number of studies focusing on higher education and research, including the status of University-Business Cooperation in Europe; and European Industrial Doctorates – towards increased employability and innovation.

Zsuzsa joined Technopolis in March 2008 from the Hungarian National Office for Research and Technology, where she worked as a programme manager. She was responsible for developing strategies and overseeing the implementation of major programmes supporting collaborative university-business research activities (Regional University Knowledge Centres) as well as a mobility programme dedicated to young researchers to facilitate their repatriation.

Anne-Mari Järvelin (PhD) has over 25 years of experience in regional innovation systems, cooperation between universities and companies, design and evaluation of innovation programmes, development of innovation strategies, service innovations, and innovation ecosystems and platforms. During her career Anne-Mari has worked in several teaching, research and leadership positions in the university sector. She has accumulated experience in research-, development- and innovation-related tasks at universities, companies, research and innovation financers and ministries. She is currently a senior consultant at the Finnish company 4Front.

Anne-Mari has gained practical experience in the area of human capital development in R&I and increasing international researcher mobility while working as Partnership Director at Tampere University of Technology during 2013-2017. She was responsible for developing international relationships in order to increase researcher mobility and enhance interaction and cooperation between researchers in various countries. During that time, she was also involved in building concepts that would increase the likelihood of international students and researchers staying in Finland after completing their studies or research projects.

Dr Žilvinas Martinaitis is an associated professor at Vilnius University and research manager at Visionary Analytics (Lithuania), a private research institute specialising in education and innovation policies. He has 15 years of experience in carrying out research and evaluation projects that focus on higher education, research and innovation, labour market and social policies. In Vilnius University he teaches research design and education, and research policy analysis. Žilvinas has published on management of intellectual capital in universities, migration and mobility of highly skilled workers, and smart specialisation. He holds a MSc from London School of Economics and a PhD from Vilnius University.

Žilvinas has led or contributed to a number of projects focused on strengthening human capital in R&I. In 2018, he was a team leader in a project that aimed to identify and assess innovative practices for continuous professional development in higher education (client: Joint Research Centre). From 2017-2018, he led a study to support the impact assessment on the Strategic Innovation Agenda of the European Institute of Innovation and Technology (client: DG EAC). The study focused on ways to reinforce integration between higher education, research and business. Žilvinas has led a group of researchers carrying out a study on research cooperation in the Baltic Sea Region: existing networks, obstacles and ways forward (client: Ministry of Education and Science of Latvia, 2017). The study focused on the scale of international collaborations between researchers from Estonia, Latvia, Lithuania and Poland. It also highlighted key obstacles that impede more effective integration in international networks and participation in the EU Framework Programmes. Žilvinas was key expert in a project on Intellectual Capital Reporting and Management for Universities (client: UEFISCDI, Romania). Intellectual capital of universities includes human, structural and relational capital. The project resulted in guidelines for the management of intellectual capital in universities as well as three academic publications. Furthermore, Žilvinas has contributed to or led a number of evaluations of R&I as well as human capital development in Lithuania.

THE POLICY SUPPORT FACILITY SUPPORT TEAM

The project was overseen by the PSF Team in the EC's Directorate-General for Research and Innovation. Karina Firkaviciute coordinated the exercise and ensured liaison with the Latvian authorities. The PSF contractor supported the EC's PSF Team in this activity. This involved work by Asel Doranova, project manager at Technopolis Group, Erik Arnold, who acted as the quality reviewer. Anet Vingre prepared a background report about research and innovation in Latvia

THE LATVIAN AUTHORITIES

The Latvian authorities provided data and background documentation useful for the group's work and supported the visits to Latvia by inviting the representatives of research institutions and other relevant stakeholders to meet the group. The Ministry of Education and Research coordinated the Latvian authorities, ensuring the involvement of other relevant agencies and bodies and kindly made available facilities for meetings and workshops.

POLICY MESSAGES AND SUMMARY

This assignment was carried out under the Horizon 2020 Policy Support Facility (PSF) based on a request from the Latvian authorities. Its aim was to provide external advice in the form of operational guidelines and implementable recommendations to the Latvian authorities. This was the second PSF exercise for Latvia and focused on two topics that address the challenges of human capital development for research and innovation in the country:

- Policies for attracting and retaining people in scientific and technological careers in Latvia, and developing their skills and productivity

- Policies for developing the employment of science and technology (S&T) human resources in the Latvian business sector.

The methodology of the exercise followed guidelines set by the European Commission and centred around the work of a four-person expert panel, which combined document reviews and a significant number of stakeholder interviews. The latter were carried out during panel visits to Latvia.

The main report provides an overview of the research and innovation (R&I) system in Latvia and introduces the policy mix for the 2014-2020 period that are of relevance to the current study, before presenting the main findings along the two study questions and the respective recommendations from the panel. This summary focuses on the key findings and presents an action plan that summarises the more detailed recommendations that were put forward.

KEY FINDINGS AND RECOMMENDATIONS

The key challenges facing the Latvian higher education (HE) and R&I systems include attracting and retaining young PhD graduates, closer collaboration between the academic, research and business sectors as well as building innovation capacity in the private sector. While the overall policy mix tackles some of these challenges, most of the interventions rely on European Structural and Investment Funds (ESIF) and provide only a short-term financial boost – the long-term sustainability of the policy instruments is not ensured. This is reflected in the key challenges that were identified regarding retaining R&D personnel:

- There are low levels of predictable base funding for the research institutions which is coupled with uneven rates of disbursement of ESIF, which supports most of the R&I grants. The extreme fluctuations render long-term commitments and career planning impossible, and they prevent tenure track systems, which require long-term financial commitment, from being adopted

- There is a risk to the retention of R&D personnel attracted through targeted investments if other elements of the HE and R&I system remain underfunded and the sustainability of the impacts are in question. This was demonstrated, for example, by the sudden drop in PhD student numbers when funding was discontinued

- The pace of job creation for researchers in the private sector remains very limited, despite available incentives.

The structure of academic careers in Latvia differs from standard 'career ladders' that are used in many countries. There is no single academic career path as the national legislation distinguishes between academic and research positions. None of the positions is subject to open-ended contract, the election system is insufficiently transparent and lacks the benefits of open competition, since usually only one candidate applies for a position. The research and academic positions do not automatically correspond to a predefined set of tasks. Further, associated wages and the matching between the different career systems is not entirely straightforward. On the plus side, the system provides flexibility and enables fast-track careers.

Against this backdrop, the Government aims to increase the number of full-time equivalent (FTE) researchers from 6,000 to 8,000 by 2027, which is very ambitious, given that the number of PhD students and graduates has been significantly declining over the past years due to the fact that doctoral studies are not attractive for prospective entrants. There are low levels of PhD stipends and uncertainty regarding income stability during the doctoral period, which requires students to take up full-time positions outside academia. The low number of PhD graduates is particularly prevalent for the science, technology, engineering, and mathematics (STEM) fields. The institutional set-up of the PhD study provisions – there are 21 HEIs entitled to award PhD degrees, which is a large number of institutions for slightly more than two thousand students – combined with the lack of postdoc positions up until recently, created further obstacles in the system.

Looking into the avenue of attracting talent from abroad, the study unsurprisingly found that Latvia's potential to attract foreign researchers depends on the overall attractiveness of its HE and research system and the alleviation of specific barriers (e.g. Latvian language requirements) faced by foreign academics. The level of attractiveness is closely linked to the overall framework conditions for research careers in Latvia, which include uncompetitive wage levels, inadequate balance in job and income security, transparency in appointment and promotion systems. Further, Latvia needs to stand out in the global competition for bright students, since talent attracts talent.

The Latvian service sector, where most companies operate in less knowledge-intensive sectors, accounted for over 70% of the country's economy in 2018. In addition, the industrial sector is mainly characterised by low-tech firms and the share of RDI-related FDI is low. A large proportion of GDP (about 30%) is produced in state-owned enterprises (SOE) in Latvia, but the RDI efforts of these companies are only moderate compared with the potential they possess. Overall, the innovation capacity and absorptive capacity of S&T human resources in the Latvian business sector is rather limited.

There have been, however, signs of progress over the past years that provide the basis for further development. There is a successful biomedical and pharma industry and a relevant biomedical research base on which to build. In addition, there is a growing number of firms improving their added value through investment in the wood and ICT sectors, and the latter also sees a start-up scene emerging in Riga. There is an increasing number of start-ups and many key building blocks of a start-up ecosystem in place, but some elements, such as the loan markets, are still missing. There are favourable framework conditions in place for 'ease of starting a business' and for 'ease of getting credit' in the country and at the seed and early stage, Latvian start-ups have access to funding from venture capital funds. However, at the growing stages, access to funding is less prevalent. The emergence of new ideas and ventures is hindered by a lack of entrepreneurial skills, competences, culture and mindset in higher education. Currently, there is not enough investment in the development of students' and staff members' entrepreneurial skills.

Another impeding barrier is the low-level collaboration between academia and business. The share of enterprises[1] cooperating with research institutions is considerably lower than the EU28 average. In addition, business funding of public R&D in Latvia is at the lower-middle range among the EU countries. Competence Centres and Clusters have, at least in some sectors, succeeded in enhancing collaboration between scientific organisations and companies.

The overall impression is that all different types of academia-business collaboration activities are present, but reseach institutions often seem to lack systematic processes and strategies ensuring that these activities can deliver the maximum benefits. There are many examples of good practices around individual areas of academia-business collaboration, but a strategic and integrated system-level approach still seems to be missing. To capitalise on these strengths, there

[1] as percentage of product and/or process innovating companies

is a need for wider recognition that more innovative activities, companies and human resources are critical.

To achieve the ambitious objectives of increasing researcher numbers and enhancing the employment of S&T human resources in the Latvian business sector, the panel put forward a set of recommendations that are strategic by nature but at the same time they are practical to help the implementation in the coming years. This list provides a summary of the recommendations which are set out in more detail in the main body of the report.

Strategic recommendation: Improve the attractiveness of research careers

1. Providing competitive and stable wages from a single employment contract is a basic precondition for a career system; such contracts should establish the workload and other requirements as well as salary and most of the academic staff and researchers should work on a full-time basis in a single institution

2. This can be achieved by increasing funding of Higher Education and research, as well as addressing existing bottlenecks, tackling the fragmented study programmes and institutional landscape, reviewing the legislation establishing different academic and research positions with the view of ensuring coherence between teaching and research tracks, and dealing with disincentives in the funding system

3. There is a need to establish predictable and transparent career progression pathways that include tenure track positions as well. The Latvian Council of Science should set clear minimum requirements for entry and progression along the tenure track system in consultation with the academic community. Similarly, technical staff positions should have a clear and predictable path. To achieve this, the income streams of scientific institutes need to be more predictable to accommodate the financial commitments linked with tenure track positions.

Strategic recommendation: Improve the graduation rates and quality of PhD studies

1. Due to the low graduation rates, boosting only the numbers of PhD students would not deliver the needed results. Hence, efforts should focus on increasing graduation rates. This requires improvements in the quality of PhD studies and provision of adequate incomes for PhD students. Therefore, monthly stipends should be increased from €113 to the level slightly above average monthly wage (approx. €1,000) per month per full-time student, with a set of requirements attached such as that PhD studies are not compatible with full-time work outside the HEI (with the exception of industrial PhD programmes) and the recipients of stipends should be committed to contributing to the activities of their respective HEI

2. There is a need for coordinated efforts to address the shortages of STEM fields with a broad range of activities targeting secondary education as well as higher education and research

3. A recent World Bank study[2] provided a number of specific recommendations on improving the quality of PhD studies. This study concurs with many of their recommendations, but also proposes to:

- Clarify the concept of doctoral schools, as their mode of operation, functions, scale and disciplinary scope appears to be rather different from the schools operating in other EU countries; in addition, set excellence in research and critical mass as preconditions for offering PhD studies

- Ensure that public funding for tuition costs of PhD studies is secured for this specific purpose and incorporate the costs to cover international mobility and review the funding per student per field of education.

Strategic recommendation: Foster internationalisation (including support for the mobility of researchers working in Latvia as well as attraction of talent from abroad)

1. Support researcher mobility to leading international scientific institutes both for established research and as part of PhD studies. These measures will help to strengthen competence and develop international networks, as well as increase the global visibility of the Latvian higher education and research system

2. Make targeted efforts to attract talent from abroad. This is a challenging task, and can be addressed by pursuing two paths:

- Growing the existing 'islands of excellence' by targeting young researchers who have finalised their postdocs at established institutions and aim to set up their own research teams as well as enter tenure track

- Creating new 'islands of excellence' by identifying a limited number of areas and targeting established researchers in areas where there is potential to create internationally competitive pools of excellence.

Strategic recommendation: Create favourable conditions that foster building and developing entrepreneurial and innovative ecosystems

1. Build innovation ecosystems around key smart specialisation areas by engaging all key stakeholders in the development and creation of a shared vision. Changing the role of Clusters/Competence Centres towards ecosystem facilitation would be an important step in securing the development of ecosystems in the long run

[2] World Bank, 2018

2. Engage local and regional governments as financers and enablers of ecosystem development and foster joint innovation projects between academia and business

3. To build constantly evolving ecosystems that support the emergence of and nurture new potential ideas and entrepreneurs, strengthen the entrepreneurial culture of higher education institutions and scientific institutes and invest in the development of students' and staff members' entrepreneurial skills.

Strategic recommendation: Reinforce the role of existing stakeholders and attract new ones to increase the country's absorption capacity of S&T human resources

1. Develop a long-term approach to public funding for start-ups and for start-up support mechanisms, such as incubators and accelerators with the sustainability of the initiatives considered

2. Launch specific projects and calls to support SME modernisation, such as digitalisation programmes

3. Secure the availability of early-stage and later-stage venture capital funding, by increasing the amount of public co-financing to local seed and early-stage funds and by co-investing in international funds; by direct investments to start-up companies; or by supporting the integration of Latvian start-up companies into existing start-up hubs

4. Strengthen the role of SOEs as RDI performers by eliminating the current obstacles in governance

5. Attract foreign RDI-related FDI by identifying the top fields of science and potential foreign investors, and provide targeted incentives and support to the companies which have the highest potential to contribute in Latvia.

Strategic recommendation: Foster collaboration and mobility among HEIs/scientific institutes, businesses and local/regional stakeholders

1. Create and strengthen the entrepreneurial culture in higher education institutions to foster a 'culture change', where the whole university/research community perceives collaboration with companies and society as an integral part of education and research

2. Motivate SMEs to collaborate with HEIs and scientific institutes, through the provision of hands-on advice, activation, communication and easy-to-take first-step services

3. Build up intersectoral researcher mobility by creating clearly structured and targeted schemes for PhD students, postdocs and senior researchers

4. Promote the importance of science in society for various target groups. Utilise different means of valorisation and out-reach in order to make the importance of science visible for different target groups.

These recommendations are presented in the form of an action plan in the following figure that also indicates which recommendations should be tackled in short- (1-3 years), medium- (3-5 years) and long term, to achieve the desired targets by 2027 with a sustainable impact beyond. The details of the recommendations are set out in the main report.

Action plan

Study question 1: Policies for attracting and retaining people in S&T careers in Latvia and developing their skills and productivity

Strategic recommendations	*Short term actions (1-3 years)*	*Medium term actions (3-5 years)*	*Long term actions (5-7 years)*
Improve the attractiveness of research careers by (1) ensuring competitive and stable wages	Provide the framework conditions (employment contracts) and funding to enable most of the academic staff and researchers working on a full-time basis in a single institution		Increase funding of research institutions to create favourable conditions for internationally competitive salary levels
	The HEIs should strategically review their offer by merging the existing programmes around core competences of HEIs and their units	Introduce thresholds for minimum numbers of students in a study programme	Reduce fragmentation of the study programmes
		Mobility of students between the departments of a HEI and between different HEIs should be encouraged	
	Review adverse incentives in the funding system	Support the development of credible medium-long term projections of financial sustainability of HEIs and scientific institutes	Reduce fragmentation of the institutional landscape by further merging HEIs and scientific institutes
	Review the legislation on academic and research positions to ensure coherence between teaching and research tracks	Provide financial support covering the costs of mergers	
Improve the attractiveness of research careers by (2) establishing predictable and transparent career progression		Move away from a system exclusively based on fixed term contracts awarded on the basis of open competition, towards a mixed system, including tenure track	
	The Latvian Council of Science should set clear min. requirements for entry and progression along the tenure track system in line with the results of consultations with the academic community	Increase the level of basic funding to institutions or if not possible, then the research funding allocated on a competitive basis should be reviewed to allow for more sustainable commitments to research careers (e.g. larger and longer projects)	
Improve the graduation rates and quality of PhD studies	Increase the level of monthly grants to the level slightly above average monthly wage for full time students	Incentivise institutions to support their PhD students in graduating within four years	
	Introduce a set of activities and coordinated effort to boost STEM student numbers for the future		
	Clarify the concept of doctoral schools, the preconditions for offering PhD programmes and review the funding per student per field of education		
Foster internationalisation by supporting the mobility of researchers working in Latvia as well as attracting talent from abroad	Support researchers (established) to undertake shorter and longer term mobilities and integrate mobility into the PhD studies		
	Identify and support a limited number of research units / research fields that have the potential to achieve/achieved global excellence and recognition, thereby can attract talent as host institutions		
		Create and develop internationally competitive 'islands of excellence' and provide sufficient funds for hiring international teams of younger researchers	

Study question 2: Policies for developing the employment of S&T human resources in the Latvian business sector

Strategic recommendations	*Short term actions (1-3 years)*	*Medium term actions (3-5 years)*	*Long term actions (5-7 years)*
Create favourable conditions that foster building and developing entrepreneurial and innovative ecosystems	Change the role of Clusters / Competence Centres towards ecosystem facilitation	Build innovation ecosystems around the key smart specialisation areas based on shared vision	
	Provide financing for building the ecosystems through annual calls for joint innovation projects, providing stable funding in key areas		
	Invest in the development of students' and staff members' entrepreneurial skills	Strengthen the entrepreneurial culture among universities and research institutions by integrating entrepreneurship modules in the curricula	
Reinforce the role of existing stakeholders and attract new ones to increase the country's absorption capacity of S&T human resources	Develop a long-term approach to public funding for start-ups (including later stages) and to elaborate start-up support mechanisms		
	Launch specific projects and calls to support the modernisation of the SMEs, such as digitalisation programmes	Secure the availability of early-stage and later-stage venture capital funding, by increasing the amount of public co-financing for local seed and early-stage funds; by facilitating direct investments in start-up; and by supporting the integration of Latvian start-up companies into existing start-up hubs	
	Strengthen the role of SOEs as RDI performers by eliminating the current obstacles in governance	Attract foreign RDI-related FDI with targeted incentives in identified top fields of science	
Foster collaboration and mobility among HEIs / RIs, businesses and local/regional stakeholders	Create and strengthen the entrepreneurial culture in higher education institutions		
	Support HEIs to develop a systematic approach to business collaboration through increased networking	Foster the development of a strategic approach to collaboration including the establishment of functional operational models and dedicated personnel	
	Make the benefits of academia-business collaboration more visible		
	Build intersectoral researcher mobility by creating clearly structured and targeted schemes for PhD students, post-docs and senior researchers		
	Motivate SMEs to collaborate with research institutions through easy-to-take first-step services		
	Promote the importance of science in society for various target groups, where the government can act as funder and facilitator, but the research institutions provide the actions		

1 Introduction

1.1 Scale and scope of the assignment

This document is the final report of the Specific Support on the Development of the Human Capital for Research and Innovation in Latvia. The assignment was carried out under the Horizon 2020 Policy Support Facility, which is an instrument that provides support for the EU Member States and countries associated to Horizon 2020 in improving the design, implementation and evaluation of their national research and innovation policies and systems. The PSF was set up by the European Commission, Directorate-General for Research and Innovation (DG RTD).

The aim of the assignment was to provide external advice in the form of operational guidelines and implementable recommendations to the Latvian authorities. This was the second PSF exercise for Latvia and focused on two topics that address the challenges of human capital development for research and innovation in the country:

- Policies for attracting and retaining people in scientific and technological careers in Latvia and developing their skills and productivity
- Policies for developing the employment of science and technology human resources in the Latvian business sector.

1.2 Methodology used

The methodology of the study followed guidelines set by DG RTD and centred around the work of a four-person expert panel supported by national experts. The methodology built predominantly on document review in combination with stakeholder interviews that were carried out during panel visits to Latvia.

The background report prepared by the national experts provided information on: the structure of, and key stakeholders in, the Latvian economy and research and innovation system; the main policies and strategies influencing the governance of the system; the key measures that are available to foster the attraction and development of human capital in research and development; and, in addition, a brief analysis of relevant statistical data and bibliometric indicators.

The expert panel's work built on two visits to Latvia during which a series of interviews were carried with the relevant stakeholders as well as on additional document review. The panel visits were carried out in September and November 2019. The objective of the first visit was to consult as many stakeholders as possible from across the research, higher education and policy landscape in Latvia, to seek their views on the two questions addressed by the assignment, and it was therefore implemented as a series of group interviews. The subsequent visit was aimed at testing the feasibility and relevance of the findings and the recommendations formulated by the expert panel in a workshop with relevant stakeholders and through discussions with representatives of the Ministry of Education and Science. This final report of the study incorporates the results of the workshop as well as further comments received from the Latvian stakeholders and the European Commission.

2 Background and context

The background report prepared as part of this Specific Support[3] as well as the final report of the previous Latvian PSF[4] contain extensive and recent information on the economic, innovation and research performance of the country. This chapter provides a brief overview of the Latvian research and innovation system, focusing on contextual information of relevance to the two study questions.

2.1 Research and innovation system in Latvia

2.1.1 Headline figures

Latvia is categorised as a moderate innovator according to the European Innovation Scoreboard and its performance has been improving relative to that of the EU.[5] The country's gross expenditure on R&D (GERD) is highly dependent on EU funds and has been fluctuating around 0.5-0.6% of the GDP in recent years, which is still very much below the EU average of 2.03%. The R&D expenditure of the business sector is especially low and is coupled with low numbers of high-tech firms in the economy and small numbers of new doctoral graduates. These challenges are also reflected in the fact that, among all of the 12 pillars that are used as part of the Global Competitiveness Index,[6] Latvia scores lowest when it comes to its 'Innovation capability'. At the same time Latvia scores rather highly on rankings of international business environment and entrepreneurship framework-conditions, highlighting that the country has a favourable and enabling environment based on a set of indicators assessing its macro-economic stability, ICT adoption, infrastructure and institutions,[7] as well as its physical, commercial and legal infrastructure.[8]

In terms of public R&D funding per sector of activity, higher education is the largest beneficiary and the business sector receives the least funding. Although EU funds play an important role in funding and increasing Latvia's R&I capacity, the total amount of Cohesion Funds invested in Latvia on research and development are lower than in the neighbouring countries.[9] Latvia's success rate

[3] The Background Report can be downloaded from the Europa website: https://rio.jrc.ec.europa.eu/en/library/specific-support-latvia-ii-background-report

[4] The previous PSF focused on the Latvian Research Funding System. The final report that was published in February 2018 can be accessed at: https://rio.jrc.ec.europa.eu/en/library/specific-support-latvia-final-report-–-latvian-research-funding-system-0

[5] European Innovation Scoreboard 2019 Latvia – accessible at: https://ec.europa.eu/docsroom/documents/35899

[6] Global Competitiveness Index for Latvia 2018 – accessible at: http://reports.weforum.org/global-competitiveness-report-2018/country-economy-profiles/#economy=LVA

[7] Indicators from the Global Competitiveness Index

[8] Indicators from the Global Entrepreneurship Monitor

[9] Latvia PSF II – Background report, 2019

in the Horizon 2020 Programme has decreased slightly over time but is still a bit above the EU average (12%).

Table 1: Breakdown of research funding by type (basic, competitive and infrastructure) and origin (in EUR thousand)

	2016			2017			2018		
	Fundamental	Applied	Experimental	Fundamental	Applied	Experimental	Fundamental	Applied	Experimental
Higher education sector	25,430	18,828	4,021	31,150	27,645	5,581	55,037	36,851	5,649
Government sector (state research institutions)	7,064	24,007	4,077	9,220	21,578	5,213	9,084	26,530	6,834
Business sector	1,002	7,077	18,903	2,284	10,239	25,014	2,379	12,111	31,785
Total	33,496	49,912	27,001	42,654	59,462	35,808	66,500	75,492	44,268

The main indicators that describe the research and innovation performance of Latvia in implementing its Smart Specialisation Strategy are summarised in Figure **1.**

Figure 1: Key indicators monitoring the implementation of the Smart Specialisation Strategy of Latvia (RIS3)

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Latest data	Progress against 2010	Target in 2020
	Position in EIS (European innovation scoreboard)	modest	modest	modest	modest	modest	modest	modest	modest	moderate	moderate	moderate	moderate (2019)	●	moderate
	R&D expenditure (% of GDP)	0.58	0.45	0.61	0.7	0.66	0.61	0.69	0.63	0.44	0.51	0,63	0.63 (2018)	●	1.5%
	Productivity in the manufacturing sector (EUR k per worker)	16.0	16.0	18.5	18.8	18.7	18.4	19.4	19.7	20.2	21.8	22.2	22.2	●	29.0
IV1	Number of research personnel (FTE)	6 533	5 485	5 563	5 432	5 593	5 396	5 739	5 570	5 120	5 378	6039	6 039 (2018)	●	7 000
IV2	Number of tertiary education graduates (in thousands)	24.2	26	26.5	24.8	21.5	21.6	17.4	17	15.8	14.6	15.4	15.4	●	24.6
IV3	% of population 30-34 years old with tertiary education diploma	26	31	33	36	37	41	40	41	43	44	43	43	●	40
IV4	Number of state funded research institutions	39	40	40	41	41	41	40	29	21	22	21	21	●	20
IV5	Number of peer reviewed research papers (SCOPUS)	857	922	1 032	1 731	1 565	1 656	1 601	1 978	2 052	2 373	2 257	2 257	●	1 500
IV6	Success rate in EU framework programme	23	21	20	23	16	19	22.22	7.31	13.6	12.12	20.44	20.44	●	30

Source: Latvian Ministry of Education and Science, 2019

Looking closely at the changes in human resources over time, it is clear that the number of full-time research and development personnel was decreasing until 2018. The increase in numbers in 2018 was, however, not due to a sudden influx of researchers to the system, but rather changes in the way research personnel numbers are reported. Since 2018, the figures better reflect the total number of research personnel in the system by including research technicians and laboratory personnel as well in the total FTE. While the increased number brings the total staff closer to the target that was set – the policy goal was to reach 7,000 FTE by 2020 – there is still a significant gap of almost one thousand FTEs missing to reach this goal. This is caused by underfunding of the research system, demographic challenges, and high rates of emigration by PhD students. In the absence of intervention, these trends are likely to drive a continuing decrease in the total number of research personnel in coming years.

Another important problem in the system is that only 15% of Latvia's researchers were employed by industry in 2018.[10] Further, the numbers of STEM graduates and PhDs awarded were below the EU average.

2.1.2 Research and innovation system governance

Despite the small size of the country, there are a significant number of organisations and bodies involved in the governance and implementation of research and innovation policy. The key roles and responsibilities of the main stakeholders in the system are as follows.[11]

- The Latvian Parliament, and the Cabinet of Ministers are the two high-level political institutions that make decisions on research and innovation policies and funding

- The Research and Innovation Strategic Council headed by the Prime Minister is a strategic advisory body (it has not convened since 2018)

- The Latvian Council of Science is tasked with formulating and coordinating science policy and acting as a research funding council. It provides advice on R&D and higher education policy formulation and implementation, representing the voice of the academic research community

- The National Development Plan of Latvia for 2014-2020 and the development of the upcoming plan until 2027 is coordinated by the Cross-Sectoral Coordination Centre, part of the State Chancellery

- The Ministry of Education and Science (MoES) and the Ministry of Economy (MoE) are the lead policymaking bodies for research and innovation. The MoES has two main agencies, of which the State Education Development Agency is the larger with the greater role in implementing R&I support measures, while

[10] Research and Innovation Observatory country report series, Draft Report Latvia, 2019 – based on data from MoES, 2018

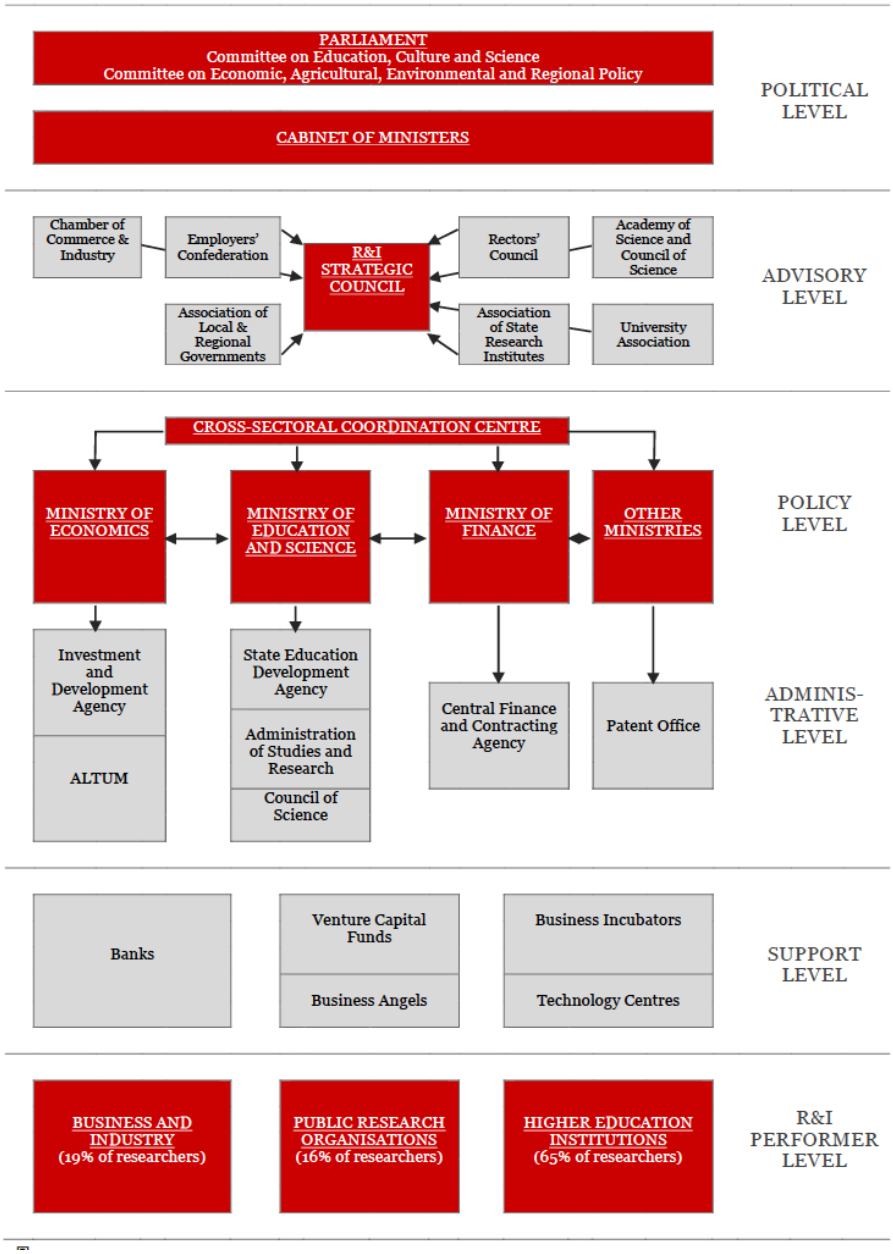
[11] These paragraphs build on the more detailed descriptions provided in the Background Report

the Administration of Study and Research (ASR) agency is tasked with administrative and financial oversight of the implementation of state-funded fundamental and applied research projects, and supporting the Latvian Council of Science. The MoE is in charge of business support and innovation and designs and monitors Structural Funds programmes for business competitiveness and innovation capacity. It implements its programmes through the Investment and Development Agency of Latvia (LIIA).

- The Ministry of Finance is responsible for annual budget planning and is the Managing Authority for EU Structural Funds. Its agency, the Central Finance and Contracting Agency, implements the Structural Funds

- The JSC Development Finance Institution Altum (ALTUM) provides alternative risk capital funding for businesses with insufficient collateral.

Figure 2: Key stakeholders in the governance of the research and innovation system of Latvia – 2019



Source: PSF Latvia II - Background report

Recent years have seen improvements in the coordination and involvement of sectoral ministries in planning and implementing research priorities through the state research programmes. However, the implementing system remains fragmented. In line with the recommendations of the first Policy Support Facility exercise for Latvia that was focused on the country's research funding, the Ministry of Education and Sciences announced new plans in October 2019 for the consolidation of the system to ensure smoother and more efficient implementation and, thereby, reduce the administrative burden on the scientific community. At the core of the centralised system is the Latvian Council of Science, which will also become the main science policy implementation agency. The new Council is expected to start its operations at the latest in July 2020.[12]

Similar developments are also discussed regarding the institutions working with business. According to initial proposals, LIAA will have a greater role in technology development and innovation in addition to its roles in inward investment and business support.[13]

2.1.3 Research performers

Most research in Latvia is done by research institutions. For the purposes of this study we understand that higher education institutions and scientific institutes together are called research institutions. The list of scientific institutes is included in the Register of Scientific Institutes in Latvia. The Law on Scientific Activity establishes four categories:

- Public agency – operating with property i.e. infrastructure and financial resources made available for use by the agency
- Derived public entity – established by a decision of the Cabinet of Ministers. All major state scientific institutes belong to this category
- Structural unit of a higher education institution
- Private law legal entity or its structural unit – may also be founded as a state or local government capital company

In 2011, there were 150 units listed in the Register, but the number was reduced significantly on the basis of the results of an international Research Assessment Exercise (RAE) and the changes introduced in the Law of Scientific Activity 2013, setting the minimum size of a scientific institute as having at least five persons with PhD degrees in the relevant field of science. Currently, 67 institutes are registered.

The findings of the research assessment exercise are also of importance for the work of this expert panel. The RAE concluded that in mathematics and natural

[12] Based on a press release from the Latvian Ministry of Education and Science (9 October 2019), translated from Latvian

[13] Based on a press release from the Ministry of Economy (28 May 2019), translated from Latvian

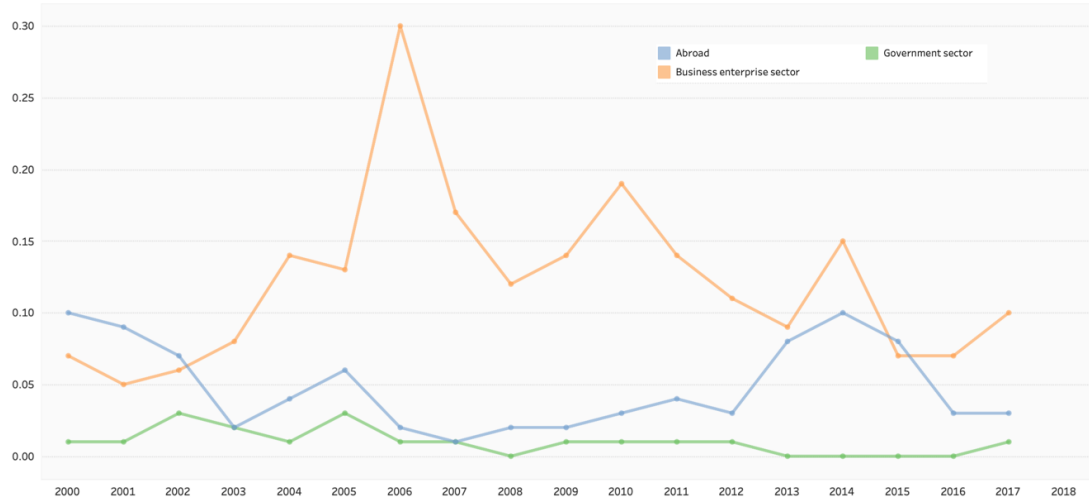
sciences there were comparatively strong and well-established scientific institutes, although they varied in terms of quality. Engineering and computer sciences were rather fragmented with some important high spots but many low performers. The field of life sciences mainly comprised national players. Some of these research units were internationally competitive for quality and relevance. Agricultural research was assessed as being overly inward-looking and too focused on national needs. Social sciences were highly fragmented with many relatively new research units, while humanities had slightly higher quality and relevance.[14]

Around 58% of Latvia's researchers work in higher education institutions. There were 49 HEIs operating in Latvia in 2017, according to the MoES. The two main universities – the University of Latvia (UL) and Riga Technical University (RTU) – account for more than 40% of researchers and academic staff working within the sector. The HE system, however, also faces problems due to fragmentation and being overcrowded. Regional universities do not have the critical mass to generate competitive Master's or PhD degrees. Nonetheless, the number of study programmes grew by a third between 2005 and 2017, while the student population declined by 38%. The new system of accreditation of study programmes and branches, which works on a three-year cycle and incorporates a quality review, is expected to contribute to a reduction in the number of study programmes, although the culture of strong opposition to reforms hinders changes in the system.

Private research performers play a minor role in the Latvian system. The level of business expenditure on R&D (BERD) in Latvia was the lowest (0.16% of the GDP compared to the 1.41% EU average) in the EU in 2018. Figure **3** below illustrates the development of sources of funds of BERD in Latvia between 2000-2017.

[14] Technopolis Group, Arnold et al: Latvia Research Assessment Exercise, Summary report, April 2014, accessible at: https://www.izm.gov.lv/images/zinatne/ZISI/zisi_03.pdf

Figure 3: BERD by source of funds (value or intensity) in Latvia as percentage of GDP



Source: European Research and Innovation Observatory[15]

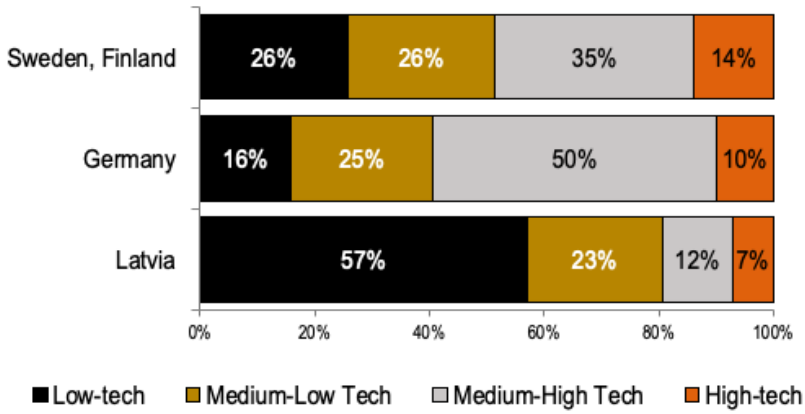
The private sector is dominated by SMEs, but the proportion of high- and medium-sized technology companies is low. It is, therefore, difficult for scientific institutes to collaborate with SMEs. Although Latvia has satisfactory levels of foreign direct investment, this is not focused on R&D-intensive activities. There are few foreign companies with R&D centres in the country. Those that do, however, may get good value for money as there is high-level expertise available at reasonable cost in some fields of science. Identifying niche areas of excellence with the potential to attract further foreign R&D-intensive investment is an area that has been identified for further action by policymakers but remains to be followed up.

The large, state-owned companies are major players and employers in the Latvian economy. They account for 5.6% of the turnover and 5.4% of the employment generated by the business sector in the country.[16] Some have diverse and often strategic collaborations with selected research and higher education institutions both nationally and internationally. However, they perform little R&D themselves, have low levels of R&D spending – partially due to the regulations that govern them – and do not represent a driving force for training more PhDs. Apart from a few select examples, there is little demand for R&D from the private sector and research-industry links remain weak.

[15] https://rio.jrc.ec.europa.eu/en/country-analysis/Latvia/key-indicators/26155, page visited 28 January 2020

[16] OECD (2019), OECD Economic Surveys: Latvia 2019, OECD Publishing, Paris

Figure 4: Manufacturing by technological intensity levels (%)



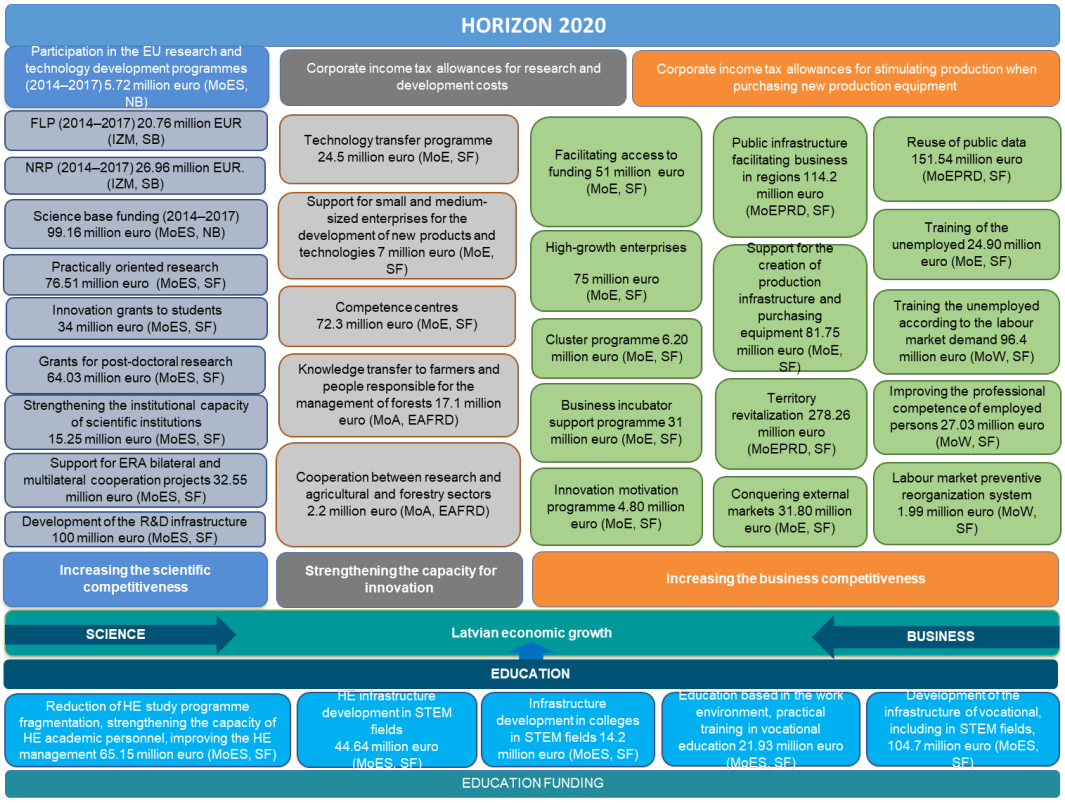
Source: Presentation of the Ministry of Economy, 2019

A positive development, however, is the growing start-up community predominantly focused around the capital, Riga. This benefits from micro-loans for start-ups, several incubators and a range of more general innovation support measures.

2.2 Policy mix

The overall R&I policy mix for 2014-2020 (see Figure **5**) includes a number of instruments that directly contribute to the development of human capital in research and technology as well as fostering the creation and development of science-industry links. This section provides a brief description of the key measures that are currently available in the Latvian system and are of high relevance to this Specific Support exercise.

Figure 5: R&I policy mix



Source: Ministry of Economy, 2019.

The Programme 'Innovation grants to students' (€34m ESIF funding) funds a number of sub-programmes that are run by Latvian HEIs aimed at developing entrepreneurship and innovation skills. Notably, this scheme co-financed the first industrial PhD programme in the country. In May 2019, Riga Technical University and Latvian Mobile Telephone (LMT), the largest mobile telephone service provider, announced a cooperation in starting an industrial PhD programme. The programme is being piloted and, so far, two PhD students have been enrolled at RTU. The cooperation between LMT and RTU in the framework of the industrial PhD programme focuses on developing new technologies for the company. Based on experience so far, the University aims to develop similar collaborations with other companies in the future.

The measure that seeks to 'Strengthen academic staff of higher education institutions in the areas of strategic specialisation' is part of a broader instrument that supports the reduction of fragmentation of higher education study programmes, strengthening capacities of academic staff and improving HE governance (overall funding €65.15m of which €34m has been allocated to this dedicated measure). This measure aims to support the employment of 420 doctoral students and to attract 300 researchers from abroad to teach at Latvian

higher education institutions, as well as improving the professional competences of 1,140 academic staff-members.[17]

The instrument, 'Grants for post-doctoral research' (€60.9m ESIF funding), aims to fund approximately 455 postdocs. The scheme provides grants up to €133,806 for a period of 36 months – calculated based on a full-time employment contract with a salary of €2,731 per month plus €800 for additional expenses – to perform research in Latvia. This financial package is internationally competitive and makes the measure attractive for both local and foreign young researchers. The first two calls of the scheme were launched in 2016 and 2018. They were highly competitive and funded 196 postdocs in total. The measure also proved to be successful in attracting talent back to the country, as 24 of the beneficiaries (12% of all grantees) have defended their dissertations abroad. An aspect where the scheme proved to be less successful was the engagement of private companies. According to the design of the scheme, the postdoc grant holders can be based in either public or private research organisations, SMEs or large companies registered in Latvia. However, only nine companies submitted applications during the first two calls. This illustrates a lack of R&D and supervision capacity in the private sector, or perhaps insufficient dissemination of information to potential private companies.

Further, the policy mix also covers a range of initiatives that indirectly foster the development of human capital through support to R&I activities, building research-industry links as well as generating demand for innovation in the enterprises. Support for R&I activities is provided through:

- Basic research funding (€23m in 2019, national budget), which provides block grants to HEIs and scientific institutes. The distribution of funds relies on a formula that takes into account both input and output indicators

- State research programmes (€26.9m for 2014-2017, national budget) which last for three (optional to have an additional year of a no-cost extension) years and allocate grants through competitive calls for proposals with the ultimate objective of supporting high-impact societal and industry-relevant research

- Practically orientated research grants (€76.5m for 2014-2020, ESIF funded) provide support to research institutions and enterprises to develop innovative solutions for practical socio-economic challenges. The projects approved during the first call for proposals – launched in 2017 – have created 43 new R&D positions (FTE) and employ 146 Master's and PhD students. The second call for proposals – finished mid-2019 – aims to create 67 new R&D positions

[17] Cabinet of Ministers Regulations No. 25 Riga, 9 January 2018 (prot. No 2 § 22), Implementing Regulations for the First, Second and Third Project Applications Selection Round of Specific Objective 8.2.2 'To Strengthen Academic Staff of Higher Education Institutions in the Areas of Strategic Specialisation' of the Operational Programme 'Growth and Employment'

During the 2014-2020 time period, significant resources have also been allocated to fostering research-business collaborations. Relevant measures include:

- Technology-transfer system and innovation vouchers (€24.5m for 2014-2020, ESIF funded). The scheme provides co-financing for private companies to acquire services from scientific institutes and to support the employment of researchers in private companies. The measure funds a range of initiatives addressing different needs to help connect business and scientific institutes throughout the different stages of technology transfer. Available support covers the early steps, such as the work of technology scouts through networking events to start up vouchers and acceleration funds. Although such schemes are widely used internationally, since their introduction in Latvia in 2017 only two companies have implemented projects that include attraction of researchers

- The measure, 'Support for development of new products and technologies within competence centres' (€72.3m for 2014-2020, ESIF funded) provides funding for R&I projects that are carried out by researchers, businesses or both. The eight Competence Centres are organised in line with the Smart Specialisation Strategy niche areas in Latvia's major manufacturing industries. The Centres involve most of the 230 R&D-active companies in Latvia. By the end of 2018, the programme had funded 191 research projects that were carried out by 492 researchers, including 175 PhD students and recent PhD graduates.

A number of other programmes also aim to increase innovation capacities in businesses. These include, among other things, an innovation motivation programme, support for employee training, support for clusters, incubators, technology intensive start-ups, and tax incentives for R&D.

3 Key study findings

3.1 Policies for attracting and retaining people in scientific and technological careers in Latvia and developing their skills and productivity

The overall policy mix clearly demonstrates the ambition to tackle some of the key challenges facing the Latvian HE and R&I systems. These include attracting and retaining young PhD graduates, closer collaboration between the academic, research and business sectors as well as building innovation capacity in the private sector. However, the long-term sustainability of some of the policy instruments has not been secured. Since most of the interventions rely on ESIF, they provide a short-term financial boost for dedicated target groups (e.g. generous doctoral stipends in 2007-2013 or postdoc scholarships in 2014-2020), which 'evaporates' after the programmes are discontinued. This leads to imbalances that could curtail the expected benefits of the investments, particularly with regards to retaining R&D personnel. In this respect, Latvia faces three particular challenges.

First, the balance between competitive short-term funds and long-term base funding is strongly tilted towards the former. Latvian scientific institutes receive most of their income by competing for students and R&I grants. Positions at higher education institutions depend on teaching, while positions in other scientific institutes depend on obtaining project funding. This division creates two seemingly separate worlds. Incomes tend to fluctuate significantly as student numbers are decreasing and calls for research proposals have not been regular in the past. The uneven rate of disbursement of ESIF, which funds most of the R&I grants, is combined with low levels of predictable base funding from the national budget. As a result, some scientific institutes claim that institutional funding constitutes only 10% of their incomes. There are, however, major variations among the institutes. The most successful in terms of attracting competitive funds are those related to forestry, chemistry (pharmaceuticals), life sciences and ICT.

This has significant implications for attracting and retaining top talent. Commitment to careers in academia as well as institutional development of HR systems crucially depends on a reasonable degree of income predictability. Some variation in income linked to success rates in attracting students and/or R&I grants, is welcome as it incentivises better performance. However, extreme fluctuations render long-term commitments and career planning impossible. Faced with considerable uncertainty regarding future incomes, HEIs and scientific institutes share this risk with their personnel. As a result, they cannot adopt a tenure track system, which requires long-term financial commitment. In general, salaries are far from an internationally competitive level. Gross monthly salaries in Latvia increased from €203 in 2003 to 1,004 euros in 2018, and the objective is to reach €1,850 by 2030. The current range of monthly wages in academia varies from €625 for an assistant to €1,530 for a professor – which is coupled with fluctuations in income over time. Some people are very successful and obtain a good level of funding both from national and EU sources, while others mostly focus on teaching and have multiple part-time jobs in different institutions. In extreme cases, researchers experience temporary spells of unemployment between R&I grants.

Second, there is a risk to the retention of R&D personnel attracted through targeted investments if other elements of the HE and R&I system remain underfunded. As described earlier, the favourable stipends of the 'Support for the implementation of doctoral study programmes' attracted talented PhD students to Latvia, but the retention of these people was at risk since these PhD stipends were much higher than the average wages of PhD graduates. To mitigate this risk, a new instrument, the 'Grants for post-doctoral research' was introduced, which allowed the same cohort to benefit from additional postdoc research funding.

However, challenges to the sustainability of the impacts remain. This is clearly demonstrated, on the one hand, by the sudden drop in PhD student numbers as soon as the PhD funding was discontinued, and the funds were redirected towards the cohort that, by then, had become postdocs. Although there was still a pool of talent from which to select PhD candidates, the lack of incentives discouraged higher numbers from enrolling in the institutions. On the other hand, the additional support for the cohort that benefited both from generous PhD stipends and postdoc support created wage expectations that will pose challenges for Latvian institutions to meet in future because the average wages of researchers/associate professors are lower than the income of the postdocs who are the beneficiaries of these grants.

Third, the pace of job creation for researchers in the private sector remains very limited despite the incentives available. Only five companies used the 'Innovation voucher' scheme to employ researchers (out of 92 'innovation vouchers' awarded), a small fraction of postdocs carry out research projects in private enterprises, and the new industrial PhD scheme initiated by RTU is so far focused on collaboration with one company (LMT). This poses a significant challenge for the Government ambition of increasing the number of researchers in the Latvian economy.

3.1.1 Current career paths – key issues, opportunities and barriers

Structure of academic careers

Typically, academic careers are structured around four stages:

- Stage I: doctoral training, which focuses on preparation for academic careers
- Stage II: postdoctoral stage, which can be characterised as a 'probationary period' for an academic career. Entry into a postdoc position is highly competitive and postdocs work on the basis of fixed-term contracts
- Stage III: independent researcher stage (docents, associate professors, researchers and similar positions). These positions are typically filled through open competition. Some countries and HEIs at this level provide access to a tenure track, whereas others offer fixed-term contracts
- Stage IV: established researchers' phase (professors, senior researchers and similar). Depending on the national system, internal procedures and strategies

of HEIs, some positions at stage IV are filled through open competition, whereas others result from promotion and offer tenure

The structure of academic careers in Latvia differs from such standard 'career ladders' in many aspects.

First, there is no single academic career path in Latvia. National legislation distinguishes between academic and research positions. Academic positions are established in HEIs (predominantly involve teaching functions) and are regulated by the Law on Institutions of Higher Education. Research positions are regulated by the Law on Scientific Activity. The distinction between research and academic positions regulated by separate laws is a historical legacy, which has not been addressed due to political sensitivities. At a conceptual level, such a separation stands in contrast to the principle of unity between education and research in higher education. In the early XIX century, Humboldt stipulated that cutting-edge research is not separable and in fact provides a foundation for high-quality teaching. Integration of research results into education remains an underlying principle for most leading universities. In practice, this separation creates significant fragmentation for individuals, as a single person may have multiple contracts to cover different aspects of their work. Further, this impedes HEIs' attempts to establish a simple, clear and unified framework for researcher careers, because of different requirements for academic and research tracks.

Second, 'career ladders' in academic and research positions are not entirely consistent with the different stages of academic careers, as discussed above:

- Academic positions in HEIs consist of the following categories: assistant, lecturer, docent, associate professor and professor. The Law on Higher Education Institutions stipulates that a person can be appointed to the position of lecturer, docent or associate professor if they hold a doctoral degree. Further, "A person who has a doctoral degree and has not less than three years of work experience in the position of associate professor or professor may be elected to the position of professor" (section 28). Hence, at least in principle, postdocs can be elected to the position of associate professor and after three years they can already get promoted to professorship

- Research positions in Latvia consist of the following categories: assistant, researcher and senior researcher. The minimum criteria for taking up these positions are rather low. According to the Law on Scientific Activity (article 26.1): "Persons with a doctoral degree in science may be elected to the position of a senior researcher. Persons with a doctoral or a master's degree may be elected to the position of a researcher." Hence, at least in principle postdocs can become senior researchers, whereas a person without doctoral degree can only be appointed to the position of a researcher.

Although matching the two different career systems is not straightforward, this system provides significant flexibility. On the positive side, it enables fast-track careers, where positions as researchers and associate professors can be offered to young postdocs if they meet predefined requirements. HEIs tend to use this opportunity for attracting and retaining young staff, this helps in addressing the problem of the generally very low wages that are available for entry level

positions (assistants, lecturers and docents). On the negative side, this system causes inflation of academic ranks and undermines efforts to develop career advancement systems based on gradual progression and promotion.

Third, until recently, the respective laws stipulated that none of the positions are subject to open-ended contract, i.e. candidates had to be appointed in open competition every six years.[18] Associate professors and professors were appointed by the Council of Professors of the relevant higher education institution unit. If the unit does not have sufficient number of professors to form a Council, different HEIs can establish a joint Council. This implies that careers were highly vulnerable: each member of academic community, irrespective of achievement and value to the institution, is subject to periodic (re)selection. Although general criteria for appointment are formally set, the institutions have significant autonomy in personalising the requirements for each position, so as to tailor them to a specific candidate. Further, the Councils have significant autonomy in interpreting to what extent the candidates adhere to the criteria. This has the following repercussions:

- The system is insufficiently transparent to outsiders and enables gravitation towards 'old boys clubs'. It appears that most competitions do not have more than one candidate. This could be due to the low attractiveness of careers or to tailoring of specific selection criteria for particular candidates

- The system does not produce the benefits of open competition. Most advanced countries and their HEIs aim to strike a balance between the benefits of career-based and open competition models (see the Table **2** below). To get the best of both worlds, HEIs increasingly combine both systems by offering tenure track positions as well as establishing new positions that are subject to open competition. The balance in Latvia is strongly tilted towards open competition, which does not allow exploitation of the benefits of a career-based model. At the same time, the low level of real competition for academic and research positions undermines the potential benefits of the open competition model.

[18] In 7 June 2019 The Constitutional Court ruled that professor and associate professor contracts should be open ended.

Table 2: The benefits and risks of open competition and career-based systems

	Benefits	Risks
Career-based model	• High autonomy of researchers/ professors (academics) • Development of collegial academic culture • Long-term research agendas, maintenance of core competences and "institutional memory" • High motivation of junior staff to demonstrate outstanding results • Clear rule-based career system and job security compensate for lower level of remuneration	• Stagnation of research agendas • Lower performance of tenured professors • Exclusion of new staff with innovative research agendas
Open competition-based model	• Stronger strategic orientation in shaping the composition of staff and research priorities • Openness to recruitment from other HEIs and countries • Larger diversity of staff • Opportunities strategically to build competence in newly emerging fields	• Higher costs of hiring to compensate for lower job security • Incentivising concentration on publications which tend to receive most of the attention during the competitive process • Short-term research agendas • Losing knowledge and core competences in case of high turnover

Source: Adapted from World Bank, 2018, Vol. 3, p. 70.

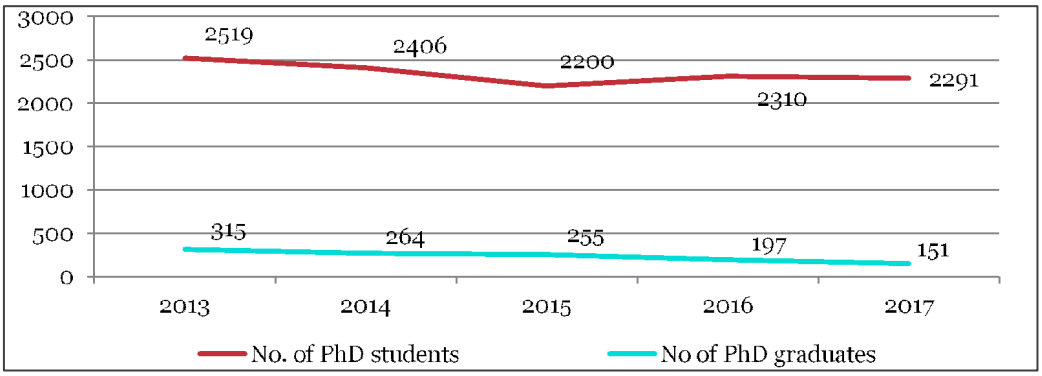
Fourth, research and academic positions do not automatically correspond to a predefined set of tasks and associated wages. The workload – the number of teaching and contact hours, participation in research projects for example – is agreed upon separately, on an individual basis. The workload of an individual depends on multiple factors, including the administrative tasks associated with the position, the number of students, courses offered, success in securing grants and the changes in these factors over time. This results in people often taking on multiple jobs, as only a few contracts offer a full-time workload at one institution, and academic and research staff need to compensate for the fluctuations of the workload and salary over time. Working across multiple HEIs and scientific institutes, as well as taking up jobs outside academia, leaves an overall impression that the level of income security is very low, which stands in contrast to the remuneration practices in most well-established institutions.

PhD studies

Against this backdrop, the Government aims to increase the number of full-time equivalent (FTE) researchers from 6,000 to 8,000 by 2027. This is a very ambitious objective, given that the number of PhD students and graduates has been significantly declining over the past years (see Figure 6) and there are over 1,000 scientists currently older than 65 who are likely to retire within the next decade. Hence, the number of PhD graduates is not sufficient to maintain the

current number of researchers, assuming that two-thirds of PhD graduates take up research careers. [19]

Figure 6: Number of PhD students and graduates



Source: Eurostat

Having an insufficient annual number of PhD graduates is also caused by the problem that PhD studies are not attractive for prospective entrants. This is evidenced by a lack of competition to enter PhD programmes in most cases, and especially in STEM fields. The key factors inhibiting attractiveness include:

- Low level of PhD stipends (€113 a month), which do not cover basic living costs and are significantly below the minimum (€430) as well as the average wage. Past policy measures well reflect the importance of the size of stipends, as showcased by the boost in the number of PhD students during the 2007-2013 period when the 'Support for the implementation of doctoral study programmes' was implemented.

- Uncertainty regarding income stability during PhD studies. As already described, securing funding from various national and international calls for proposals generates income fluctuations for the institutions – their ability to fund PhD students becomes intermittent. Hence, some established researchers say that they only take new PhD students when they have secured a research grant. Even this might only offer a temporary solution, since grants are typically awarded only for two to three years. To compensate for the low and rather unpredictable income levels through these channels, a large proportion of PhD students have full-time jobs outside academia.[20]

[19] This assumption is based on a study of researchers' careers, carried out in Lithuania, which is largely similar to Latvia. See: MOSTA (2019) Mokslo daktarų karjera Lietuvoje: užimtumas, pajamos ir veiklos sektorius.

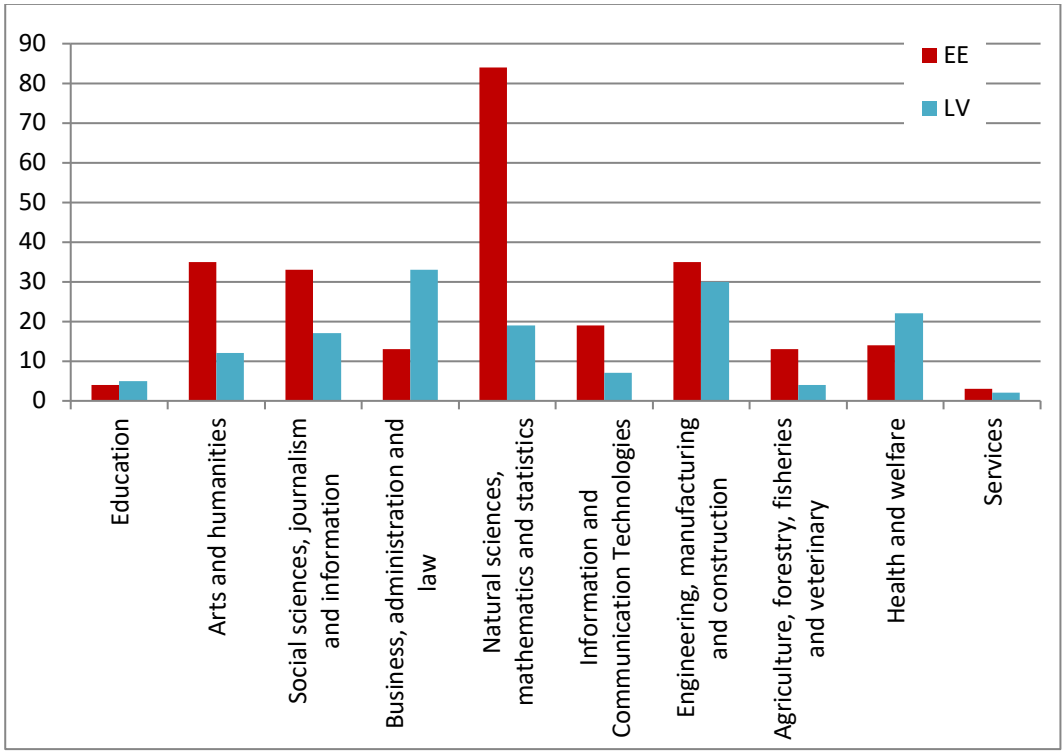
[20] Clearly in some occupations (e.g. medical practitioners) continuous work (not necessarily full time) is necessary in order to maintain professional certifications. However, such special cases cannot justify the current practices.

- Both these factors contribute to the very low and declining graduation rate of PhD students, with fewer than half of the students graduating within four years. Due to low stipends and other income from academic work, most PhD students take up full-time jobs outside academia and, as a result, do not have sufficient time to work on dissertations. A total of 65% of surveyed PhD students argue that lack of time due to work is the main reason behind insufficient progress with PhD studies and dissertations, according to a survey carried out in 2018/2019 at Riga Technical University.[21]

The challenges are particularly large in specific fields of education (see Figure 7). Latvia is trailing behind Estonia, which has a smaller RDI system, in terms of natural sciences, mathematics and statistics graduates. Latvia aims to develop information and communication technologies, but between 2013 and 2017 it produced only 53 new PhD graduates or, on average, 11 each year. Renewal of human resources in mathematics faces particularly big challenges: nearly 50% of researchers are 60 or more years' old, but recently there have been only one or two PhD graduates per year.

[21] RTU Doktorantūras skola, 2018/2019. studiju gada doktorantu aptaujas rezultātu kopsavilkums. Available: https://estudijas.rtu.lv/pluginfile.php/1634802/mod_resource/content/2/2018.2019.%20studiju%20gada%20doktorantu%20aptaujas%20rezult%C4%81tu%20kopsavilkums.pdf

Figure 7: Number of PhD graduates by field of education in 2017



Source: Eurostat

The institutional framework is highly fragmented and there are 21 HEIs entitled to award PhD degrees, which is a large number of institutions for slightly more than 2,000 students. The majority of students are enrolled in a handful of universities, which implies that PhD programmes in the smaller HEIs may lack critical mass and cannot exploit economies of scale in the provision of quality education. Further, in some disciplines research excellence and infrastructure are concentrated in scientific institutes rather than HEIs. In practice, these scientific institutes participate in PhD studies and students can decide which research group to join. They can also have their supervisors from a scientific institute, as the same researchers typically work at both types of institutions. However, scientific institutes cannot award PhD degrees. There are different constellations based on the relationship between the HEI and the other types of scientific institutes in terms of the organisation of the PhD studies, as the system links basic funding for PhD students to both types of institution. This implies a need for rationalisation and pooling of resources.

Institutions use different practices to attract talent to the PhD programmes. While standards and procedures for admission to PhD studies are set by individual HEIs, informal relationships between supervisors and future students are of particular

importance in determining the outcomes of the admission process.[22] Some interviewees claim that they nurture talented students from the early stages of their studies, by engaging them through part-time jobs in research projects already during their undergraduate and graduate studies and encouraging them to apply to a PhD programme. The system is therefore based on personal connections, to a large extent, which reduces the transparency of admissions. However, it is viewed as a tried-and-tested approach to recruiting talented PhD candidates. Such a model also has an impact on the quality of studies, and it is largely influenced by:

- The quality of research carried out by the supervisor and their 'home' department more generally. The international research assessment exercise carried out in 2014 suggested that, while there are internationally competitive islands of excellence, the performance of most research units leaves significant scope for improvement.[23] Most of the research excellence is located in scientific institutes, which do not formally participate in PhD studies

- The competences and experience of supervisors in providing training and mentorship as well as their capacity to provide transferable skills. Until recently, there were no formalised programmes that support supervisors in acquiring such skills and most of the training for PhD students is provided via one-on-one mentoring and individual work on dissertations

- The level of financial resources allocated to PhD studies within HEIs. Public funding for PhD studies is three times higher than the allocation per undergraduate student. Therefore, stakeholders interviewed consider the level of public funding for PhD studies sufficient. However, owing to institutional underfunding these resources have to be used to fill other gaps as well

- Opportunities and capacities of HEIs to offer jobs for PhD students that would advance their competences. Only 36% of students suggest that teaching and research provide their main source of income, according to an OECD survey carried out in 2016.[24] Hence, a significant proportion of PhD students hold jobs outside academia, which has a negative effect on the time they can allocate to their PhD studies.

[22] World Bank (2018). World Bank Support for higher Education in Latvia. Vol. 3: Academic Careers.

[23] Technopolis Group (2014) Latvia. Research Assessment Exercise: Summary report.

[24] As cited in World Bank, 2018.

Postdoc careers

Until recently there were virtually no postdoc positions in Latvia. Therefore, the typical career paths of PhD graduates included the following options:

- Seeking opportunities – postdoc grants – in other countries
- Leaving the academic career – most of the students work outside academia during their studies, therefore it is common to continue doing so after successful completion of their PhD studies
- Continuing on the academic/researcher career path – HEIs and scientific institutes try to attract top students by offering them senior positions, which have higher remuneration, but would typically be taken by more established researchers. As a result, some of the associate professors and heads of academic departments are in their early or mid-thirties

The 'Grants for post-doctoral research', described in Chapter 2.2, is a very successful scheme in attracting large numbers of qualified candidates, including graduates of foreign universities. Despite its achievements, the programme has not enabled postdoc positions in Latvia to be institutionalised. In fact, there is no formal definition of postdocs in the national legal system beyond operational documents of the funding programme or HR management systems of most HEIs and scientific institutes. To date, it is not clear whether the programme will be funded during the post-2020 programming period. Hence, there is a risk that the achievements of the programme will wane, once the funding is discontinued.

3.1.2 The role of international relations and mobility

Since the early 1990s, Latvia has suffered from a significant brain drain, which was predominantly driven by differences in wages. Emigration of young talent is a trend that continues. Although there are no official data, some estimates suggest that about 15% of Latvian researchers are currently working abroad.[25] According to the survey of diaspora scientists,[26] the main motivations for moving to a foreign country are studies (40%) and to perform academic or scientific work (33%). In the past two years, 44% of members of the science diaspora have not been involved in scientific activity that is associated with Latvia or collaborated with scientists in Latvia. Further, most members of the science diaspora do not plan to return to Latvia or are undecided.

[25] Bela, B., Berzins, K., Krebs, V., Mierina, I., Vingre, A. 2018. Latvia's science diaspora: cooperation networks and opportunities. Available here: https://www.izm.gov.lv/images/statistika/petijumi/LU-SPPI-DMPC_Zinatnieku-diaspora-2018.pdf

[26] Mieriņa, I., Ulnicane, I., Vingre, A., Buzinska, L., van der Steina, A. 2017. Diasporas zinātnieku piesaiste un sadarbības veicināšana. (In Latvian).

Data on inbound and outbound mobility (see Table **3**) suggest that:

- Data for inbound mobility show that only 2% of academic staff working in Latvia have foreign citizenship, but about 10% of Latvian academics obtained their PhDs abroad, which is rather close to the EU average and in line with the experiences of other small Member States

- Outbound mobility data suggest that Latvian researchers are more mobile during their PhD studies than at later stages of their careers. The reduced levels of mobility at the later stages of researchers' career is also reflected in the high proportion of experienced researchers who have not participated in a mobility period longer than three months (80% of researchers)

Table 3: Inbound and outbound mobility of researchers in Latvia and selected neighbours

	LV	EU	LT	EE
Inbound mobility: share of researchers currently employed in another country than their country (countries) of citizenship, in % by panel country	**2.0%**	13.3%	1.0%	6.2%
Inbound mobility: share of researchers obtaining or having obtained a PhD in another country than their country of citizenship, in % by panel country	**10.2%**	13.8%	9.0%	15.7%
Outbound and return mobility: share of R1-R2 researchers that during their PhD have moved for 3 months or more to another country than the country where they did or will obtain her PhD, in % and by country of PhD	**17.6%**	18.2%	21.9%	28.2%
Outbound and return mobility: share of R2-3-4 researchers that have worked abroad for 3 months or more at least once in the last ten years of their post-PhD career, in % and by panel country	**12.2%**	27.4%	16.7%	27.7%
Non-mobility: share of R1 PhD candidates and R2 (post-doctoral or equivalent) PhD holders that were never PhD degree mobile nor >3 months mobile during their PhD, in % and by country of PhD	**73.8%**	69.7%	71.5%	65.8%
Non-mobility: share of R2-3-4 researchers that have never worked abroad for more than 3 months during their post-PhD career, in % by panel country	**79.9%**	54.5%	64.1%	51.2%

Source: European Commission, MORE3 study (2016). Notes: R1 – doctoral or equivalent; R2 – Post-Doctoral or equivalent; R3 – Established Researcher; R4 – Leading Researcher

Latvia's potential to attract foreign researchers depends on the overall attractiveness of its HE and research system and the alleviation of specific barriers faced by foreign researchers. The level of attractiveness is closely linked to the overall framework conditions for research careers in Latvia. As discussed above, these include competitive wage levels, adequate balance in job and income security, transparency in appointment and promotion systems, etc. Further, Latvia needs to stand out in the global competition for bright minds, since talent attracts talent.

There are, however, significant barriers in the current system that limit, if not prevent, foreign researchers from working in Latvia. As already described, the appointment of staff is carried out by the Councils of Professors composed of the staff of the relevant research area, raising concerns about the transparency and openness of the selection process. One of the biggest barriers is language. First, most vacancies are advertised only in Latvian in a dedicated newspaper, and researchers from abroad are not likely to learn about these vacancies. Second, some of the application documents need to be submitted in Latvian. Last, Latvian language requirements for teaching in HE provide barriers to accessing academic positions.[27]

3.2 Recommendations

To achieve the ambitious objective of increasing researcher numbers, there is a need to improve the attractiveness of research careers, increase the graduation rates and quality of PhD studies, and attract researchers from abroad.

(1) Strategic recommendation: improve attractiveness of research careers

1. Competitive and stable salary from a single employment contract is a basic precondition for a career system. This implies that most of the academic staff and researchers should work on a full-time basis in a single institution. Employment contracts should establish the workload and other requirements as well as salary. Setting competitive salary levels will require additional resources. In 2017, Latvian HEIs (excluding colleges) spent, on average, €15,600 per annum on salaries of academic staff (calculated per head rather than in FTEs; net of social security taxes). This is just slightly more than €1,000 per month on average. The text box below discusses what could be internationally competitive levels of salaries, based on data from Spain as well as the implications for HEIs budgets.

[27] The Law on Higher Education Institutions stipulates these requirements, Section 56 describes the use of official language and section 33 describes election of professors.

Salary levels

Spain is selected as a benchmark, because it offers rather low, but generally acceptable, salary levels and, as a result, does not suffer from mass brain drain. Further, members of academic staff in Spain are regarded as 'civil servants', so the same transparent salary levels and bands are set for all researchers. The salary level for each category of academic staff consists of two components: basic salary and premiums. The latter depend on the evaluation of research activities (assessment carried out every six years) and teaching (awarded every five years). Some additional salary allocation can be provided by the regional governments, based on performance as well.

For example, for a full professor who has 20 years of experience since becoming a civil servant (shown as an example in the table below), the total salary includes:

- The basic salary of €43,075
- Six times the premium after the years in the post (€603.33 after every three years spent as a civil servant)
- Four times the teaching premium (€1,884) – this premium is awarded every five years, a maximum of six times in total
- Three times the research premium (€1,892) – it is awarded every six years, but only after a successfully completed research assessment – and this premium can be awarded a maximum of six times in total

In total, the annual salary is €59,908

We use two scenarios to translate Spanish salary levels to Latvian ones:

- Direct translation, using the salary levels for academic staff in Spain (column 'Total"). Here the salary levels are closer to the lower band, when compared to the other advanced HE and R&I systems. Similar to Latvia, due to the deep financial crisis, salary levels in Spain have been cut and remained frozen for nearly a decade
- Account for differences in GDP per capita (in purchasing power parities), which is 24.8% lower in Latvia than in Spain.

Data below refers to annual salaries (including taxes and social security contributions). The three positions requiring PhD degree do not neatly correspond to the classification of academic positions in Latvia, but they are to a large extent comparable.

	Spain				Estimates for Latvia (based on GDP per capita)
	Minimum requirement	Basic salary	Premium	Total	
Full professor (CU)	20 years of experience	€43,075	Based on the years in post (€603.33 awarded every 3-years x 6): €3,620 Teaching (€1,884 awarded every 5-years x 4): €7,536 Research S (€1,892 awarded every 6-years x 3): €5,677	€59,908	€ 44,931
Associate professor (TU)	10 years of experience	€34,172	Years in post (3-year periods x 3): €1,810 Teaching (5-year periods x 2): €3,768 Research (6-year periods x 1): €1,892	€41,642	€ 31,231
Assistant	PhD degree	70% TU: €26, 800		€26,800	€20,100
PhD candidate		€22,600		€22,600	€16,950
Senior lab. technicians	4-5 year degrees or Master	€15,577	Job-placement: €6,524 Administrative category: €9,184	€31,285	€23,463
Technicians	Graduates, 3-year degrees	€13,805	Job-placement: €5,866 Administrative category: €6,890	€26,561	€19,920

Budgets of HEIs

Providing competitive salary levels will have budgetary implications. To gauge them, below we provide comparative data for HEIs in Latvia, Spain and Lithuania. For instance, the University of Latvia has a similar number of students and academic staff (headcount) as University Jaume I (Spain). Both universities also spend similar shares of their budgets on salaries and social security contributions (59% and 65% for University of Latvia and University Jaume I accordingly). However, the budget of University of Latvia is 37% smaller than the budget of Spanish University.

HEI	No. of students (thousand)	No. of academic staff headcount/ FTE (thousand)	Expenditure			
			Total (€ mill)	Salary (%)	Social security (%)	Scholarships (%)
University of Latvia 2017 (Latvia)	15	1.4/N.A.	65.6	47%	12%	4%*
Riga Technical University 2017 (Latvia)	14.3	0.98/N.A.	50	47%	12%	5%
University Jaume I 2019 (Spain)	15	1.4/N.A.	103.9	64.7% (incl. SS)	---	---**
Polytechnic University of Valencia 2019 (Spain)	28.5	2.6/N.A.	341.3	48%	9.2%***	---**
Vilnius University 2018 (Lithuania)	17.8	2.8/1.8	99.61	53%	17%	10%

Notes: * includes transport expenditure; ** scholarships to Spanish university students awarded by the Ministry of Education; *** Social security payments are very low for civil servants

Ensuring competitive and stable salaries will require further increases in the level of funding. However, significant progress can be also achieved by addressing the existing bottlenecks:

- Reduce fragmentation of the study programmes. The large number of small study programmes and multiple units with few students implies that academic staff have significant teaching workloads, but incomes per hour are low. Furthermore, this also implies that relatively small annual changes in the student numbers translate into large fluctuations in the workload and corresponding salaries of academic staff. This problem can be addressed through three complementary initiatives:

First, the HEIs should strategically review their offer by merging the existing programmes around the core competences of HEIs and their units, offering joint courses for the first year undergraduate students, etc. The Government can facilitate this process by designing 'profiling' programmes similar to the ones in Finland (see text box below). These can be funded from ESIF in a competitive manner during the 2021-2027 programming period.

Competitive funding to strengthen university research profiles

Targeted funding to strengthen Finnish universities' research profiles was one of the instruments proposed in the research and innovation policy action programme drafted by the Ministry of Education, Science and Culture and the Ministry of Employment and the Economy in 2012. The corresponding proposal was also included among the recommendations issued in the international evaluation of the Academy of Finland.

The aim of this funding mechanism is to support and speed up the strategic profiling of Finnish universities in order to improve their capacity for enhancing the quality of research. Based on their own strategies, universities are invited to apply for funding with concrete plans for improving conditions for high-quality/high-impact research, detailing proposed profiling measures with clear schedules for each step. The funding is intended for measures that strengthen the universities' strategic research fields (including new initiatives) and support any related deselections. The funding is open to all scientific, scholarly and artistic disciplines.

The funding is applied for by universities, each university with its own application. The funds are made available in the form of fixed-term development funding to be used to cover the specific costs associated with the transitional changes. Funding encourages universities to establish new tenure track positions to their strategic research fields, which could include building on existing strengths or developing potential in relatively new fields of research.

For more information visit https://www.aka.fi/en/research-and-science-policy/university-profiling/

Second, the Government should also introduce thresholds for minimum numbers of students in a study programme after consultations with the academic community. These should take into account the specificities of each study field.

Third, mobility of students between the departments within an individual HEI, and between different HEIs, should be encouraged. This step aims to ensure students' access to a broad range of knowledge, that cannot be offered by a single department or HEI. This would also help share resources among the HEIs. Collaborations could take different forms, ranging from joint (interdisciplinary) programmes offered by several HEIs to unit-mobility, based on the principles of the Erasmus programme.

- Reduce fragmentation of the institutional landscape. A significant share of HEIs' academic staff and scientific institutes' researchers work across multiple institutions and hold multiple positions within the same institution. From the individuals' perspective, this is necessary for securing sufficient aggregate incomes. However, from a systemic perspective this is not efficient and results in low returns from any given position. The Government can facilitate discussions within the academic community, by providing: a) support for the development of credible medium-long-term projections of financial

sustainability of HEIs and scientific institutes; b) financial support covering the costs of mergers

- Review the legislation establishing different academic and research positions with the view of ensuring coherence between teaching and research tracks, and allowing for smooth transitions between the different positions

- Review adverse incentives in the funding system. The level of institutional base funding largely depends on the number of elected academic and research staff (FTE). This provides incentives for institutions to have a large number of elected staff employed on a part-time basis.

2. Predictable and transparent career progression pathways are essential for building long-term commitment to a research career and for incentivising performance. There is a need to move away from a system exclusively based on fixed-term contracts awarded on the basis of open competition, towards a mixed system, including tenure track positions. This implies that:

- Predictability and stability of HEIs' and scientific institutes' income should increase in order to accommodate the financial commitments linked with tenure track positions. The Government can achieve this by increasing the level of basic funding to institutions. If this is not feasible, the Government should review its investment priorities. In the past, the Government has allocated significant funding to programmes targeted at PhD students and postdocs. While these programmes provided a temporary boost to specific target groups, the long-term sustainability of their impacts are not clear. Reallocation of these investments to competitive research funding could build more sustainable commitments to research careers[28]

- Concerning the technical staff that supports the researchers, the proportion that currently exists in Latvian institutions is adequate. However, their careers should also have a clear and predictable path. Measures are needed to tackle fragmentation by increasing the homogeneity of contracts, but also flexibility, to assure they adapt to the needs of the researchers. Provide incentives based on performance

- The Latvian Council of Science should set clear minimum requirements for entry and progression along the tenure track system in line with the results of consultations with the academic community. In addition to these minimum (common) requirements, each HEIs and scientific institutes could introduce other characteristics in line with the necessities of teaching and/or research in this particular field and on the strategic institutional priorities. The system adopted in Spain provides a good example in this respect.

[28] To counter possible adverse effects of competitive funding favouring established researchers, separate calls can be announced for young and established researchers

Individual research productivity assessment in Spain: the sexennium

In 1989, the Spanish government reorganised the university system, including the introduction of a very simple and effective indicator for assessing research activities. This system is still in place after 30 years and has allowed for a specialised and consistent evaluation of individual research. It is based on a research performance incentive that academics ('civil servants') can apply for every six years and open only once a year (in December). The evaluation is carried out by the National Evaluation Commission of Research Activity (Comisión Nacional Evaluadora de la Actividad Investigadora or CNEAI in Spanish), which appoints independent experts (5-10 per commission) for two or three years in 11 evaluation fields. Initially, both university professors and scientific researchers in the public system (working not only in universities but also in research institutes) could apply to these 'sexenniums'. Since then, this has been extended to the rest of the public and private research sector.

Every year, the composition of the commissions, as well as the specific criteria to be applied in the different fields, are published in the Spanish Official Journal (Boletín Oficial del Estado or BOE). In December, an on-line platform is opened where the applicants upload information about five contributions (that they select) from the previous six years, providing brief information about them (title and reference, summary and quality indicators). Every contribution (it can be a book, a paper, a patent, an exhibition, etc., depending on the field) is given a mark between 0 and 10. To obtain the sexennium, they have to reach 30 points (an average of 6 points per contribution). The maximum number of sexenniums a researcher can accumulate is six.

Although it was conceived as a small incentive (around €125 per month per sexennium), it turned out to be a simple method to assure a minimum level of research quality. Therefore, the sexennium has been used as a requirement for several research activities, such as PhD thesis supervision, to be a jury in public competitions (for university professors), etc. The sexenniums are not static: the commission members make suggestions about the minimum requirements concerning the quality of the contributions, so that with time, these requirements have become more demanding, following the progress of science and technology.

(2) Strategic recommendation: improve the graduation rates and quality of PhD studies

1. It is not the number of PhD students, but the number of PhD graduates that matters for strengthening the body of researchers in Latvia. Due to low graduation rates, boosting only the numbers of students would not deliver the needed results. Hence, efforts should focus on increasing graduation rates. This requires improvements in the quality of PhD studies and provision of adequate incomes for PhD students. Therefore, we recommend:

- Increasing the level of monthly stipends from €113 to the level slightly above average monthly wage (approx. €1,000) per month per full-time student.[29] This would require additional €23.4 million per annum (assuming that there are 2,200 students and stipends are not taxed). If this is not feasible, as a temporary measure, we recommend reducing the student intake and using the resources saved for stipends. Such a counter-intuitive measure may boost the number of graduates as well

- Recipients of stipends should be committed to contribute to activities performed within the HEI (with the exception of first year students), i.e. teaching and research activities of the host research group. To avoid exploitation, the PhD contract should set a maximum number of hours a PhD student is expected to work on teaching and research

- These steps should be accompanied by requirements that PhD studies are not compatible with full-time work outside respective HEI (with the exception of industrial PhD programmes)

- The Government should incentivise institutions to help their PhD students graduate within four years. For example, decisions on the number of state-funded PhD student positions in each institution could take into account what share of their students graduate within four years.

1. While the overall number of PhD graduates in Latvia is very low, STEM fields face particularly large challenges. In 2017, there were only 56 STEM PhD graduates in total, and in some sub-fields, such as mathematics, there was only one graduate. At the same time, most of the engineering fields and mathematics are characterised by a body of researchers where more than 30% of scientists are older than 65 years. Addressing this problem requires coordinated effort, including: addressing shortages of STEM teachers in secondary education, expanding access to extracurricular activities in STEM fields, information campaigns on career pathways of STEM graduates targeted at secondary school students, development of joint Master's and PhD programmes with foreign universities to boost the prestige of STEM studies, and a higher share of

[29] It is essential to ensure balanced payment structures for different categories of academic staff. Hence, increases in stipends significantly beyond €1,000 net per month would also require further significant increases in wages for postdocs, associate professors, and professors.

competitive R&D funding targeted at S3 priorities that naturally cover some of the STEM fields

2. A recent World Bank study[30] provided a number of specific recommendations on improving the quality of PhD studies, including: setting quality, standards, reviewing funding mechanisms to ensure completion and promote efficiency and quality, strengthening the taught component of doctoral programmes and skills development, development of quality assurance mechanisms, strengthening quality of supervision, setting up of doctoral schools and others. While supporting these recommendations, we also propose:

- Clarifying the concept of doctoral schools. A number of HEIs claim to have functioning doctoral schools, however their mode of operation, functions, scale (i.e. number of students) and disciplinary scope appears to be rather different from the schools operating in other EU countries

- Setting excellence in research and critical mass as preconditions for offering PhD programmes. The results of the upcoming RAE could provide valuable information regarding which study programmes meet these criteria. The bar should be sufficiently high to incentivise the pooling of available HEIs' and scientific institutes' resources for the development of joint study programmes or for setting up joint doctoral schools. It is particularly important, formally, to involve scientific institutes in doctoral training, given that they have a significant concentration of research excellence, received investments to develop their research infrastructure, and they have been historically 'informally' involved in doctoral training

- Ensuring that public funding for tuition costs of PhD studies is secured for this specific purpose, i.e. not diverted to cover an institution's other financial needs. Some of the funding should be earmarked to cover the costs of international mobility, such as participation in conferences, study/research visits, etc. This should provide more clarity and empower students to use the funding for advancing their research project

- Funding per student per field of education should be reviewed with the goal of reducing the significant differences among the programmes. Currently, some of the arts (e.g. music, choreography, audio-visual media) study programmes receive over three times more funding than social sciences and nearly twice as much as PhD programmes in natural sciences. These proportions are based on the differences in the costs of study at undergraduate level. However, the factors that affect the cost of PhD studies (e.g. cost of equipment and materials used) are highly different from those affecting undergraduate studies. For the latter, the substantial differences in the sizes of the programmes can explain significant variation in the associated costs. Lithuania provides a good point for comparison. Similar to Latvia, Lithuania differentiates funding levels per student in different Bachelor's and Master's programmes. However, in Lithuania funding per PhD student is the same for

[30] World Bank, 2018

all fields of study (€9,449 per annum as of 2019), which is considered largely sufficient to cover all the costs of the different study programmes.

(3) Strategic recommendation: foster internationalisation (including support for the mobility of researchers working in Latvia as well as attraction of talent from abroad)

1. There should be strong support to increase the levels of researcher mobility (in the form of fellowships and research visits, for example) to leading international research institutions. Longer-term mobility of experienced researchers is an effective way to strengthen competence and develop the international networks necessary for participation in the European Framework Programmes and other international research programmes. Mobility periods should also be integral parts of PhD studies. Personal connections and networks are particularly effective in boosting the global visibility of the Latvian higher education and research system. In addition to more focus on longer-term mobility, participation in relevant conferences by the researchers and PhD students also contributes to building international visibility and networking. There are different existing opportunities offered to seek funding for mobility periods (e.g. Erasmus+ Programme). Based on crude calculations, the costs of participation in international conferences for every PhD student and researcher within HEIs and scientific institutes would be approximately €5.2 million per annum.[31]

   Fostering such increased levels of international mobility and enhanced visibility does not necessarily require a separate funding programme. The costs of mobility of PhD students could be covered from earmarked public funding for tuition costs of PhD studies (see above). The costs of mobility of other researchers could be covered from the budgets of research projects and/or funded through dedicated Research Council calls launched annually.[32]

2. Make targeted efforts to attract talent from abroad. This will be challenging. First, countries that in the past have experienced brain drain are usually the most successful in attracting nationals. However, a survey of members of the Latvian scientific diaspora suggests that most them do not plan to return or are undecided.[33] Second, it is challenging to attract

[31] Assumptions behind the estimates: full costs of participation in a conference, on average, is about €1,000 per participant; in 2018 there were 3,005 scientists (researchers with PhD) in HEIs and RIs as well as approximately 2,200 PhD students.

[32] Predictability and low administrative costs are essential for such schemes. Hence, it is important that calls are launched every year and proposals are assessed in a timely manner. Evaluation criteria could focus on the demonstrated research excellence of the applicant (different criteria for young and advanced researchers), prestige of destination institution/conference, in case of a conference - whether a publication can be expected based on the conference paper.

[33] Bela, B., Berzins, K., Krebs, V., Mierina, I., Vingre, A. 2018. Latvia's science diaspora: cooperation networks and opportunities. Available here:

top researchers, because they typically hold a tenure track or tenure position at an established university and therefore have few incentives to move elsewhere for a prolonged period of time. To address these challenges, a combination of the following approaches should be adopted:

- Grow the existing islands of excellence. Latvia should identify and support a limited number of research units/research fields. The scheme should target young researchers who have finalised their postdocs at established institutions and aim to set up their own research teams as well as enter tenure track. This offer will be attractive if the host unit has already achieved global excellence and recognition. The grant should offer an internationally competitive salary and cover the costs of relocation. Similar programmes are available in many other counties. The textbox below showcases an example from Lithuania

- Create new 'islands of excellence'. Latvia should identify a limited number of research fields, where it aims to create internationally competitive pools of excellence. The scheme should target established researchers and provide them with sufficient funds for hiring international teams of younger researchers. To make this attractive for established researchers, the scheme should allow for shorter visits (1-3 months per year) over prolonged period of time (e.g. five years). The rest of the team should be employed on a full-time basis. The host institutions should provide sufficient freedom and administrative/managerial support for launching research programmes and setting up (or improving the existing) Master's and PhD programmes. Further, based on the high visibility of the scheme, the host institutions should make particular efforts to raise additional resources from companies (e.g. by offering named positions)

https://www.izm.gov.lv/images/statistika/petijumi/LU-SPPI-DMPC_Zinatnieku-diaspora-2018.pdf

Attracting researchers from aboard: Lithuanian experience

Just like Latvia, Lithuania has long suffered from brain drain. Hence, recently it launched two broadly similar schemes:

- 'Attraction and reintegration of brains – SMART': call launched in 2018, the total budget allocation was €14.5 million, with a funding per project up to €1 million. The call funded 13 projects in total led by researchers from abroad, including 11 Lithuanian nationals. The maximum project duration is 48 months[34]

- 'Distinguished professors programme': call launched in 2019; with a total budget of €5.8 million. The funding per project was up to €1 million with project duration of between 36 and 42 months. There were 29 applications submitted requesting a total of €26.3 million. It is expected that six or seven projects will be funded (the proposals are being evaluated at the end of 2019 when writing this report)[35]

Both schemes provide funding for ambitious research projects that are led by researchers who have been employed in foreign HEIs or scientific institutes for at least five years over the past six years. The funding covers the wages of the lead researcher and his/her team, in addition to research expenses and overheads at the host institution (Lithuanian HEI or research institute). The wages of the team (but not lead researcher) are calculated on the basis of standard fixed rates used by the Research Council of Lithuania. Wage levels for the lead researcher are significantly higher. Overall, the results of the first call suggest that the schemes managed to attract top-notch scientists, although implementation involved several challenges. Relevant lessons learned from the first call include:

- The number of eligible applications for the first call was relatively small. Hence, the second call engaged in a wider information and dissemination campaign as well as dropped the requirement of physical presence on a full-time basis throughout project implementation for the lead researchers

- The high hourly rates set for the lead researchers of the first call were challenged by the National Audit Office as unjustified. Hence, the second call used the previous wages of the attracted researchers as a basis for estimating hourly rates

[34] See: https://www.lmt.lt/en/research-commissioned-by-the-state/attracting-foreign-researchers-for-research-implementation/2750

[35] See: https://www.lmt.lt/en/competitive-research-funding/researcher-initiated-projects/distinguished-professors-programme/3243

The success of the efforts discussed above will depend critically upon:

- Leveraging ESIF and national resources with the funding opportunities offered by FPs, such as the COFUND instrument of Marie Skłodowska-Curie Actions, ERA chairs, Teaming and Twinning actions, in the latter Latvia has good track record in securing funding

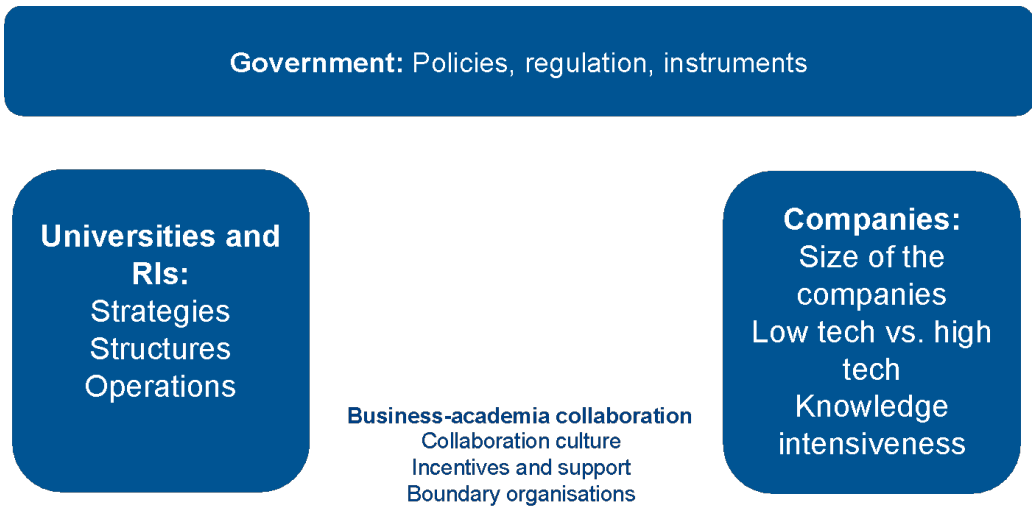
- Global outreach and information dissemination campaigns

- Measures taken to ensure continuity and the sustainability of impacts. The host institutions should be obliged to offer employment contracts at the end of the projects. Further, the incoming researchers should be required to attract additional grants from national and international schemes. This could be used to co-fund the costs of the project as well as provide resources for covering wages after project completion.

3.3 Policies for developing the employment of S&T human resources in the Latvian Business sector

This chapter focuses on the second research question of the study, more specifically the demand side of the human resources developed, with a special focus on employment opportunities and perspectives in the business sector. In Figure **8**, the main elements affecting the absorptive capacity of S&T human resources in the business sector are presented. These are discussed in more detail in the subsequent chapters.

Figure 8: Elements affecting the absorptive capacity of S&T human resources in the business sector



3.3.1 Policies and interventions supporting the development and employment of S&T human resources

Government has a key role in supporting universities, RIs and companies with funding that enhances academia-business collaboration and, subsequently, has potential to increase the absorptive capacity of companies. Government regulations provide framework conditions that can both enhance and complicate, or sometimes even prevent, collaboration. In addition to providing the framework conditions, governments have more direct ways to intervene in building the absorptive capacity of businesses. They can establish and provide support to intermediary organisations working to bring businesses and academia together.

At policy level, the national government has several programmes that enhance collaboration between academia and businesses. These include the Technology Transfer programme (€40m for 2016-2020, ESIF funded) and the Innovation Voucher scheme (€24.5m for 2014-2020, ESIF funded). The latter scheme provides co-financing for private companies to acquire services from research institutions and to support the employment of researchers in private companies. The measure supports a range of initiatives addressing different needs to help connect business and scientific institutes throughout the different stages of collaboration. Available support covers the early steps, such as the work of technology scouts, networking events, start-up vouchers, and acceleration funds.

The technology transfer programme includes technology scouts who provide a one-stop shop for companies to find and access expertise from higher education and research institutes. The new set-up with the technology scouts represents a way to modernise the technology transfer system in Latvia. The technology scouts work for LIAA, but they are located at various institutions. One of them is permanently at UL, while another one is based at RTU. Five other scout teams are working in the Smart Specialisation scientific areas. The technology scout programme is connected to the Innovation Voucher programme, which provides support for collaborative activities once the company has established a connection with the relevant academic partner. Since the introduction of Innovation Voucher Scheme in Latvia, in 2017, only 5 companies out of total 92 have implemented projects that include the attraction of researchers within their project.

At the moment, the key instruments for enhancing collaboration between businesses and academia include the Cluster programme and the Competence Centre programme. During the 2014-2020 programming period, 14 Clusters were supported. The objective of the Cluster programme is to increase the competitiveness and export capacity of SMEs, promoting greater productivity and high value-added products and services. The programme supports cooperation and networking among SMEs, education and research institutions and other partners to develop common marketing, internationalisation and research activities as well as other projects aimed at developing new products and access to new markets.

The Competence Centre programme is funded by Structural Funds, and like its counterparts in other European countries, it aims at increasing the competitiveness of businesses through collaborative research carried out for the

purposes of new product and technology development. In total, there were eight Competence Centres (€72.3m for 2014-2020, ESIF funded) established in the priority areas defined in the country's Smart Specialisation Strategy. In practice, the established Competence Centres are vehicles for distributing funding for collaborative R&D projects. The funding support varies between 25% and 80%, depending on the type of enterprise (SME, large enterprise), the type of research (industrial research, experimental development), and on the publication of research results. The Centres engage most of the 230 R&D active companies in Latvia. By the end of 2018 the programme had funded 191 research projects that were carried out by 492 researchers, including 175 PhD students and recent PhD graduates. The Competence Centre programme provides a good foundation for further developing academia-business collaboration. However, it has not yet succeeded in attracting non-innovative companies to take part in research-related activities.

During the upcoming 2021-2027 period, the Ministry of Economy plans to provide part of the funding targeted for industry development in different value chain ecosystems in the fields of smart cities, smart materials and biomedicine. At the core of this value chain ecosystem development is a strategic and systematic approach to business collaboration and fostering entrepreneurial excellence. Over time, other Smart Specialisation areas might also have the potential for developing similar ecosystems. There are plans in the future to address the bioeconomy and smart energy as well.

A number of other programmes also aim to increase innovation capacities in businesses. These include an innovation motivation programme, support for employee training, incubators, technology intensive start-ups, and others. Almost all relevant support instruments for companies are in place, but the absorptive capacity for these measures among companies is fairly low. Reasons for this could be the following:

- As a majority of the industrial companies are low-tech companies, most service companies are not very knowledge-intensive and SMEs dominate the business sector, the innovation capacity of companies is low
- Companies may perceive many of the support measures as being too burdensome and bureaucratic
- Companies, and especially SMEs, are not aware of the possibilities available.

The value and importance of science and technology in society is not sufficiently recognised or valued in Latvian society. This has many consequences, of which one of the most crucial is the unpopularity of science and technology among students.[36] The Ministry of Economics has the Innovation Motivation programme

[36] See more e.g. Kiselova R. and Gravite A. (2017): STEM Education Policies and their Impact on the Labour Market in Latvia. *Current Business and Economics Driven Discourse and Education: Perspectives from Around the World,* BCES Conference Books, 2017, Volume 15. Sofia: Bulgarian Comparative Education Society, ISSN 1314-4693 (print), ISSN 2534-8426 (online), ISBN 978-619-7326-00-0 (print), ISBN 978-619-7326-01-7 (online)

targeted especially at young people with the aim of increasing their awareness and to encourage them to become entrepreneurs and engage with innovation activities. The European Researchers' Night is an international annual event also targeted at young people. In addition to these national and international activities, some universities have further dedicated actions such as RTU's engineering high school. Despite these efforts, there is a clear need for further actions targeted at young people and adults. To reach the desired target audiences, science and research campaigning has to go off-campus; it needs to be showcased at places where people spend their time. (e.g. at schools, shopping centres, parks). A school related example of LUMA centre is provided below. Another example of this is 'science slams', where scientists present their scientific work in a given time frame – usually 10 minutes – in front of a non-expert audience. Presentations are often entertaining and follow unconventional formats like stand-up comedy. The presentations are judged by the audience. Science slams can take place in a restaurant, pub or school, and they can be open to all fields of science or limited to a certain theme.

The LUMA example

The aim of the **LUMA Centre Finland** is to inspire and motivate children and youth to learn mathematics, science and technology through the latest methods and activities of science and technology education. The aim is also to support the life-long learning of teachers working at all levels of education from early childhood to universities, and to strengthen the development of research-based teaching.

LUMA Centre Finland combines all the LUMA centres in Finnish universities. The LUMA2020 programme, funded by the Finnish Ministry of Education and Culture, started in the autumn of 2019 across Finland. The aim is to develop formal education from early childhood to upper secondary education, as well as science and technology-education-related free time activities for children, youth and their families. The programme will also support the continuous professional development of teachers from early childhood education to higher education through new project learning models and practices introduced. A total of 161 learning communities were selected for the LUMA2020 programme. In these learning communities there are formal learning communities such as kindergartens, schools and vocational schools, but also informal learning communities such as hobby schools.

The results of the programme include free online courses (MOOCs) and other virtual activities, such as virtual clubs for all kindergartens and schools in Finland. The programme provides online education materials for teachers and a number of regional meetings over the 2019-20 period. The programme will culminate in nationwide LUMA Days at Aalto University in 2020. During the event the learning projects and learning communities will be presented to the public.

For more information visit https://www.luma.fi/en/

3.3.2 Latvian business sector

The Latvian business sector suffers skill shortages especially in ICT, as well as construction, engineering, metalworking, shipbuilding, healthcare and medicine. For example, the ICT sector needs approximately 3,000 young professionals each year, but the universities are only providing around 600 ICT specialists a year.[37] At least in some sectors of the economy, there is a shortage of highly qualified labour. More generally, it can be argued that the innovation capacity and absorptive capacity of S&T human resources in the Latvian business sector is rather limited. This is mainly due to the five reasons explained below.

First, the industrial sector is mainly characterised by low-tech firms (see Figure 5). The share of both medium-high and high-tech firms is 15% of the total manufacturing sector, while the corresponding EU average is 47%. The main industrial export sectors include wood products, agri-food, machinery and electrical equipment, chemical products, and metal products. The first two sectors – wood products and agri-food – have a good knowledge base in the country, with well-embedded research institutions and skills development. They are also related to Latvia's S3.

Second, the service sector plays a significant role in the Latvian economy. The service sector accounted for over 70% of the economy in 2018. Of all business sectors, ICT was the second-fastest growing in 2018, just above construction and above transport and storage. Transport and tourism account for almost 60% of service exports, followed by ICT (16%) and business services (14%).[38] Studies have shown that service companies innovate with greater emphasis on human capital development than manufacturing companies.[39] For service companies wanting to innovate, it is therefore important to invest in human capital. Innovations in service companies often tend to be non-technological. They mostly involve small and incremental changes in processes and procedures and have often already been implemented by other service companies.[40] As most of the Latvian service companies operate in less knowledge-intensive sectors (like transport, tourism, retail), innovation would require considerable human capital investment and development. Among the service sectors, ICT, and to some extent also financial services, are clear exceptions when it comes to innovativeness and human capital development.

Third, companies in the Latvian business sector are small compared with the EU28 average. SMEs account for 70.0% of value added and 79.0% of employment, significantly higher than the respective EU averages of 56.8% and

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[37] See more https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/latvia-mismatch-priority-occupations

[38] OECD Economic Surveys – Latvia, May 2019.

[39] See e.g. Tether, B. (2005): Do Services Innovate (Differently)? Insights from the European Innobarometer Survey. *Industry and Innovation, Vol. 12, No. 2, pp. 153-184;* Gallouj, F. Savona, M. (2009): Innovation in services: a review of the debate and a research agenda. *Journal of Evolutionary Economics, Vol. 19, pp. 149-172*

[40] ibid

66.4%. The majority of SMEs are in the wholesale and retail trades or manufacturing sectors, with a combined contribution of 44.9% to total SME value added and 43.4% to SME employment. Latvian SMEs' annual productivity is considerably lower than the EU average – at under €17,200 per person, it is less than half the EU average of €43,900. The relatively small size of the companies, together with the fact that most SMEs operate in less knowledge-intensive sectors, makes it hard to create the critical mass of innovative companies needed to achieve targets for R&D expenditure and employing highly educated professionals.

Fourth, although the share of foreign-owned companies in Latvia is higher (6%) than the EU average of 1%, the share of RDI-related FDI is low. In 2017, Latvia attracted €650 million in FDI. Investments from EU countries dominate FDI in Latvia. According to Bank of Latvia statistics, in 2018 one quarter of the total FDI was in finance and insurance, 15% in retail and wholesale, 13% in real estate and 12% in manufacturing. Agriculture, forestry and fishing attracted about 4%, as did construction and transportation. Professional, technical and scientific services accounted for less than 2%. Thus, it can be argued that most FDI is not RDI intensive. A survey of foreign investors shows that, in general, their view of the Latvian investment environment is positive. However, they see the availability and quality of the workforce as one of the acute problems, and the quality of education and science as one of the chronic problems.[41]

Fifth, a large proportion of GDP (about 30%) is produced in state-owned enterprises (SOE) in Latvia, but the RDI efforts of these companies are only moderate compared with the potential they possess. These firms share with other companies' concerns about the lack of adequate skills among mid-level and technical employees, and about the need to develop more business-oriented knowledge and skills in the Latvian educational system, to serve the needs of the labour market in the coming years.

In international markets, Latvian companies' competitiveness is to a large extent based on low labour costs, and exports focus on low-tech industrial sectors. However, labour costs are rising and, as Latvian productivity levels are below the EU average, it is important to invest in productivity gains in order to sustain international competitiveness. Thus, there exists a clear need for RDI investments and RDI-related human capital in most sectors of Latvian business.

In spite of the weaknesses discussed above, there are also some positive developments:

- There seems to be an increasing number of examples of firms improving their added value through investments in RDI. Private firms with business-to-business products in the wood and ICT sectors seem to have been developing

[41] The Foreign Investors Council in Latvia (FICIL) Sentiment Index 2018.

higher added value products in close collaboration with external partners and customers[42]

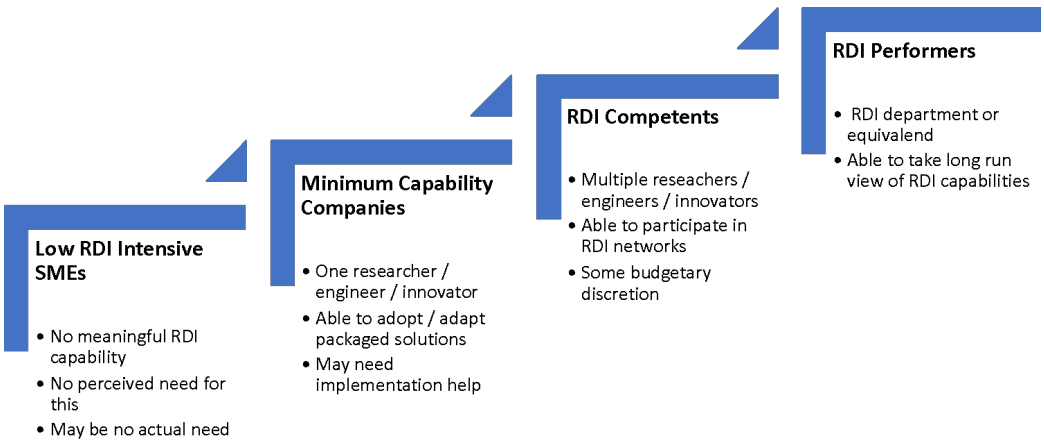
- Latvia has a small but successful biomedical and pharma industry, as well as a relevant biomedical research base which is located in universities, university hospitals, and research centres. A good example is Latvia Biobank, which is co-owned by the University of Latvia (Latvian Biomedicine Study and Research Centre) and a university hospital, in what seems to be a very strong institutional collaboration, and is funded by the EU ERIC scheme. The biobank collects data and conducts biomedical research. It also collaborates with industry, undertaking clinical trials of pharmaceutical products. Although clinical trials are in the late phases of product development rather than in the first steps of research, positive interaction with industry – both national and international – is clearly emerging around the biobank. This is one strong performer of R&D in the country

- There is a small but dynamic start-up scene emerging in Riga, particularly in the IT sector and around the Riga-based universities. However, the start-up ecosystem in Latvia is still small and faces several barriers including considerable red tape and the lack of venture capital at national level.

3.3.2.1 Enhancing absorptive capacity in SMEs

As noted earlier, it can be argued that the innovation and absorptive capacity of S&T human resources in the Latvian business sector is rather limited. Thus, there is a clear need for a system that fosters capacity building in addition to support given to RDI activities; helping and enabling companies to do RDI-related activities. Figure **9** provides a way to describe different levels in capacity building.

Figure 9: Simple hierarchy of RDI capacity



Source: Modified from Arnold and Thuriaux, 1997

[42] See e.g. https://www.em.gov.lv/en/news/21617-european-commission-support-programmes-for-competency-centres-and-clusters-promote-the-development-of-innovations-in-latvia

At level 1, Low-RDI SMEs, the absorptive capacity is very low or non-existent. There are successful examples of how to start from the first steps. For example, companies can hire a university student for an internship or engage a group of students as part of their curricular or extra-curricular activities in problem-based learning (e.g. a Demola project). An example of how universities can approach SMEs is presented in the text box below. Another more resource-intensive way of increasing the capabilities of a company is hiring an innovation expert. For a small company this might seem to be a risky first step to take, especially alone, but as a shared resource with other small companies, it might seem to be more feasible.

The FirmTeam example

FirmTeam at the Lappeenranta University of Technology, Finland is a group of students who are working to enhance the collaboration between university students and SMEs. With FirmTeam's help, a company can receive research assistance for business development, fresh ideas from potential employees and have access to future talents.

FirmTeam students actively contact SMEs in the region and tell them about the possibilities that students can offer. For example, a company can get various research work done by students, including current technology insights, market studies or future roadmaps. Students can do assignments, theses, part-time jobs, summer jobs and project work in the company. The service is free of charge for companies.

For more information contact: firmatiimi@groups.lut.fi

In case of Minimum-Capability Companies at level 2, it is important to enhance company interest in investing in RDI. Building linkages and creating collaboration with external knowledge sources, like universities and scientific institutes, is a feasible way to do it. As the Innovation Vouchers scheme has not been very popular among SMEs, the technology scouts provide an essential preparatory activity for creating the linkage. Experiences in other countries like Sweden and Finland show that SMEs need hands-on advice when starting their innovation activities and finding the right collaboration partners in universities and scientific institutes. An example of these experiences is provided in the following text box.

The Industry Puzzles Friday example

Industry Puzzles Fridays offer SMEs easy access to the expertise of researchers and other professionals based at Tampere University, Finland. The service is designed to help SMEs achieve, among others, the following goals:

- Turn product ideas into reality
- Develop products or production processes
- Put new technologies into use
- Resolve problems that don't have existing solutions in the market

The service is designed for existing and active companies, and the local Chambers of Commerce, together with the Entrepreneurs' Association, help in communicating the benefits of the service for SMEs. After getting a short description of the company's problem, The Tampere University Company Services puts together a multidisciplinary team of experts and schedules an hour-long meeting for the parties.

The service is free of charge. All discussions and information provided by the company are kept strictly confidential. The purpose of the meeting is to map out potential solutions and opportunities for collaboration with the University.

For more information visit: https://www.tuni.fi/en/services-and-collaboration/industry-puzzles-friday-easy-access-expertise

For universities and scientific institutes, collaborating with companies at levels 1 and 2 requires an effort to encourage SMEs to collaborate. During such 'activation', face-to-face communication (e.g. meetings, seminars) are the most effective methods. Especially for companies at level 1 thinking of collaborating with a university or scientific institute, engagement is a big decision, and thus the activation must be seen as a process not as a one-off measure.

Small companies at levels 1 and 2 tend to have few resources, so they often need public support to start collaboration. The public support measures have to be easily accessible and non-bureaucratic. In practice, this means hands-on advice for the companies, for example in questions related to the most suitable support measures for their needs, the method of application and reporting procedures.

At level 3, the emphasis shifts towards increasing access to knowledge networks and producers. At the highest level, companies are competent research performers and can easily cooperate with universities or participate in international research networks, often without state support.

Companies at levels 2 and 3 can also increase their capabilities by cooperating with larger companies. Thus, in addition to enhancing the cooperation between businesses and academia, it is important to build and develop innovation networks among companies of different sizes. The Clusters/Competence Centres

could take a more comprehensive role in their respective fields and act as facilitators and coordinators of innovation ecosystems. This would mean, in practice, spreading the actions of Clusters/Competence Centres from funding to networking, activation and education of SMEs, and supporting them in the funding application process.

3.3.2.2 Creating a start-up culture

Start-ups, and especially spin-offs, are likely to hire researchers as they often need resources for product, service and business model development. Many studies have shown that researchers are not at their best as entrepreneurs, but they can be valuable for start-ups as experts and developers.[43]

In many countries, policy has been focused on growth, entrepreneurship and start-ups, with a number of studies[44] showing their central role in economic reform and competitiveness. Alongside the emphasis on technology and innovation, the importance of entrepreneurial skills and experience has been increasingly emphasised. In practice, this has often meant that policymakers provided more comprehensive services (not purely financial) and more intensive (fast-paced, milestone-oriented) support rather than simple R&I measures. In other words, in addition to funding, this has meant the provision of non-financial support, such as networks, advice and training. The peer-learning perspective is also often strongly involved in start-up communities.[45]

While Latvia now has an increasing number of start-ups and many key building blocks of a start-up ecosystem are in place, some elements are still missing. Following the examples of Nordic countries, incubators and support mechanisms for start-ups have been established during recent years. There is also, at least to some extent, venture capital available at all stages of development, from the pre-seed to growth capital stages.

Most of the funds are invested in information technology start-ups, favouring specific business models such as business-to-business (B2B) and software-as-a-service (SaaS) or software solutions with a licensing business model. ALTUM also runs co-funded accelerator funds, and the amount of funding available for science-based or deep-tech innovations has increased. Latvia also has an active business angel network (LatBan),[46] but very few VC companies invest in early-

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[43] See, for example, D'Este, P. et al. (2012) Inventors and entrepreneurs in academia: What types of skills and experience matter? *Technovation vol. 32/5, pp 293-303;* Goel, R. K. & Grimpe, C. (2010): Are all academic entrepreneurs created alike? Evidence from Germany. *Economics of Innovation and New Technology, Vol. 21/3;* https://qz.com/502143/why-scientists-make-bad-entrepreneurs-and-how-to-change-that/

[44] See, for example, van Stel A, Carree MA, Thurik R. The effect of entrepreneurial activity on national economic growth. *Small Business Economics. 2005;24(3):311-321;* Autio E, Kenney M, Mustar P, Siegel D, Wright M. Entrepreneurial innovation: The importance of context*. Research Policy. 2014;43(7):1097-1108*

[45] See more Kaihovaara et al. (2017): Innovation ecosystems as drivers of research–industry cooperation. Publications of the Government's analysis, assessment and research activities 28/2017 (in Finnish).

[46] See more https://www.latban.lv/en/about-us page visited 26.9.2019.

stage ventures. In addition, the emphasis on ICT-related fields limits the group of start-ups to be funded. This makes it difficult for non-ICT start-ups to acquire early-stage funding, and thus get their business started.

Table 4: Company development and investment stages

Company development stages	Investment stage	Meaning
Idea	Seeding finding	Low level of financing needed to prove the idea
Start-up	Seed funding/angel investment	Funding for product developments and marketing related expenses
Development	Early-stage VC	Early sales and manufacturing funds
Growth/Scale-up	Second stage VC	Working capital for companies selling products, but are not yet profitable
	Thirds stage VC	Expansion funding for profitable company
	Fourth stage VC	Bridge funding for exit
Maturity	Exit	Listing on stock exchange

At the seed and early venture capital stages (see Table 4), Latvian start-ups have access to funding from venture capital funds e.g. Change Ventures and Imprimatur Capital, as well as from financial institutions e.g. Capitalia. During the growth capital stages, venture capital managers e.g. Expansion Capital, FlyCap, ZGI, BaltCap and Inventure offer investments up to €10 million. In the final stages, companies might receive funding of up to €15 million from various venture capital and private equity managers such as iTech Capital, Flint and Livonia Capital Partners. The average funding deal size in Europe is around €1.2 million in seed funding, and €7 million at early stage VC, with some €16 million at second stage VC and €22 million at the third stage.[47] So if the company is scaling up fast and expanding to international markets, it might not get needed funding from the local VC companies, and thus the company has to leave the country in order to secure the necessary funding. In order to keep the companies in the country, and continue contributing to employment, the VC market has to be developed.

Some Nordic and European VC companies are showing interest in the Latvian market. However, to attract further VC companies to the country would require a start-up ecosystem of sufficient size to provide a range of potential ventures to be funded. Thus, we are facing a chicken-and-egg problem: in order to have a VC market, we need more potential ventures; and in order to build an ecosystem which creates potential ventures, we have to have a functioning VC market. One way to approach this problem is to increase the amount of public co-financing to

[47] See more Annual European Venture Capital Report. 2018 full year report. Deal.co. https://blog.dealroom.co/wp-content/uploads/2019/02/Dealroom-2018-vFINAL.pdf page visited 3.2.2020.

local seed and early-stage funds,[48] and make co-investment to international funds which have potential for investing in Latvian ventures. Another approach is that the respective government agency invests directly in the start-up companies. This latter approach, however, does not develop the early-stage venture capital market as well as the first one. It also means investment skills from the private sector will be needed, either by employing people or by co-investing. The third approach is to support the Latvian start-up companies in integrating into existing start-up hubs (for example Helsinki). The downside of this approach is that the start-up companies may move to these countries, and their contribution to the Latvian economy and ecosystem may thus be limited. As the number of start-ups in Latvia is small (around 450 in 2018),[49] and as funding especially for scale-ups is limited in the country, several measures have to be taken in order to secure funding for potential ventures.

One underdeveloped element of the start-up ecosystem is a focus on entrepreneurial skills in the higher education system. There is not enough investment in developing entrepreneurial skills among students and staff, to build a constantly evolving ecosystem with a steady flow of new potential ideas and entrepreneurs. In many countries, universities (especially technical ones) have developed compulsory entrepreneurship modules in their degrees to enhance entrepreneurial skills, and to show that entrepreneurship can be a potential career path.

A long-term approach is needed to public funding for start-ups and for start-up support mechanisms. Incubators and accelerators offering, for example, business development support, contacts and facilities are especially important for science-based or deep-tech start-ups. As the funding of incubators and accelerators in Latvia often depends on EU funding, they may operate only for a few of years and then disappear. This means that potential entrepreneurs cannot be sure that support will be secure if they start a company further down the line. Without secured finance, the expertise and capabilities developed during the operations will drift away.

3.3.2.3 Attracting RDI - related FDI

Most FDI in Latvia is not RDI intensive. However, most foreign-owned companies are large, therefore some have the potential resources and capabilities to perform RDI, especially as some universities (like LU, RTU) and scientific institutes (like LIOS, ISSP) are very experienced in collaborating with international companies.

To increase investments made by foreign companies in RDI, two prerequisites have to be met. The level and quality of the science base has to meet the highest international standards, and in Latvia some fields of life sciences are already at this level. The second prerequisite is to have collaboration mechanisms between

[48] ALTUM has already made some investments in local early funds (e.g. ZGI Capital and Expansion Capital AIFP).

[49] Ekonomikas ministrija (2019): Latvijas jaunuzņēmumu ekosistēmas novērtēšana, pašreizējā stāvokļa identificēšana un uz tās balstītu riekšlikumu izstrāde. Id.nr. EM 2018/58

research institutions and companies in place, and more visible to potential foreign investors.

The top Latvian research institutions already collaborate with international companies, mainly through research projects. However, these companies do not establish their own research laboratories or units in Latvia. LIIA should work with the scientific community and potential foreign investors to identify areas where strengthening Latvian research is likely to encourage FDI and national investment in these areas.

When these prerequisites are met, the Government can offer incentives for foreign companies to establish their RDI operations in Latvia. An example of such possible incentives is provided in the text box below.

The Italian FDI example

In Italy, the government supports FDI via tax credits, including 25% for private investments in R&D (50% for projects with universities or research institutions) and 15% for investments in machinery and capital goods. Further public support is granted to new investments in manufacturing and R&D, especially in southern regions.

The 2015 Stability Law and 'Investment Compact Decree' provided the following:

- Patent box – partial tax exemption on income derived from patents, know-how and trademarks if R&D activities are performed by an Italian company
- Enhanced R&D tax credit
- Full deductibility from local tax of labour costs for employees hired on a permanent basis
- Extension of the tax incentives provided to technological start-ups and innovative SMEs
- Refinancing of prior tax credits/incentives for the purchase of industrial equipment

In September 2016, the Government launched a three-year industrial plan, 'Industria 4.0', aimed at boosting private investment in research and development. In addition, the tax rate has been reduced from 27.5% to 24% in 2017. Finally, structural reforms are carried out in other areas such as: administration, tax organisation, the fight against fraud or education, and the labour market (Jobs Act). The law on "protection of savings in the banking sector", known as *savla risparmio*, aims to strengthen the confidence of households in the banking sector.

For more information visit: https://www.ice.it/en/sites/default/files/2018-10/guide-doing-business-2018.pdf

3.3.2.4 State-owned companies as engines for increasing business innovation

State-owned enterprises play an important role in the Latvian economy. Their purpose, according to the Latvian legislation, is to eliminate market failures and undertake public policy assignments by providing services or managing assets that are strategically important for the development of the state. SOEs account for 6.25% of the total employment, 13.4% of all assets and 9.7% of all profits in Latvia. In 2018, Latvia had altogether 159 enterprises, in which the state either directly or indirectly owned a stake. Out of these, 66 were 100% directly owned by the state. Out of these fully state-owned companies, 34 operate in healthcare, culture, sports or education, 11 in transportation and the rest in fields like communication, media, energy, forestry and agriculture, and real estate management.[50]

All SOEs are governed by the same law, the Commercial Law of the Republic of Latvia (CL), according to which the main purpose of commercial activity is to generate profit for the company owners or shareholders. Despite this, Latvian SOEs range from profit-making businesses operating in a free market to regulated utility companies or providers of public goods heavily subsidised by the state budget.[51]

While Latvian SOEs are owned by various line ministries, their strategic and operational governance is handled by the Cross-Sectoral Coordination Centre, which is part of the Prime Minister's office. The CSCC's mandate includes strategic goal-setting, reporting, transparency, recruitment and remuneration policies as well as ownership evaluation. The CSCC has issued a number of guidelines (e.g. related mid-term strategic goals) for SOEs.

Recently, SOEs with the support from the Ministry of Economics have started proactive activities to encourage innovation as well as cross-sectoral cooperation to define and implement innovative projects. These include project ideas for drone-based forest monitoring, smart houses, 5G solutions, autonomous cars, biorefining, etc. Cooperation takes place at three levels:

(1) Management Task Force – it ensures coordination and long-term development of the SOE's cooperation platform, with participation of both state-owned companies and representatives of the public sector (Ministry of Economics, Cross-Border Coordination Centre)

(2) Project Working Groups – encompassing specific interdisciplinary SOE project development teams, which bring together new product development specialists from different SOEs to develop new collaborative innovation projects

[50] KPMG (2019): State ownership policy review in Latvia. Final report. http://www.valstskapitals.gov.lv/images/userfiles/SOE_Review_LV__Final_report.pdf

[51] KPMG (2019): State ownership policy review in Latvia. Final report. http://www.valstskapitals.gov.lv/images/userfiles/SOE_Review_LV__Final_report.pdf

(3) Innovation Forums – Open Innovation Forums are organised once every six months to present the accomplishments as well as to bring together some of the key topics in the innovation process through the involvement of industry experts

As SOEs play a central role in the Latvian economy, they are seen also as having potential for acting as 'motor' companies in RDI activities in their sectors. In the sectors like forestry and agriculture, energy, and telecommunications, the SOEs have invested in RDI and cooperated actively in numerous ways with competence centres, universities and scientific institutes operating in their respective fields. These SOEs have relatively small RDI units, and they outsource the majority of the RDI work to universities and scientific institutes.[52] A few large state firms have developed framework agreements with universities, creating some internships and jobs for university students. However, this is far from being a widespread practice.

The way the SOEs are governed has impeded innovation to date. Fully state-owned SOEs tend to be micro-managed by the state. RDI has been seen mainly as expenditure that has no direct bearing on the operation or performance of the company, rather than as an investment in the future. Recent research has highlighted the importance of SOEs as innovators and shown evidence of a positive relationship between investment in R&D and the growth of sales in the public companies.[53] Latvian SOEs have shown a reluctance to take on the fixed costs of maintaining internal R&D capabilities, rather than outsourcing RDI work. The corporate governance mechanism needs to be changed in order to support and encourage SOEs to invest in RDI and also to develop their own intramural RDI activities.

3.3.3 Academia-business cooperation

The status of academia-business cooperation in Latvia and the focal areas of such activities provide important contextual information to this study question. In general, companies that collaborate with academic institutions are more likely to hire researchers than those companies that do not collaborate. Thus, connections with higher education institutions and scientific institutes not only pave the way for more research-intensive activities in companies but they may also lead to researcher recruitment.

University-business collaboration takes many forms, embracing a diverse set of activities and initiatives in education, research and knowledge exchange. Looking more specifically at research activities, various forms of joint research and development and intersectoral mobility (staff and students) play important roles.

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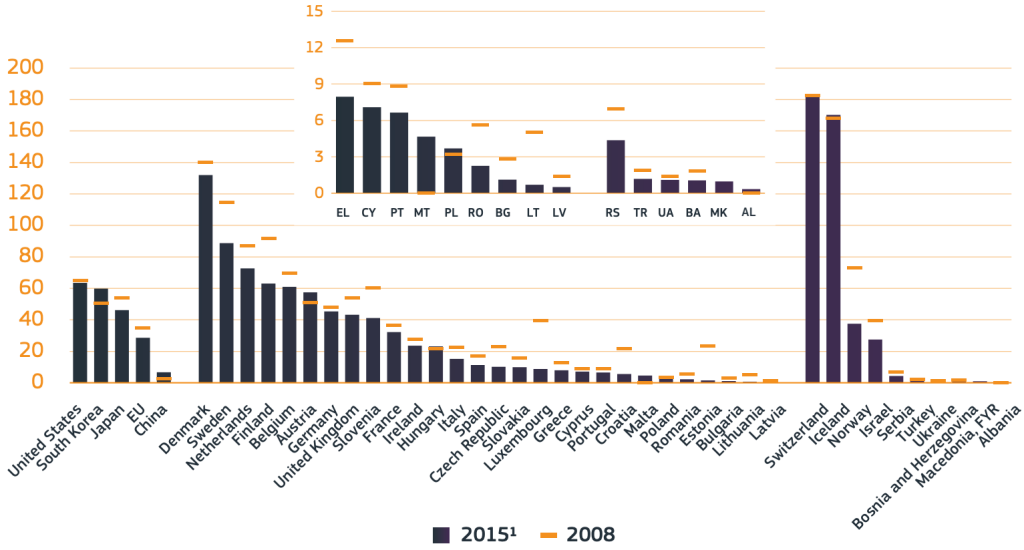
[52] KPMG (2019): State ownership policy review in Latvia. Final report. http://www.valstskapitals.gov.lv/images/userfiles/SOE_Review_LV__Final_report.pdf

[53] González Álvarez, N., Argothy, A. (2018) Research, development and growth in state-owned enterprises: empirical evidence from Ecuador. *Industry and Innovation*, Volume 26, 2019 – Issue 2: Innovation in State-owned Enterprises: Implications for Technology Management and Industrial Development; see also Mazzucato M. (2013) *The Entrepreneurial State: Debunking Public vs. Private Sector Myths,* AnthemPress, London, 2013

One of the existing measures of such research collaboration is university-business co-publications. As seen in Figure **10** below, Latvia is performing poorly when the number of co-publications is compared to its population (it is last among all EU Member States). In absolute terms, Latvia was at the same level as Lithuania in 2017.[54]

Figure 10: Number of academia-business co-publications in some countries in 2008 and 2015 relative to population

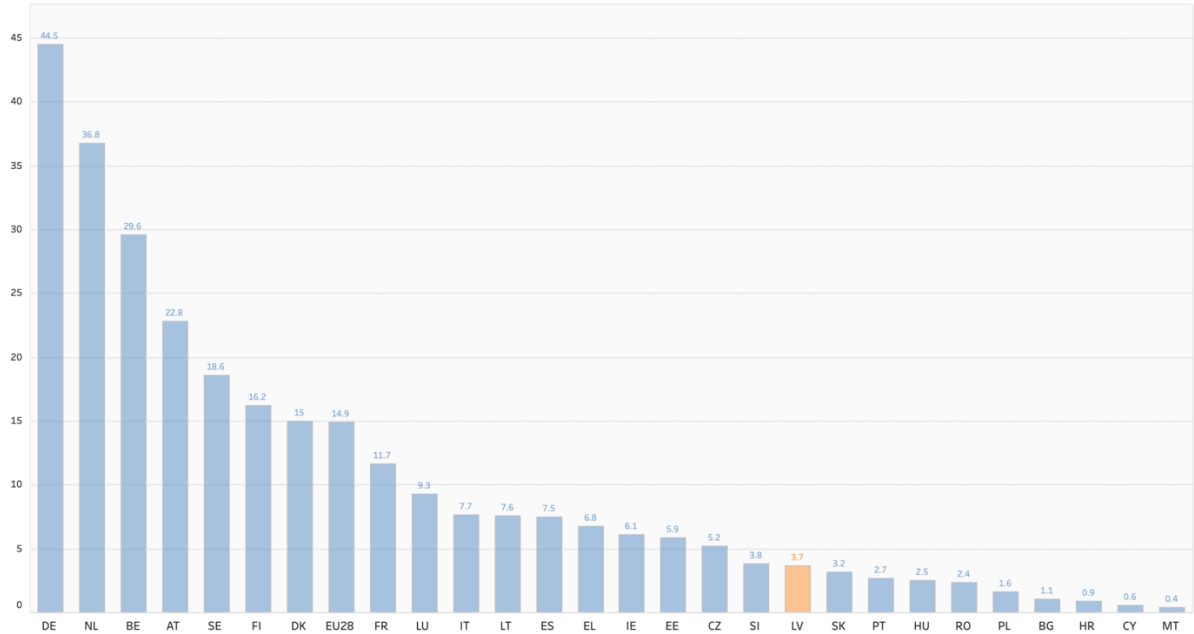


Source: European Commission

Looking at the input-side, measures of the intensity of academia-business collaboration, public R&D financed by companies is an often-used measure. This measure shows (see Figure **11** below) that Latvia is in the lower middle range when it comes to business financed public R&D, well below the EU average (€14.9 per inhabitant). Only seven countries are above the average.

[54] Latvia PSF II – Background report

Figure 11: Public R&D financed by business enterprises in EU-countries in 2017 euros per inhabitant



Source: European Commission[55]

As already described, the private sector is dominated by SMEs and the share of high- and medium-technology companies among them is low. As in most countries, the larger the company the more likely it is that it collaborates with research institutes and higher education institutions.[56] In the case of Latvia there has been a slightly decreasing trend in collaboration between business and academia between 2012 and 2014. The share of enterprises[57] cooperating with universities or research institutes is considerably lower than the EU28 average. In Latvia 8.6% of the innovative SMEs collaborated with HEIs, while the same ratio was 32.5% in Finland, 19.6% in Sweden, 16.8% in Estonia with an EU average of 16.4%. Looking at the percentage of innovative companies collaborating with scientific institutes, the proportion is even lower. In Latvia, only 5.3% of Latvian innovative SMEs cooperate with research institutes, while in Finland this proportion is 27.7% and in neighbouring Estonia it is 10.7%.[58]

Here we discuss two ways to enhance academia-business collaboration and the absorptive capacity of industry, namely a 'collaboration culture' and the use of

[55] https://rio.jrc.ec.europa.eu/en/country-analysis/Latvia/key-indicators/25620

page visited 28 January 2020.

[56] Pleśniarska A. (2018): The Intensity of University-Business Collaboration in the EU.

[57] As percentage of product and or process innovating companies.

[58] Pleśniarska A. (2018): The Intensity of University-Business Collaboration in the EU.

intermediary organisations. The third way – incentives and support measures – was discussed already in Chapter 3.3.1.

As noted previously, the number of researchers employed by the private sector in Latvia is low because the business landscape is dominated by SMEs that mainly operate in the low-tech or service sectors and which lack awareness of the potential that hiring a researcher might bring. Science, research and innovation are not priorities in political agendas or for society at large. The importance of RDI as a source of growth is not understood by most people. Increasing the level of awareness of the benefits of RDI is the first step towards changing the culture and shifting towards a more innovation-friendly environment. International rankings[59] rate Latvia well on benchmark scales for 'ease of starting a business' and 'ease of getting credit'. Therefore, favourable framework conditions already exist to some extent. However, to capitalise on these strengths, there should be wider recognition that more innovative activities, companies and human resources are necessary.

Perceptions of the role of science and technology in advancing welfare in society at large need to change. More specifically, this should be done in relation to academia-business relations, the role of research and innovation in business development, and the role applied research can play to help start a shift towards more innovative and entrepreneurial attitudes. These changes can be fostered by awareness-raising, success stories, and fostering the creation of a more innovation-friendly culture in society. Communication in an easy-to-understand manner through selected channels that are used by the target group is needed.

As described above, academia-business collaboration in Latvia has traditionally not been very intensive. The Competence Centres and Clusters have in certain fields (like the wood sector) improved the situation, but in the business sector, overall, the connections with research institutions are either missing or very weak. Specific measures are needed to create the connections and then build mutual trust. In principle, there are two different approaches to this:

- One-to-one: build connections and create partnerships by using a one-to-one approach; technology scouts present an example of this method

- Innovation ecosystem: build innovation ecosystems where companies of different sizes, universities, educational institutions, research institutions and other players collaborate together. An innovation ecosystem needs a clear, shared vision together with resources that facilitate collaboration. Ecosystems create the foundation for long-term collaboration, and a basis for building multi-partner projects.

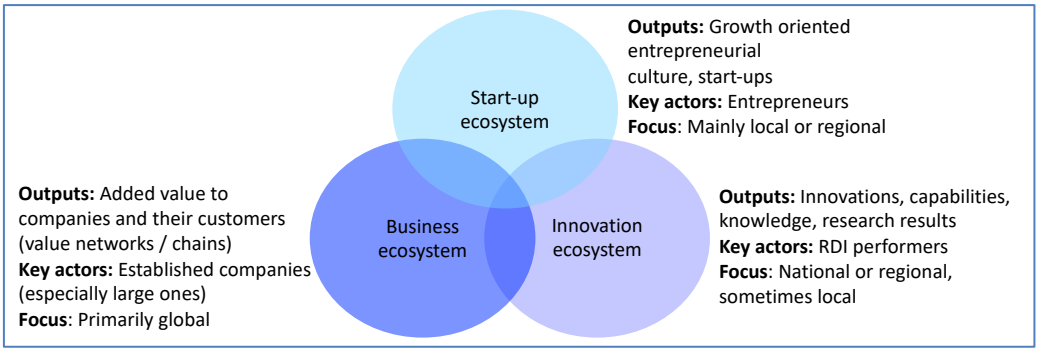
The 'ecosystem' concept is derived from the natural sciences. In the context of this study it is used mainly refereeing to key features of ecosystems such as their complexity, non-linear development, openness, self-steering, dynamism and interdependence between different actors. Ecosystems are complex 'adaptive'

[59] Global Innovation Index 2017 and Global Competitiveness Index 2017

systems and understanding them requires the identification of their key players and stakeholders, and the relationships and dynamics between them.[60]

In the context of business and innovation, 'ecosystem' has been used to describe networks of interdependence between businesses, entrepreneurs, research, public administration and third-sector actors. Different ecosystems can be distinguished according to their level of business development. The features of different types of ecosystems are presented in Figure **12**. *Innovation ecosystems* are closely linked to research and development. Their key players are business R&D units, universities and research institutes. *Entrepreneurial or start-up ecosystems* are local ecosystems formed by start-up and innovative companies. Current, future and former growth-oriented entrepreneurs are at the heart of them. *A business ecosystem* usually refers to an established (often global) ecosystem formed by some key companies (e.g. Google, GE or Meyer) or on a platform. Well-established business ecosystems are also often referred to as 'clusters'. However, an ecosystem differs from a cluster in that it is inherently a more open, diverse and dynamic entity and does not need to be confined to a specific geographical area, as clusters generally do.

Figure 12: Different types of ecosystems



Source: Kaihovaara et al. 2017[61]

The collaboration activities in innovation ecosystems linked to RDI are based on a shared interest in developing new products, services and solutions. Innovation ecosystems are usually centred around universities and scientific institutes, but they also involve large numbers of different-sized companies, NGOs and public-sector organisations. Innovation ecosystems tend to be local or regional with strong linkages to regional/local 'spearhead areas'.[62]

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[60] See, for example, Williams, B. & Hummelbrunner, R. (2010): *Systems Concepts in Action: A Practitioner's Toolkit*. Stanford University Press.

[61] Kaihovaara et al. (2017): Innovation ecosystems as drivers of research-industry cooperation. Publications of the Government's analysis, assessment and research activities 28/2017 (in Finnish).

[62] See more Kaihovaara et al. (2017): Innovation ecosystems as drivers of research–industry cooperation. Publications of the Government's analysis, assessment and research activities 28/2017 (in Finnish).

The new value chain ecosystems in Latvia fall in business ecosystem category as their emphasis is on building value chains for the global markets. There is however need for strengthening the breeding ground for these kinds of world class value chains by developing and supporting innovation ecosystems. Scientific institutes and universities are the key entities around which innovation ecosystems are formed. Companies of different sizes work together with the research institutions in order to crated new knowledge, capabilities, and innovations.

The collaboration activities in innovation ecosystems linked to RDI are based on a shared interest in developing new products, services and solutions. Innovation ecosystems are usually centred around research institutions, but they also involve large numbers of different-sized companies, NGOs and public-sector organisations. Innovation ecosystems tend to be local or regional with strong linkages to regional/local 'spearhead areas'.[63] The examples from Nordic countries show that local governments can have a role in enhancing and sometimes also financing the innovation ecosystems (see text box below).

Collaboration among the different actors of the innovation ecosystem needs to be facilitated. This facilitation is often performed by universities, scientific institutes or by other intermediary organisations. As in Latvia, not all of the research institutions have the resources and capabilities needed for such ecosystem facilitation; intermediary organisations are needed to accomplish this task.

As the previous PSF Latvia study clearly pointed out there is a need to strengthen intermediary organisations in the country. Cluster organisations, Competence Centres, technology scouts, technology transfer offices (TTOs) and incubators are acting as intermediaries, but there is certainly need for mechanisms that enhance applied research and create and strengthen collaboration with different partners. Some of the RIs actively collaborate with business partners, but it is mainly with those already actively involved in RDI.

The Competence Centres and Clusters have, at least in some sectors, succeeded in enhancing collaboration between scientific organisations and companies. One approach to strengthening the role of intermediary organisations is to expand the tasks of the Clusters/Competence Centres, and increase their partner networks to include more SMEs and other partners, for example cities. These new types of Clusters/Competence Centres would have a wider portfolio of tasks in innovation ecosystem function. The innovation ecosystems are facilitated, not managed. This means mainly supporting the vision and strategy formulation process, matchmaking activities, and communication activities. As ecosystems fluctuate and evolve, the facilitator should keep track of the potential partners (local, national and international). Thus, facilitation is more like coordinating a network of actors, which is constantly changing and moving.

[63] See more Kaihovaara et al. (2017): Innovation ecosystems as drivers of research–industry cooperation. Publications of the Government's analysis, assessment and research activities 28/2017 (in Finnish).

Changing the role of Clusters/Competence Centres would help to achieve critical mass in a given sector or subject field, which is an important prerequisite to reducing fragmentation and creating better and easier access to expertise at various technology development stages. Regional and/or local governments have a central role as financers and enablers of ecosystem development. Innovation ecosystems are based on, and develop further, the local knowledge base, creating a breeding ground for innovation. They also facilitate the process of bringing about innovations in multiparty collaborative settings. Thus, innovation ecosystems can be seen as critical for the local/regional economic development.

Adding new value chain ecosystems can reinforce available instruments aimed at enhancing collaboration in Latvia providing they focus on building world-class business concepts. If their focus is simply to reinforce localised innovation, current mechanisms can be tweaked to build more open, ecosystem-type collaboration.[64]

The Arctic Design Cluster example

Although it is called a Cluster, the *Arctic Design Cluster* in Lapland, Finland is actually an example of an innovation ecosystem. It brings together expertise in Arctic conditions, culture and knowledge on materials, and aspires to resolve the challenges of a sparsely populated area. The main purpose of the 'Cluster' is to make local businesses, products and services nationally and internationally competitive by utilising specialised knowledge from research, art and design. At the heart of the Cluster is the Arctic Design Centre of Expertise at the University of Lapland where businesses, science and art meet.

Created by the Faculty of Art, the Design Centre promotes cooperation between local businesses, educational institutions, the city of Rovaniemi and regional development organisations. The city of Rovaniemi is responsible for arranging bi-annual Arctic Design Week which promotes northern design expertise and business, while inspiring designers, students, scientists and artists. Small design businesses can create, test and display their prototypes with new technologies developed by the University. The Arctic Design Centre can boost the innovation behind new products but also the re-design of mature ones.

The Arctic Design Cluster set out to be involved in at least 15 potential synergy and collaboration projects by the year 2020. Leaders of these cluster projects are global enterprises surrounded by consortia including researchers and businesses, and especially SMEs. Businesses are attracted by the bright ideas, high-quality research and investment opportunities.

For more information visit: https://arcticsmartness.eu/arctic-design/

[64] See more about the differences between business and innovation ecosystems, Kaihovaara et al. (2017): Innovation ecosystems as drivers of research–industry cooperation. Publications of the Government's analysis, assessment and research activities 28/2017 (in Finnish).

3.3.4 Universities and scientific institutions

Internationally, for some decades, universities and, to some extent scientific institutes, have been setting up TTOs focused on patenting inventions and exploiting them through licensing or spin-offs. In practice, only a few big and famous universities make substantial amounts of money from this activity, mainly in the fields of life- and biosciences, and most earn less than the cost of running the TTO.

During recent years, thinking has shifted from technology transfer towards a broader concept of academia-business collaboration consisting of a wide range of activities like collaborative research, consultancy and contract research, mobility schemes, training and professional development, and licensing inventions. Among other benefits, this allows the university to do collaborative research with the prospect of potential income from patents and licensing.

When looking beyond research collaboration, the differences between higher education and scientific institutes, and the heterogeneity within these two groups of institutions, have to be taken into account. The overall impression of Latvia is that all of the different types of academia-business collaboration activities are present, but higher education institutions and scientific institutes often seem to lack systematic processes and strategies ensuring that these activities can deliver the maximum benefits. There are many examples of good practices around individual areas of academia-business collaboration (e.g. incubators, lifelong learning, TTOs, and even platforms like https://www.materize.com or Usescience at RTU), but a strategic and integrated system-level approach still seems to be missing.

When considering academia-business collaboration there are great differences between the higher education institutions. HEIs in the Riga region have more advanced models for collaboration, especially when it comes to valorisation. Thus, it can be argued that there is a clear need to leverage or extend the good practices to other research institutions. The Investment and Development Agency of Latvia maintains an innovation and technology website, 'Labs of Latvia' (labsoflatvia.com), which aims to inform, inspire and encourage entrepreneurs, scientists, investors, business starters and other interested persons to seek development opportunities, to cooperate and jointly develop the innovation and technology environment in Latvia. Labs of Latvia offers information on business, innovation and technology, trends, stories, events, support tools for business development, and other useful materials. More opportunities for networking and the exchange of experiences (i.e. seminars, learning networks) are needed in Latvia. To increase business-academia collaboration capabilities, a common development programme for all research institutions could be a useful tool.

Table 5: Different forms of academia-business collaboration

Academia-Business collaboration areas	Academia-Business collaboration activities
Education	Curriculum co-design (e.g. employers involved in curricula design with HEIs) Curriculum co-delivery (e.g. guest lecturers) Mobility of students (e.g. student internships/placements) Dual education programmes (e.g. part academic, part practical) Lifelong learning for people from business (e.g. executive education, industry training and professional courses)
Research	Joint R&D (incl. joint funded research) Consulting to business (e.g. contract research) Mobility of staff (i.e. temporary mobility of academics to business and of businesspeople to HEIs)
Valorisation	Commercialisation of R&D results (e.g. licensing/patenting) Academic entrepreneurship (e.g. spin offs) Student entrepreneurship (e.g. start-ups)
Management	Governance (e.g. participation of academics on business boards and businesspeople participation in HEI board) Shared resources (e.g. infrastructure, personnel, equipment) Industry support (e.g. endowments, sponsorship and scholarships)

Source: Davey et al. (2018). The State of University-Business Cooperation in Europe. Final report. European Commission

Mobility schemes for researchers offer potential not only for increasing the collaboration between research institutions and companies but also for the companies to test whether hiring a researcher generates added value. In many countries these schemes have proven to be very successful, and often leading to permanent employment of the researchers in companies. Examples of two successful mobility schemes are provided in the text boxes below.

The Science Foundation Ireland example

The **Science Foundation Ireland (SFI) Industry Fellowship Programme** supports industry-academia research partnerships by funding collaborative industry-academia research projects and stimulating excellence through knowledge exchange and the training of engineers and scientists. This is done through the temporary placement of academic researchers (PhD students, postdocs and senior researchers have separate schemes) in industry, and of industry researchers in academia. Female candidates are strongly encouraged to apply to the Industry Fellowship Programme.

A LinkedIn group called SFI Industry Fellowship Programme has been set up by the Foundation to facilitate networking between industry and academic researchers. Companies are encouraged to make their interest known to the academic community, and/or to advertise specific research opportunities, by posting on the group's page. Academic researchers are encouraged to engage with relevant companies.

For more information visit: https://www.sfi.ie/funding/funding-calls/sfi-industry-fellowship-programme/index.xml

Governments implement intersectoral mobility schemes allowing companies to access new knowledge by contracting students and researchers from public research centres and universities. In most European countries, legal and administrative measures are in place to facilitate the intersectoral mobility of researchers. Governments can play a role in facilitating, promoting and funding placements for researchers, i.e. researchers spend a limited period of time in other sectors in order to gain sector-specific experience and share research expertise. Those policies, often regarded as 'soft measures', could have potentially long-lasting effects on researchers' employability, employers' perception of innovation and the use of outside knowledge sources, as well as the mindset of academics by introducing a commercial perspective to their research. The policies could also trigger long-term collaborative activities.[65]

As far as the policy interventions are concerned, we can distinguish between:

- PhD students' mobility supported through internships, entrepreneurship skills training and industrial PhD programmes
- Researchers from academia benefiting from short-term placements, entrepreneurship training and tax credits that alleviate the costs of companies in recruiting highly skilled personnel
- Fellowships, industrial chairs and dual-path career regulations supporting industry researchers' mobility to academia (those measures are rarely

[65] Hristov H et al (2016): Intersectoral mobility and knowledge transfer. Preliminary evidence of the impact of intersectoral mobility policy instruments. JRC Science for Policy Report.

implemented on the national level, they are rather introduced by universities in partnership with industry)[66]

Short placements may increase company awareness of knowledge and technology transfer activities and build trust between the actors based on personal relationships. Longer placements in companies create a personal connection with the company and often result in the prolonged collaboration of the sectors and/or in the offer of a permanent employment in the host company.[67]

In Latvia, there is already Cohesion Funds' support for enterprises to attract highly qualified specialists from research institutions, to build their research capacity. One problem noticed is that, once in the business sector, rarely do these specialists continue to work in research, because business has other aims and objectives than science. This can be at least partly resolved so that only the research-related part of the employee salary can be reimbursed.

The French mobility scheme example

In **France**, the **Industrial Doctorate (CIFRE**)[68] mobility scheme is combined with tax credits which cover 30% of all R&D expenses up to €100 million, and 5% above this threshold. Salaries for research staff are wholly integrated, plus 50% of R&D operating costs and 75% of investments in R&D operations.[69]

An evaluation of the French R&D scheme shows that the combination works. The tax credit can be used to complement the funding of the industrial PhD or to employ the CIFRE recipient after his/her thesis is finalised. That means that those measures are complementary.

In the area of education, student mobility is the most well-established form of collaboration. Student internships are incorporated in many study programmes, and large state-owned companies in Latvia, as well as their multinational counterparts, take part in further curriculum-related activities. For example, the University of Latvia has strong collaboration with the IT sector to ensure that the curriculum addresses the sector's needs. There is, however, a wider need to make sure that in all fields the study programmes provided fulfil the needs of society, both in content and quantity.

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[66] See, for example, Hristov H et al (2016): Intersectoral mobility and knowledge transfer. Preliminary evidence of the impact of intersectoral mobility policy instruments. JRC Science for Policy Report; Intersectoral Mobility Schemes in Science Europe Member Organisations. Study Report. Science Europe 2017; Crossing Borders – Obstacles and incentives to researcher mobility. Policy Paper 3/2014. NordForsk.

[67] Hristov H et al (2016): Intersectoral mobility and knowledge transfer. Preliminary evidence of the impact of intersectoral mobility policy instruments. JRC Science for Policy Report.

[68] https://www.ifsttar.fr/en/partnerships-innovation/scientific-and-technical-services/cifre-industrial-agreements-for-training-through-research/ page visited 4.2.2020

[69] http://taxsummaries.pwc.com/ID/France-Corporate-Tax-credits-and-incentives page visited 4.2.2020

Joint research projects and contract research are the most established forms of research-related collaboration. For some scientific institutes almost 80% of funding comes from non-governmental sources and company funding is one of the key sources for many research institutes, although in some cases this represents a significant amount of income from abroad. There are three universities – RTU, UL and Riga Stradins University (RSU) – that are very active in conducting research and they also have established procedures to support collaboration with external partners. Notably, RTU has started the country's first industrial PhD programme in collaboration with LMT.

In the field of valorisation, commercialisation of R&D results is well supported in the universities and research institutes. Most of them have technology transfer offices in place and some have incubators as well. Further support, in the form of access to technology scouts and funding for incubators, is available through the programmes and initiatives supported by the Ministry of Economy and its agency, the Latvian Investment and Development Agency.

When it comes to the governance and management of universities and research institutes, company representatives can play roles as members of advisory/consultative bodies, but Latvia is one of the few countries in Europe where external stakeholders are not included in the governing boards of the institutions.[70] Access to research infrastructure and equipment are offered for the companies, but having shared infrastructure with companies is still uncommon. Although, since 2017, higher education institutions have been required to coordinate their development and investment plans aimed at infrastructure development with representatives of the business world.[71]

Support mechanisms for academia-business collaboration put in place by academic organisations are needed to develop and administer collaboration, as well as to create favourable conditions for collaborative activities. If support mechanisms are absent, collaboration easily becomes an isolated and unusual activity performed only by a few individuals who see it as important.[72]

The support mechanisms can be divided into three different types:

- Strategic – drafting and implementation of cross-functional high-level plans, methods, or activities at an academic institution that will enhance academia-business collaboration

- Structural – constructive personnel and institutional programmes created as a result of top-level strategic decisions within (or related to) an academic institution that enable academia-business collaboration

[70] OECD (2019), OECD Economic Surveys: Latvia 2019, OECD Publishing, Paris

[71] ibid

[72] See more Davies et al. (2018): The State of University-Business Cooperation in Europe. Final report. European Commission.

- Operational – actions or events of a practical nature undertaken by an academic institution to create and support academia-business collaboration.[73]

The following paragraphs reflect on the practices available in Latvia along these three types of support mechanisms.

At the strategic level, most research institutions mention collaboration (e.g. by using words like innovation, impact on society, cooperation) in their mission and vision statements. But moving from intention to implementation, using measures such as personal incentives to enhance collaboration, is problematic, especially at universities where salaries are made up of separate blocks for research and for teaching activities. However, there is a suite of measures available that would enhance collaboration with companies: recognition of work experience obtained outside academia during the recruitment of academics; recognition of collaborative activities during the distribution of resources (including funding); and recruitment of business professionals to strengthen knowledge transfer. All of these require systematic, institution-level decisions and processes.

Examples of the structural mechanisms to support business collaboration are presented in Table **6**. Many of these are present in Latvia, especially at universities, but plenty of room still remains to introduce additional mechanisms. There are also big differences among universities, with RTU and UL being the frontrunners.

Table 6: Structural mechanisms for academia-business collaboration

Areas	Structural support mechanisms at universities and scientific institutes	Structural support mechanisms at universities and scientific institutes in Latvia
Bridging structures	Agencies dedicated to collaboration (e.g. technology transfer office, innovation office)	Medium
	Board member or vice rector positions for the third mission	Low
	Industry liaison office	Medium
Employability and career services	Alumni networks	High
	Career services	High
Infrastructure	Co-working spaces accessible by business	Low
	Joint research institutes with companies	Low
	Incubators	Medium
	Science/Technology Park zones	Medium

[73] See more Davies et al. (2018): The State of University-Business Cooperation in Europe. Final report. European Commission.

Areas	Structural support mechanisms at universities and scientific institutes	Structural support mechanisms at universities and scientific institutes in Latvia
External integration structures	Adjunct positions available within the university for business people	Low
	Lifelong learning programmes involving businesspeople	Medium

Source: Modified from Davies et al. (2018): The State of University-Business Cooperation in Europe, Final report, European Commission

The Cerfiel example

Cerfiel is an Italian ICT Centre for Research, Innovation, and Education established in 1988. It focuses on creating digital products, services and processes, but also participates in national and international research programmes and develops digital skills and culture. Certifiel has a multidisciplinary team of over 130 people with a mix of technical, business and design skills.

Founded by the Milan Polytechnic, it now includes among its members the University of Milan, the University of Milan-Bicocca, the University of Insubria, the Lombardy Region and multinational companies. It has undertaken projects and provided solutions for Italian and multinational companies, in particular in the UK, Switzerland, France, and the USA. Cefriel is sustained solely by project financing.

For more information visit: https://www.cefriel.com/it/

Operational mechanisms can be the easiest and quickest activities to put in place because they can be implemented by any internal stakeholder. Such operational mechanisms vary from networking through communication to entrepreneurial activities. Academic networks dedicated to collaboration, networking sessions or meetings for academics to interact with businesses, student networks dedicated to collaboration, and activities facilitating student interaction with business are examples how networking-related activities can support collaboration. There are many small-scale examples of these activities at both higher education institutions and research institutes in Latvia. However, there seems to be a lack of a coordinated and strategic approach to maximise the benefits of these activities.

Enhancing the entrepreneurial mindset and attitude both among staff and students is of utmost importance to foster the creation of companies with absorptive capacity. The development of entrepreneurial skills and competences should be integrated into the curricula across all study levels as one of the key building blocks.

The HEInnovate example: Innovative and entrepreneurial higher education institutions

There are different tools that help HEIs to become more entrepreneurial both at the level of the institutions as well as in their study programmes. The European Commission and OECD joint initiative, HEInnovate, is an online self-assessment tool that is aimed at providing advice and good practice examples to help institutions to become more entrepreneurial and innovative. The tool has been used by over 1,400 HEIs, and the HEInnovate methodology is used by the OECD to prepare country reports.

The toolkit also has a dedicated assessment (EPIC) that helps measure the effectiveness of entrepreneurship courses through the skills and competency development of course participants.

Further information: https://heinnovate.eu/en

Showing doctoral students that becoming an entrepreneur can be an attractive career path, opens up many new possibilities outside academia and provides further impetus to building the absorptive capacity of the Latvian business sector. There are celebrated examples in Latvia that illustrate the benefits, such as the success of the machine translation company, Tilde.

From the point of view of academic staff, paying attention to building business partnerships and creating collaboration can be seen as burdensome and demotivating, competing for time spent on research and teaching tasks. To overcome this reluctance towards business collaboration, scientific organisations can develop a broad vision of the benefits of collaboration, showing not only the financial benefits, but also its contribution to making research and teaching more focused on real-life needs.

3.4 Recommendations

In order to enhance the employment of S&T human resources in the Latvian business sector, we recommend a set of actions that address the different actors in the country's science and innovation system. The potential actions are grouped around three strategic recommendations.

Strategic recommendation: Create favourable conditions that foster building and developing entrepreneurial and innovative ecosystems

- Build innovation ecosystems around the key Smart Specialisation areas. An ecosystem is not an ecosystem without a shared vision, therefore ensure that all key stakeholders are engaged in the development. Changing the role of Clusters/Competence Centres towards ecosystem facilitation would be an important step in this direction. Such a 'facilitator' makes sure that scientific organisations, established companies, SMEs, start-ups, NGOs and regional/local governments are invited and 'activated' to collaborate. Building on the existing Competence Centres, creating these ecosystems may imply an annual total budget of around €15 million. This budget estimate based on the experience of REDIT in Spain, which maintains a network of industry-related

research institutes in a region three times the size of Latvia. Their total annual budget is about €110 million out of which approximately 30% is government funding and the rest comes from industrial contributions and international competitive funding sources

- Regional or local governments often have central roles as financers and enablers of ecosystem development. Innovation ecosystems are based on, and develop further, the local knowledge base and create the breeding ground for innovations. Financing of ecosystems should thus include money from local/regional governments. Annual calls for joint innovation projects (university-companies) are key to providing stable funding in key areas. The Lapland example devotes around €270,000 per year in the calls for joint projects for an area of 180,000 inhabitants. In the case of Latvia, a reasonable approximation would be a budget of €2.5-3 million

- Strengthen the entrepreneurial culture among research institutions. Invest in the development of students' and staff members' entrepreneurial skills in order to build a constantly evolving ecosystem that supports the emergence of and nurtures new potential ideas and entrepreneurs. It is a very common approach for higher education institutions to integrate entrepreneurship modules as part of the compulsory curricula to enhance entrepreneurial skills and competences, and showcase entrepreneurship as a potential career path. These programmes can be implemented without extra cost, as they are part of the students' curricula.

Strategic recommendation: Reinforce the role of existing stakeholders and attract new ones to increase the country's absorption capacity of S&T human resources

- Develop a long-term approach to public funding for start-ups and for start-up support mechanisms. Incubators and accelerators offering, for example, business development support, contacts and facilities are especially important for science-based or deep-tech start-ups. Currently, as the funding of incubators and accelerators often depends on EU funding, they may operate only for a few of years and then disappear

- Launch specific projects and calls to support the modernisation of SMEs, such as digitalisation programmes (co-financed by the central or regional government, using ESIF funds as well). Based on international examples, the cost of such programme could be €2-3 million per annum, for projects between €40,000 and €100,000, with 30-40% public funding

- Secure the availability of early-stage and later-stage venture capital funding. The number of start-ups is small (around 450 in 2018) in Latvia and funding especially for scale-ups is limited. Several means should be taken to secure funding for new businesses and a constant flow of potential ventures:

    1) Increase the amount of public co-financing for local seed and early-stage funds and co-invest in international funds which have the potential for investing in Latvian ventures to develop the early-stage venture capital market

2) Facilitate direct investments in start-up companies. This approach requires investment skills from the private sector, either by employing people or by co-investing

3) Support the integration of Latvian start-up companies into existing start-up hubs (for example Helsinki), with the downside that this approach might result in some start-up companies moving to these countries, thus potentially limiting their contribution to the Latvian economy and ecosystem.

- Strengthen the role of SOEs as RDI performers by eliminating current obstacles in governance. Use the corporate governance of SOEs as a tool for enhancing the RDI investments of SOEs and motivate them to increase their own RDI activities and units. This can be done by requiring SOEs to spend certain amounts on intramural and/or external RDI activities

- Attract foreign RDI-related FDI by identifying the top fields of science and potential foreign investors. Provide targeted incentives and support to the companies which have the highest potential to contribute in Latvia. The identification of potential companies should be done in collaboration with relevant research institutions and domestic companies. In order to carry out this process, establish a specific group of experts to support LIAA.

Strategic recommendation: Foster collaboration and mobility among HEIs/scientific institutes, businesses and local/regional stakeholders

- Create and strengthen the entrepreneurial culture in higher education institutions to foster a 'culture change', where the whole university/research community perceives collaboration with companies and society as an integral part of education and research. This can be done by:

1) Supporting the HEIs to develop a strategic and systematic approach to business collaboration through increased networking and experience sharing. They should leverage and scale already existing good practice models

2) Fostering the development of a strategic approach to collaboration that builds on functional operational models and dedicated personnel, possibly in partnership with local partners (e.g. local governments). This should also include strengthening the management of research institutions by having external members included in governing bodies

3) Making the benefits of academia-business collaboration visible to both researchers and companies, so that researchers will see it as a natural part of their career and companies as a substantial contribution to their development. Provide support or make a platform available for such activities, including seminars, exhibitions and one-to-one meetings. A precondition here is that the research organisations must have a clear vision and working models for academia-business collaboration, and the Government can play facilitator and a financer role.

- Motivate SMEs to collaborate with research institutions. This can be fostered through the provision of hands-on advice, activation, communication and easy-to-take first-step services. Activities might include making existing fora for interaction and networking – e.g. seminars and workshops – more visible through targeted communication campaigns, for example showing the success stories, and the provision of specific advice on how to reach a relevant researcher. Further, the experiences gained from technology scouts should be utilised, and expanded to cover all key sectors

- Build intersectoral researcher mobility schemes by creating clearly structured and targeted mobility schemes for PhD students, postdocs and senior researchers. This can be implemented by:

    1) Integrating these schemes in the annual competitive calls for research funding

    2) Adding a matchmaking element to mobility schemes

    3) Providing grants to researchers, and thus motivating the researchers to actively seek opportunities for employment in companies.

- Promote the importance of science in society for various target groups (children, teenagers, companies, etc.). Utilise different means of valorisation and outreach in order to make the importance of science visible for different target groups. Government can act as facilitator and financer, but the content and actions should be provided by the scientific organisations.

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The Horizon 2020 Policy Support Facility (PSF), set up by the Directorate-General for Research and Innovation (DG RTD) of the European Commission under the EU Framework Programme for Research and Innovation, supports Member States and countries associated to Horizon 2020 in reforming their national science, technology and innovation systems.

The aim of the PSF Specific Support to Latvia, carried out by a panel of independent European R&I policy experts from June 2019 to February 2020, was to provide tailored advice and concrete recommendations on (1) attracting and retaining people in scientific and technological careers in Latvia and developing their skills and productivity, and (2) developing the employment of science and technology (S&T) human resources in the Latvian business sector.

The final report of the PSF Specific Support to Latvia provides an overview of the research and innovation system in Latvia and introduces the policy mix for the 2014 and 2020 period that are of relevance to the current study, before presenting the main findings along the two study questions and the respective recommendations from the panel.

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